What Is The World Made Of?

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What are physical things? A reductionist answer analyzes physicality into non-physical terms. This paper surveys the field of candidate analyses, identifies some problems with the most widely-held "realist" analyses, and points the way to an alternative analysis along broadly Kantian or phenomenalist lines.

1 The target of analysis

An analysis of matter is an ostensible reduction of the physical to something more basic. (Here, "matter" denotes physical phenomena in general, not just matter in the narrow sense that contrasts with energy.) It's a theory that yields non-trivial completions of sentences like:

> *Necessarily, for all x, x is physical if and only if...*
>
> *Necessarily, it is physically the case that p if and only if...*
>
> *Necessarily, there's a world physically indistinguishable from ours if and only if...*

—where the import of "necessarily" is metaphysical. A *successful* analysis of matter would yield completions of these and similar sentences that were both non-trivial and true; it would be a reduction of the physical to something more fundamental, analogous to the reduction of the biological to the chemical, or the thermodynamical to the statistical-mechanical, or (in some views) the mental to the physical. Ideally, it would also be a *conceptual* analysis, in the sense that its truth would be knowable *a priori,* though whether this ideal is attainable is a separate question from whether a successful analysis is possible.

As with any analysis, we need to begin with some working understanding of what it is that we're trying to analyze. We might try to do this by fixing the reference of "the physical world" as that which science investigates. However, it's doubtful that being scientifically investigated requires being physical; for example, the scientific study of consciousness doesn't seem to presuppose that consciousness is a physical phenomenon. (It's true, but unhelpful, to note that the physical world is what the *physical* sciences investigate.)

Frank Jackson suggests a better approach, which is to isolate physical properties and relations "by pointing to some exemplars of non-sentient objects—chairs, tables, mountains, and

the like—and then...[identifying] physical properties and relations [as]...the kinds of properties and relations needed to give a complete account of things like these."[1]

An approach complementary to Jackson's is to fix the reference of "the physical world" as that which explains the regularity of experience. Experience seems to occur non-randomly, and we often make accurate predictions based on it; this is true, even if (implausibly) experience actually occurs at random, and our success at making predictions based on experience is due to sheer luck. The regularity of experience is simply its prediction-friendliness and prima facie non-randomness.

There's a metaphysically possible universe indistinguishable from ours in regard to the experiences that occur in it, but in which all experience occurs at random. In such a universe, the regularity of experience is just a statistical fluke. But no one believes that this metaphysically possible universe is our universe. We all believe that the regularity of experience does have some explanation. We even have a special term for the presumed explanation: we call it "the physical world."[2]

I said that fixing the reference of "the physical world" (or "physical phenomena") as whatever explains the regularity of experience complements Jackson's ostensive definition of physical properties and relations. This is because the properties and relations we need to give a complete account of things like tables and mountains are precisely those we need to give a complete account of whatever explains the regularities of experience that are our ultimate basis for thinking that things like tables and mountains exist.

Acknowledging that the physical world is something we posit to explain the regularity of experience doesn't commit us to any particular view of the metaphysical significance of experience in relation to the physical world. In particular, it doesn't commit us to holding that the physical world depends for its existence on its explaining the regularity of experience. Presumably it's only a contingent truth that the physical world explains the regularity of experience, since the physical world (or at least most of it) might have existed even if none of the experience whose regularity it explains had existed. Also, the physical world might explain the regularity of experience by having properties it could lack without lacking any of its physical properties; e.g., by having various non-physical experience-causing powers. The platitude that the physical world explains the regularity of experience doesn't settle these questions. Nor does it tell us anything about the nature of the physical world, beyond that it must be such as to explain, if only contingently, the regularity of experience.[3]

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[1](Jackson, 1998, 7).

[2]As we'll see, some idealists believe that the relationship between experience and the physical world is too intimate to be explanatory; however, as we'll also see, there are compelling reasons to think that idealists are wrong about this.

[3]The "or at least most of it" qualification is a nod to physicalism about the mental.

2 Why analyze matter?

Starting out, it's an open question whether a successful analysis of matter is possible. The view that it isn't is what Berkeley calls "materialism," and what I'll call *anti-reductionism about the physical* or "anti-reductionism," for short. The opposing view that a successful analysis of matter *is* possible is *reductionism about the physical* ("reductionism," for short).

The purpose of this paper is to explore the prospects for various forms of reductionism. But since anti-reductionism is the path of least resistance, I should say something about why we might want to deviate from it. There are, I think, three reasons.

First, a successful analysis of matter would satisfy our curiosity about the nature of the physical world. Given any explanatory posit, it's natural to wonder about its true nature: the nature it has "in itself," and in virtue of which it explains what it does. Nobody was content to think that the nature of genes was exhausted by their explaining observed patterns of biological heredity, or that the nature of germs was exhausted by their explaining observed epidemiological patterns, or that the nature of atoms was exhausted by their explaining observed patterns in the behavior of matter. In each case, people assumed that the explanatory posit had some nature over and above its explaining whatever it was posited to explain. We might abandon this assumption in relation to a certain explanatory posit if repeated attempts to learn more about it fail, or if there emerge arguments showing that the posit has no discoverable further nature, or that the posit is best understood as a convenient fiction. But the default assumption is that our explanatory posits do have some further nature. One reason to seek an analysis of matter is that it would tell us the further nature of that mother of all explanatory posits, the physical world.

Second, an analysis of matter stands to simplify our overall picture of the world, provided that the terms of the analysis include only things that our fundamental ontology already includes. If we reduce physical facts to facts about spacetime relations among things whose natures are exhausted by their spatiotemporal properties and relations, we simplify our fundamental ontology, provided that it already included spacetime; if we reduce physical facts to facts about causal relations among things whose natures are exhausted by their positions in the causal network they constitute, we simplify our fundamental ontology, provided that it already included causation; if we reduce physical facts to facts about conscious states, we simplify our fundamental ontology, provided that it already included conscious states.[4]

Third, a successful analysis might clarify otherwise murky relationships between physical reality and other things. For example, an analyis of matter in experiential terms might clarify

[4]Some anti-reductionist views achieve a comparable simplification. For example, panpsychism brutely identifies fundamental physical phenomena with fundamental conscious phenomena. Though not an analysis of matter, panpsychism simplifies our ontology, since it implies that physical and experiential phenomena have a single fundamental nature.

the relationship between the physical world and the experience by which we apprehend it, and an analysis of matter in abstract structural terms might clarify the relationship between the physical world and the mathematics by which we describe it.

None of these are reasons to believe that a successful analysis of matter is possible, but they are reasons to hope that one is, and therefore to put some effort into exploring the prospects for a successful analysis.

When assessing different analyses of matter, it's important not to lose sight of the purpose of such analyses. Otherwise, the whole project might come across as needlessly complicating our picture of the physical world.

Consider reductionist theories of psychological phenomena, like belief and desire. Their aim is to give an analysis of such phenomena. This is different from the aim of psychology, which is to explain behavior in psychological terms. If psychologists explain behavior by invoking a law according to which people tend to behave in ways that they believe will satisfy their desires, philosophers of psychology can accept this explanation. What the philosophers bring to the table is an analysis of the terms of the psychologists' explanation, not an alternative to the psychologists' explanation.

The philosophical analysis is bound to be complex. Consequently, if we were to translate psychological explanations of behavior into statements in which the terms "belief" and "desire" were replaced by their philosophical analyses, the resulting translations would be much more elaborate than the original psychological explanations they translated. But that would not mean that the philosophical analyses were somehow deficient. To fault the philosophical analyses for introducing complexities additional to what psychologists require to account for behavior would be to lose sight of the analyses' aims.

The aim of reductionist theories of the physical is to give an analysis of physical phenomena. This is different from the aim of physics, which is to explain the behavior of physical phenomena in physical terms. Just as a philosopher of mind who proposes an analysis of psychological phenomena can happily accept a psychologist's explanations of human behavior, a philosopher of matter who proposes an analysis of physical phenomena can happily accept a physicist's explanation of physical phenomena. What the philosopher brings to the table is an analysis of the terms physicists use to explain physical phenomena, not an alternative explanation of those phenomena.

If we were to translate a physicist's explanation of the motion of a celestial body into a statement in which all physical terms were replaced by their equivalents according to some analysis of matter, the translation might be extremely complex, compared to the original explanation. But that wouldn't mean that the analysis was deficient. To criticize an analysis of matter for introducing complexities additional to what physicists require to account for the behavior of physical phenomena would be to lose sight of the aims of the analysis.

3 Reduction: realist vs. mentalist

Two basic requirements that any analysis of matter must satisfy are (1) that the analysis not be circular, and, (2) that the analysis not entail that physical states of affairs are abstract states of affairs. Call these the *Non-triviality* and *Concreteness* requirements.[5]

The non-triviality requirement heavily constrains the reductionist project: it leaves us with a very limited range of phenomena that can serve as terms of a successful analysis of matter. To satisfy it, the terms of the analysis must not be properties or relations whose individual instantiations metaphysically entail the existence of something physical. Acceptable terms include topic-neutral properties and relations like number, causation, probability, distance, and duration, as well as anti-physical properties and relations such as some theorists hold conscious properties to be.

Some terminology: by calling F a "ϕ property," I mean that it's metaphysically necessary that if x has F, then $\phi(x)$; so, for example, a physical property is one such that necessarily, only physical things have it, and a mental property is one such that necessarily, only mental things have it. By calling G an "anti-ϕ" property, I mean that it's metaphysically necessary that x has G only if $\neg\phi(x)$; so, for example, an anti-chromatic property is one such that necessarily, only colorless things have it. A property H is "topic-neutral" just in case it is neither a physical property, nor a mental property, nor an anti-physical property, nor an anti-mental property: it's a property instantiable by physical things, non-physical things, mental things, and non-mental things. Examples include the property of having parts, and the relation of causal dependence.

There are two broad types of analysis of matter: *realist analyses* and antirealist or (as I prefer to call them) *mentalist analyses*.

Realists and mentalists agree that our only source of information about the physical world is experience, but they disagree about the metaphysical significance of this fact. According to realists, it has no metaphysical significance, or at least none relevant to the nature of physical reality. The existence of the Moon clearly has experiential implications, since if it didn't, we wouldn't know anything about the Moon. But according to realists, these implications are merely contingent: the Moon could exist in a world in which its existence had no implications related to experience. This is in contrast to mentalists, who think that the existence of the Moon has experience-related implications in *every* possible world in which the Moon exists

[5] James Ladyman and Don Ross suggest that we might dispense with the Concreteness requirement by "reject[ing] the dichotomy between the abstract and the concrete" (Ladyman and Ross, 2007, 186). However, the arguments Ladyman and Ross give "against attributing any significance to the abstract/concrete distinction" are, by their own admission, "not compelling," merely "suggest[ing] the possibility of a rapprochement between the objects of physics and mathematics." (Ladyman and Ross, 2007, 160). What they have in mind by the suggested "rapprochement" is unclear.

(though not every mentalist thinks the implications include the existence of experiences of the Moon).

Realist analyses of matter employ wholly non-mental terms. The hallmark of a realist analysis is that if it is correct, then no physical truth or fact has any metaphysical implications related to experience. According to realists, the physical facts of our world do not metaphysically depend on there being any contingent truths about the mental. This includes contingent truths about the existence of mental phenomena (minds, thoughts, experiences, etc.), contingent truths about powers to cause mental phenomena (e.g., experience-causing powers), contingently true counterfactuals concerning minds or mental states, and contingent truths about probabilities pertaining to experience.

Realists acknowledge that experience is ultimately our sole source of information about the physical world. Still, according to them, the physical world does not depend for its existence or physical nature on revealing itself to us in experience, or even on its being able to do so. If physical things had no capacity to reveal themselves to us in experience, we wouldn't know anything about them. But according to realists, the physical things of our world could exist and constitute the physical world they actually constitute even if they had no such capacity. In the realist view, the relationship between the mental and the physical is like that between the present and the past. The present is our only source of information about the past, but past states of affairs are metaphysically independent of present states of affairs. Likewise, say realists, though experience is our only source of information about the physical world, physical states of affairs are metaphysically independent of experiential states of affairs.[6]

What does realist reductionism exclude?

Most obviously, it excludes analyses of matter that reduce physical states of affairs to states of affairs involving actual minds and experiences, such as the idealist analyses of Leibniz and Berkeley. It also excludes a Kantian analysis of matter that reduces the existence of physical phenomena to the existence of things—further natures unknown—with suitable experience-causing powers. Kantians, unlike metaphysical realists, hold that there can't be a physical world where nothing has the power to cause experience. Finally, it excludes a phenomenalist analysis of matter, like Mill's, that reduces the existence of physical phenomena to the truth of counterfactual conditionals of the form, "if such-and-such experiential state of affairs existed, such-and-such other experiential state of affairs would exist."

These alternative analyses of matter are so-called antirealist accounts of the physical. The label "anti-realism" is unfortunate, since it wrongly suggests that the relevant analyses imply that physical phenomena are unreal. That's why I prefer to call them "mentalist" analyses of matter.

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[6] Caveat: metaphysical realists who accept physicalism must allow that some physical phenomena metaphysically entail the existence of mental phenomena.

As the foregoing examples illustrate, mentalism is a big tent, covering more than just theories that construe physical things as combinations of actual conscious experiences. If you are a Berkeleyan idealist, you are a mentalist, but you can also be a mentalist if, like Kant, you construe physical things as experience-causing powers that exist regardless of whether their possessors exert them so as to cause actual experiences, or if, like Mill, you construe physical things as experience-happening possibilities or tendencies that exist regardless of whether they manifest themselves in the form of actual experiences. The hallmark of mentalism is its implication that how things are in any physical respect metaphysically depends on how things are in some mental respect. But different mentalist analyses differ in what they take to be the relevant mental respect.

The key difference between realist and mentalist analyses of matter is that the latter, but not the former, have broadly mental phenomena in their reduction base. This has two important implications. First, it means that mentalists, unlike realists, are committed to saying that the mental terms of their analyses are not physical; otherwise, the analyses would be circular (violating the Non-triviality Requirement). Second, it means that mentalists are subject to fewer constraints than realists when carrying out their analyses of matter. Realists are subject to a third requirement additional to the Non-triviality and Concreteness requirements: the requirement that their analyses contain no mental terms. Call this the *Realist Requirement*.

4 Realist analyses of matter

Different realist analyses of matter differ in how they try to meet the Non-triviality, Concreteness, and Realist requirements. The challenge is to find a reduction base *B* that satisfies the following conditions:

1) (Non-triviality) *B* does not include anything physical (no physical particulars, properties, relations, states, etc).

2) (Concreteness) *B* includes something concrete (something besides abstract mathematical entities, logical or mathematical relations, etc).

3) (Realism) *B* is such that an analysis of matter in terms of it entails that the physical is metaphysically independent of the mental.

A realist reduction base may include as many abstract logical or mathematical properties, relations, structures, etc. as realists see fit, but to satisfy the Concreteness requirement, the base must also include some non-abstract terms of analysis. In order for the analysis to satisfy the Realist requirement, these non-abstract terms must be non-mental. And, to satisfy the Non-triviality requirement, they must also be non-physical. In other words, a successful

realist analysis of matter must employ exclusively topic-neutral terms, at least one of which is a term for something concrete.

Nobody has ever proposed a realist analysis of matter detailed enough to yield an actual reduction of even a small portion of physical reality. This is as it should be, since the sole value of an analysis of matter is in what it tells us about the fundamental nature of physical reality: no practical or scientific question hinges on the outcome of the debate between reductionists and anti-reductionists about the physical, or between realist reductionists and mentalist reductionists. Whatever we stand to gain from actually carrying out a particular reduction of physical phenomena, we would gain from establishing that the reduction is possible (if only in principle). If we could establish that, actually carrying out the reduction would be a waste of time.

For the purposes of assessing realist analyses of matter, we can therefore deal with analytical schemata, rather than actual analyses. As it happens, there is a convenient way to schematize realist analyses of matter, due to Frank Ramsey, Rudolf Carnap, and David Lewis. This is the so-called Ramsey-Lewis method of defining theoretical terms. Below, I describe the method using a toy example, and explain, in general terms, how we can use the method to generate schematic versions of the four main types of realist analysis of matter.[7]

4.1 Schematizing realist analyses of matter

Suppose you ask an architect what he means by "column," "plinth," and "capital." He replies: "A column is a vertical architectural element that rests on a plinth and supports a capital, a plinth is a level load-bearing architectural element that underlies a column, and a capital is a decorative architectural element that a column supports."

The architect has given you a circular set of definitions, defining "column" in terms of "plinth" and "capital," and each of "plinth" and "capital" in terms of "column." The good news is that, provided you know what the architect means by "vertical," "architectural element," "rests on," "supports," "level," "load-bearing," "underlies," and "decorative," his explication can enlighten you as to the meanings of "plinth," "capital," and "column," despite its formal circularity. The Ramsey-Lewis method of defining theoretical terms makes this clear, by deriving non-circular definitions of the relevant terms from the architect's remarks, as follows:[8]

x is a *plinth* if and only if there are properties F, G, and H, such that

$(\forall y)[Fy \leftrightarrow y$ is a level load-bearing architectural element $\wedge\ \exists z(Gz \wedge y$ underlies $z)] \wedge$

[7] For the Ramsey-Lewis method, see Ramsey (1929/1978), Carnap (1956), Lewis (1970), and Lewis (1972). In Maxwell (1970), Grover Maxwell uses the method much as I do here.

[8] Lest we be too quick to criticize the architect for his performance, we should reflect that scientists, as a collective body, offer similarly circular definitions of their basic vocabulary: see (Eddington, 1929, 260-64).

$(\forall y)[Gy \leftrightarrow y$ is a vertical architectural element $\wedge\ \exists z_1, z_2(Fz_1 \wedge Hz_2 \wedge y$ rests on $z_1 \wedge y$ supports $z_2)] \wedge$

$(\forall y)[Hy \leftrightarrow y$ is a decorative architectural element $\ \wedge \exists z(Gz \wedge z$ supports $y)] \wedge$

Fx.

x is a *column* if and only if there are properties F, G, and H, such that

$(\forall y)[Fy \leftrightarrow y$ is a level load-bearing architectural element $\ \wedge \exists z(Gz \wedge y$ underlies $z)] \wedge$

$(\forall y)[Gy \leftrightarrow y$ is a vertical architectural element $\wedge\ \exists z_1, z_2(Fz_1 \wedge Hz_2 \wedge y$ rests on $z_1 \wedge y$ supports $z_2)] \wedge$

$(\forall y)[Hy \leftrightarrow y$ is a decorative architectural element $\ \wedge \exists z(Gz \wedge z$ supports $y)] \wedge$

Gx.

x is a *capital* if and only if there are properties F, G, and H, such that

$(\forall y)[Fy \leftrightarrow y$ is a level load-bearing architectural element $\ \wedge \exists z(Gz \wedge y$ underlies $z)] \wedge$

$(\forall y)[Gy \leftrightarrow y$ is a vertical architectural element $\wedge\ \exists z_1, z_2(Fz_1 \wedge Hz_2 \wedge y$ rests on $z_1 \wedge y$ supports $z_2)] \wedge$

$(\forall y)[Hy \leftrightarrow y$ is a decorative architectural element $\ \wedge \exists z(Gz \wedge z$ supports $y)] \wedge$

Hx.

With these definitions, we have, in effect, defined "plinth," "column," and "capital" by describing a network of logical relationships among them and other terms ("level," "load-bearing," "vertical," etc.), and then assigning each of the target terms a meaning corresponding to its place in this network. The target terms are the terms we aim to define—in this case, "plinth," "column," and "capital." The other terms—"level," "load-bearing," "vertical," etc.—constitute what I'll call the *scaffolding* of the Ramsey-Lewis definitions.

Suppose we have an ideal completed physics. Call the most detailed and accurate description of the physical world that is possible in terms of this ideal physics the Big Description. The Big Description is a huge (maybe infinite) conjunction of statements expressed in the language of ideal physics. Some terms occurring in it are abstract terms from logic and pure mathematics. The Big Description does not employ *only* such terms, however, since if it did, it would describe a purely abstract state of affairs, which the physical world is not.

Call the terms of the Big Description that are *not* abstract terms its "concrete terms." Plausibly, the concrete terms will be predicates: one-place predicates for properties, n-place predicates for n-ary relations. (If the Big Description contains non-predicative concrete terms, the discussion that follows can accommodate them with suitable modification.)

Among the concrete terms that occur in the Big Description, some are physical terms (for various physical properties, relations, etc.) and some are topic-neutral terms; examples of the latter are terms for spatiotemporal properties and relations (like volume, duration, distance, and succession), and contingent relations of dependence such as causation and conditional probability. (All of the Big Description's abstract terms are topic-neutral.)

To give Ramsey-Lewis definitions of the physical terms occurring in the Big Description, we apply the Ramsey-Lewis method to the Big Description the same way we applied it to the architect's statement above. Now, the target terms are the physical terms occurring in the Big Description: terms like "mass," "charge," "spin," "gravitational attraction," etc. The scaffolding of the Ramsey-Lewis definitions of these physical terms are topic-neutral terms occurring in the Big Description.

Different realist analyses of matter differ in which topic-neutral terms they include in the scaffolding of their Ramsey-Lewis definitions of physical terms.

In the most ambitious analysis, the scaffolding includes only abstract logico-mathematical terms: *all* concrete vocabulary occurring in the Big Description gets defined in terms of these. This is the Bare Realist analysis of matter.

In the least ambitious analysis, the scaffolding includes all of the topic-neutral terminology occurring in the Big Description (i.e., all the terminology except for the physical terms of the Big Description); only the physical terms get defined. This is the Traditional Realist analysis of matter.

In the middle sit two moderately ambitious analyses. In one, the scaffolding includes all of the topic-neutral terminology occurring in the Big Description *except* for terms for spatiotemporal properties and relations; this is the Kinematic Analysis of matter. In the other, the scaffolding includes all of the topic-neutral terminology occurring in the Big Description *except* for terms for one or more natural modality or dependence relation (e.g., causality or conditional probability); this is the Dynamic Analysis of matter.

Let's take a closer look at these four analyses, starting with bare realism.[9]

4.2 Bare Realism

The most economical way for a realist analysis of matter to satisfy the Concreteness requirement is by reducing physical states of affairs to the instantiation of abstract set-theoretical properties and relations by non-abstract entities whose only non-abstract property is non-abstractness. Such an analysis uses a reduction base comprising set-theoretic abstracta plus

[9]Bare realism, kinematic realism, dynamic realism, and traditional realism are all versions of so-called structural realism, differing in what properties or relations they take to constitute the relevant structure. This connection tends to get obscured by structural realists' habit of characterizing their view as one in which "there are no things or objects"; see, e.g., (Saunders, 2003, 132), (Ladyman and Ross, 2007, 130), and (French, 2014, v). As Chakravartty (2003) points out, structural realism, like the realist analyses considered below, is compatible with the existence of objects; it just implies that if there are objects, the only facts about them that are relevant to the world's physical nature are facts about their structural properties and relationships (e.g., their causal or spatiotemporal relationships to other objects). There's no more call to deny that a structuralist world contains objects than to deny that a directed graph contains nodes; it's just that the objects, like the nodes, are individuated purely by their positions in the network of relationships to which they belong.

the property of concreteness (i.e., the property of being non-abstract); if successful, it reduces *all* empirical facts, including facts about space and time (or spacetime), and facts about causality, probability, nomic entailment, and counterfactual dependence, to facts about the abstract logical and mathematical properties of, and relations among, concrete entities whose natures are exhausted by their concreteness together with their abstract properties. This is bare realism.

Of all realist analyses, bare realism comes closest to the Pythagorean ideal of a purely mathematical conception of the natural world. In effect, bare realism aspires to reduce physical reality to a collection of concrete entities whose only properties, apart from concreteness, are mathematical properties, and whose only relations are mathematical relations.[10]

Bare realism is subject to a fatal objection, first raised by Max Newman against Bertrand Russell's bare realist analysis of matter. Given any possible world W in which there exist exactly the concrete things that exist in our world (the actual world), every set of concrete things and every set of ordered n-tuples of concrete things that exists in our world exists in W, and vice versa. A bare realist analysis of matter like Russell's therefore implies that it's metaphysically impossible for a world containing the same concrete things as our world to differ from our world physically. Worse yet, Russell's analysis implies that any possible world with the same number of concrete things as ours is physically indistinguishable from ours, since any such world contains sets of concrete things and sets of ordered n-tuples of concrete things that differ from those that exist in our world at most in the particular concrete things they contain—and in the bare realist analysis, the particularity of concrete things contributes nothing to the physical nature of the world the things constitute.[11]

The moral of the story is that the realist's reduction base has to include more non-abstract topic-neutral terms than just the property of concreteness. As far as I can tell, there are just two kinds of terms that might fit the bill: natural modality—e.g., causality, counterfactual dependence, natural necessity, or probability—and spacetime. Correspondingly, there are three realist alternatives to bare realism: (1) analyses of matter in purely spatiotemporal terms (kinematic realism), (2) analyses purely in terms of natural modality (dynamic realism), and, (3) analyses in a combination of spatiotemporal and natural-modal terms (traditional realism). We consider these now.

[10] Even if not all mathematical properties and relations reduce to set-theoretic properties and relations, all the mathematical properties and relations relevant to physics do.

[11] See (Newman, 1928, 144-48). Newman's target is the position Russell takes in Russell (1927): see (Russell, 1927, 215, 226-28, 286-89).

4.3 Kinematic realism

According to kinematic realism, the physical world consists of the instantiation of irreducible spatiotemporal properties and relations by entities whose natures (as far as they are relevant to physical reality) are exhausted by their having such properties and standing in such relations. A classic example is Descartes's theory of the nature of the physical:

> There is no real distinction . . . between space and the corporeal substance contained in it; the only difference lies in the way in which we are accustomed to conceive of them. For in reality the extension of length, breadth, and depth which constitutes a space is exactly the same as that which constitutes a body.[12]

Though Descartes mentions only space here, it's clear that he thinks of corporeal substance as existing in time, and of different corporeal substances (or different chunks of corporeal substance) as standing in temporal relations; his emphasis on space reflects his view that spatiality is what distinguishes the physical (or "corporeal") from the mental.[13]

In the kinematic view, not only do physical properties like mass, charge, and spin, and physical relations like gravitational attraction and magnetic deflection, reduce to kinematic properties and relations: natural modalities also thus reduce. Kinematic realists think that there's nothing more to the causal, nomic, statistical, or counterfactual dependencies among physical states of affairs than physical events occurring in certain spatiotemporal patterns.[14] In the kinematic view, facts about such dependencies all reduce to facts about how things are spatiotemporally arranged in our world, or perhaps on how things are spatiotemporally arranged in our world together with how things are spatiotemporally arranged in other metaphysically possible worlds.[15]

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[12] (Descartes, 1641/1984, 227); see also (Descartes, 1644/1953, Part 2, §4). To get a more streamlined version of kinematic realism, we might reduce spatiotemporal properties to spatiotemporal relations, so that physical reality is nothing but a spatiotemporal network of entities whose natures are exhausted by their places in the network. I should say that I am assuming that Descartes does not think of geometric properties and relations as purely set-theoretic. If he did, then his position would be a version of bare realism.

[13] For a more recent version of kinematic realism, or something close to it, see (Poincaré, 1905, 178-203). Depending on how science develops, it might turn out that descriptions of the physical world in terms of four-dimensional spacetime describe aspects or features of a higher-dimensional space; see Bain (2006). I set this possibility aside, since it does not bear on the arguments that follow, which apply equally to analyses of matter in terms of spacetime and analyses in terms of higher-dimensional spatial structures.

[14] According to Descartes, the only "true" causes are God's acts of creating successive time-slices of the natural world—such causation does not, in Descartes's view, submit to kinematic reduction. But Descartes does hold that what passes for causation *within* the physical world is something purely kinematic: see (Descartes, 1644/1953, §§36-40).

[15] Given the standard semantics for counterfactuals, the statement that physical state of affairs S would exist if physical state of affairs S' existed is equivalent (in the kinematic view) to the statement that the metaphysically possible worlds spatiotemporally most similar to our own world, among worlds in which

How does kinematic realism differ from bare realism? Physicists describe kinematic properties and relations in mathematical terms. Doesn't it follow that a kinematic analysis of matter is just a bare analysis in disguise?

No. The kinematic realists' position would collapse into bare realism only if kinematic realists thought that kinematic properties and relations just *were* mathematical properties and relations. But this is not their view. Rather, in the kinematic view, properties like volume and duration, and relations like distance and temporal succession, are non-mathematical, non-abstract properties and relations that we can partly (but not wholly) characterize in abstract mathematical terms.

According to bare realists, for a physical object to have a certain shape or duration just is for it to be a concrete entity (or set of concrete entities) satisfying certain purely mathematical descriptions. According to kinematic realists, the shapes and durations of physical objects are properties the objects have over and above their satisfaction of whatever mathematical descriptions they satisfy. They're properties whose possession by the objects *explains why* the objects satisfy the relevant mathematical descriptions—that is, why the objects have the abstract properties that the mathematical descriptions describe them as having—rather than properties whose possession by the objects *reduces to* the objects' satisfaction of the relevant descriptions.

4.4 Dynamic Realism

As far as I am aware, kinematic realism has no contemporary proponents. The situation is different when it comes to dynamic realism.[16]

Dynamic realists say that physical reality is a causal, counterfactual, or statistical network of entities, where the nature of each entity in the network is exhausted by its place in the network. We might think of the diagram in Fig. 1 as a complete dynamicist representation of an extremely simple physical world comprising just three entities A, B, and C. (Perhaps these entities constitute a single quark.)[17]

S' exists, are worlds in which S exists—where S and S' are both purely kinematic states of affairs. Complicating kinematicist applications of this semantics is the fact that the semantics works best when one dimension of similarity between different possible worlds is similarity in the laws that govern them; but in the kinematic view, similarity in laws reduces to similarity in spatiotemporal structure.

[16] The closest thing to kinematic realism since Poincaré is probably David Lewis's Humean supervenience, which puts heavy emphasis on spacetime relations. However, Lewis regards the relata of spacetime relations as entities with qualities that he calls "local, natural" properties, which he seems to think of as irreducible physical properties: see (Lewis, 1986, ix-x) and (Lewis, 1983, 364). On the whole, it seems best to classify Lewis as an anti-reductionist about the physical.

[17] Such a quark would be an example of what Donnchadh O'Conaill calls a "concrete structure": see (O'Conaill, 2014, 296-97).

In causal terms: *A* is the entity that nothing causes—that's the whole truth about *A*. *B* is the entity that some entity causes and that causes some entity—that's the whole truth about *B*. *C* is the entity that *B* causes—that's the whole truth about *C*. It's causal structure all the way down.

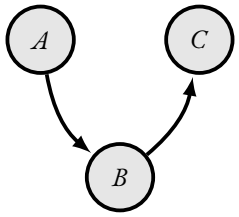

Figure 1: A small dynamical world

In counterfactual terms: *A* is the state that counterfactually depends on nothing—that's the whole truth about *A*. *B* is the state that counterfactually depends on some state and that some state counterfactually depends on—that's the whole truth about *B*. *C* is the state that counterfactually depends on *B*—that's the whole truth about *C*. It's counterfactual dependence all the way down.

In terms of nomic entailment: *A* is the state that nothing nomically entails—that's the whole truth about *A*. *B* is the state that some state nomically entails and that nomically entails some state—that's the whole truth about *B*. *C* is the state that *B* nomically entails—that's the whole truth about *C*. It's nomic entailment all the way down.

In probabilistic terms: *A* is the entity whose chance of existing no entity boosts—that's the whole truth about *A*. *B* is the entity whose chance of existing some other entity boosts, and that boosts the chance of existing of some other entity—that's the whole truth about *B*. *C* is the entity whose chance of existing *B* boosts—that's the whole truth about *C*. It's conditional probability all the way down.[18]

A dynamic realist could include multiple natural modalities as terms of his analysis. In practice, dynamic realists usually choose just one natural modality as their unique concrete term of analysis. For example, Anjan Chakravartty takes causality as his concrete term of analysis,[19] Alexander Bird takes counterfactual entailment as his concrete term,[20] James La-

[18] A probabilistic analysis inspired by quantum physics might analyse physical phenomena in terms of probability amplitudes rather than probability per se.

[19] See Chakravartty (2004). In Tooley (1997), Michael Tooley proposes a causal analysis of time, though not as part of a causal analysis of the physical.

[20] See Bird (2007), which elaborates and extends the position that Sydney Shoemaker outlines in Shoemaker (1980).

dyman and Don Ross take nomic necessity as their concrete term,[21] and David Albert takes probability (or, more accurately, probability amplitude) as his concrete term.[22]

4.5 Traditional Realism

Both kinematic and dynamic realism face important challenges, which neither can easily overcome without co-opting the other.

Dynamic realism entails that any world that duplicates ours in terms of how the entities it contains relate to one another causally, probabilistically, counterfactually, or via nomic entailment, is physically indistinguishable from our world. However, we can imagine a world that duplicates ours in the stated respects, even though all of its concrete entities exist simultaneously. We need only imagine things existing in the same network of dependence relations all at once, via causal influences that propagate infinitely fast, or via probabilistic or counterfactual dependencies among simultaneously occurring events. Such a world would obviously differ from ours physically. To distinguish our world from it, dynamic realists seem to have no choice but to introduce temporal relations as an additional term of their analysis, and, given the intimate connections between time and space in our world, spatial relations too (or, more exactly, spacetime relations).[23]

Kinematic realism entails that any world in which concrete entities are spatiotemporally distributed exactly as in our world is physically indistinguishable from our world. However, we can imagine a world where things are spatiotemporally distributed exactly as in our world, but in which radioactive elements have different half-lives from in our world, such that, for example, the probability of a radon atom decaying within a given period of time is much greater than in our world. It's just that in the imagined world, radon atoms "beat the odds" in a highly improbable (but not impossible) way, such that their actual rates of decay are the same as in our world. If kinematic realists want to distinguish this world from ours, they have no choice but to introduce causality, probability, or some other natural modality as a further

[21] See (Ladyman et al., 2007, 128-29) (though Ladyman and Ross muddy the water by suggesting that an analysis need not even have any concrete terms: see footnote 5).

[22] See Albert (2013), and for discussion of a related analysis in terms of quantum density matrices, Dulani and Ney (2026). In (Berenstain and Ladyman, 2012, 154-55), Berenstain and Ladyman float the possibility that probability might be a form of, or perhaps even the whole of, natural necessity.

[23] It also seems possible for a world to duplicate our world's modal structure despite its contents being confined to a single point of space: we need only imagine a world where the number of events occurring at any time is the same as the number of events that occur at that time in our world, but where all the events occur at the same spatial location. Easier to imagine, perhaps, is a mirror image of our world that has the same modal structure as ours, but relates to our world as a right glove relates to a left glove; however, it is debatable whether such a world is metaphysically possible: see (Van Cleve, 1999, 231-33).

term of their analysis.[24]

The most defensible realist analysis of matter is an analysis in both dynamic and spatiotemporal terms. This also happens to be the traditional realist analysis.

The earliest version of traditional realism was classic primary quality realism. As Robert Adams describes it,

> Primary Quality Realism presents us with a physical world that is very different from what it appears in sense perception to be. In place of the colors, tastes, smells, and so forth that fill our sensory fields and form so large a part of our ordinary picture of the world, and that certainly do not seem to be only powers, we are offered a world of geometrical properties and motions—little more than a mathematical framework—plus perhaps some powers.[25]

A more sophisticated traditional analysis is that of Roger Boscovich. In his analysis, the fundamental constituents of the physical world are not entities with geometric properties like size and shape, but dimensionless "material points" characterized by a single, complex force of attraction and repulsion.[26]

With one caveat, the entire nature of a material point, apart from its "materiality" (i.e., concreteness) is its possession of a force described by "a single algebraical formula" whose graph is shown in Fig. 2. In the graph, the vertical AB represents a location in space, and

[24] The difference between kinematic and dynamic realism mirrors the long-standing divide between so-called "necessity" and "regularity" accounts of natural laws. According to regularity theorists, a law of nature is just a certain kind of pattern in the spatiotemporal totality or "mosaic" of events; see, e.g., Hume (1739/2007), Mill (1843/1974), Ramsey (1928/1978), Lewis (1973), Loewer (1996), Beebee (2006), Cohen and Callender (2009), Dorst (2019), and Jaag and Loew (2020). According to necessity theorists, a law of nature is not just a pattern in the mosaic of events, but something that disposes events to occur in certain patterns or in some other way explains why such patterns exist; see, e.g., Peirce (1910), (Popper, 1992/1959, 420-41), Harré and Madden (1975), Tooley (1977), Armstrong (1983), Eells (1991), Bird (2007), (Maudlin, 2008, 5-49), and Lange (2009). A main objection to regularity theories is that it seems that for any possible world W, there are worlds featuring mosaics indistinguishable from W's, but where everything happens by sheer chance; this is a problem for regularians, since it seems wrong to call a statistical fluke a law of nature. A main objection to necessity theories is that the existence of a lawlike pattern has equal evidential and predictive value whether or not the pattern is due to some kind of natural necessitation; this is a problem for necessitarians, since it makes it hard to see what's to be gained by insisting that lawlike patterns are due to natural necessitation, particulary considering that our only evidence for such necessitation is the lawlike patterns themselves.

[25] (Adams, 1979, xv). For primary quality realism, see (Galileo, 1623/2008, 185), Hobbes (1655/1839), (Boyle, 1666, 1-16), Newton (1672), and (Locke, 1694/1979, II.iv-viii).

[26] See Boscovich (1763/1966). Boscovich's theory was long taken as a model of theoretical simplicity; see, e.g., Nietzsche (1873/2000) (an early unpublished fragment in which Nietzsche develops his own version of Boscovich's theory); Maxwell (1875), Maxwell (1877/2002b), and Maxwell (1877/2002a); (William Thomson, 1904, vi-vii, 125-31,285, 300-301, 495-98, 543, 556, 643-61, 667-68, 674-77); and (Thomson, 1907, 160-64). (For more on Boscovich's influence, see (Thackray, 1970, 151-55).) The non-advent of an enduring Boscovichian school of metaphysics is probably due to the dominance of metaphysical antirealism following the publication of Kant's hugely influential *Critique of Pure Reason*.

the curve extending to the right of AB represents the forces between material points at various distances from one another. (The curve to the left of AB is simply a reflection of the one to the right.) Points on the rightward curve farther away from AB represent the force-interactions between a material point at AB and material points located farther away from that one. Portions of the curve occurring above the horizontal line CC′ represent repulsive force; portions below the horizontal represent attractive force.[27]

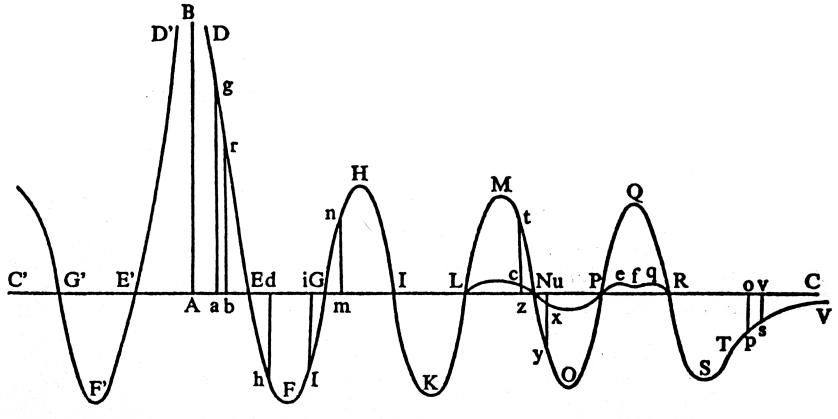

Figure 2: Boscovich's force curve

I said that Boscovich's force curve represents the whole nature of his material points, with one caveat. The caveat is that material points possess two additional features, which Boscovich calls "local modes of existence" and "temporal modes of existence," which Boscovich understands as relationships between material points and absolute Newtonian time and space.[28]

Overall, the picture we get from Boscovich is that of a physical world that reduces to a totality of mereological simples existing in a network of causal and spatiotemporal relations, where the causal relations are due to the force that each material point exerts on other points,

[27] See (Boscovich, 1763/1966, 19, 22). As the distance between two material points approaches zero, the strength of the repulsive force between them approaches infinity; this exponential increase in repulsive force (represented by the curve's asymptotic approach to AB) is something Boscovich deems necessary to accommodate the impossibility (as he argues it to be) for any two spatially dimensionless objects to come into direct contact. As the distance between material points increases, the repulsive force lessens, then changes to an attractive force, then back to a repulsive force, and so on, until eventually settling into an attractive force whose strength decreases as the square of the distance between the points increases; this rightmost portion of the graph corresponds to the inverse square law of gravitational attraction. The various ups and downs the curve displays between AB and the point where gravity kicks in are schematic and largely conjectural: they're place-holders for attractive and repulsive effects that Boscovich hypothesizes to account for a range of observed phenomena, such as fermentation and chemical bonding.

[28] See (Boscovich, 1763/1966, 60; 197-202). Boscovich accepts Newton's arguments in favor of an absolute conception of time and space: see (Boscovich, 1763/1966, 197) and (Newton, 1687/1999, 412-15).

and the spatiotemporal relations are determined by the material points' locations in Newtonian time and space.

A more recent proponent of traditional realism is Tim Maudlin, in whose view the basic terms of an analysis of matter are, in addition to abstract terms, a combination of dynamic and kinematic terms. Specifically, Maudlin takes nomic necessity (of the sort that characterizes natural laws) and temporal evolution (of the sort that ostensibly characterizes the passage of time) as ontic primitives.[29]

Traditional realism is more defensible than other realist analyses of matter, but, as always, rewards are proportional to risk. A traditional analysis offers a reductionist account of the physical, but without reducing conceptually adjacent aspects of reality, like spacetime and causality. It's a safer but less exciting alternative to kinematic and dynamic (to say nothing of bare) realism. As I now argue, however, it is still not safe from the most serious objections to any realist analysis.[30]

5 Doubts about realism

According to the most defensible realist analysis of matter, the physical world is a causal or statistical network of spatiotemporally located entities. In this view, any possible world that is indistiguishable from ours both in terms of the spatiotemporal distribution of its contents and in terms of the network of causal, statistical, or counterfactual relationships among its spatiotemporally located contents—any world *structurally indistinguishable* from our world, as I'll put it—is physically indistinguishable from our world.

There are possible worlds structurally indistinguishable from ours, but in which spatiotemporally located and causally, counterfactually, or statistically interrelated entities do not have the relationship to experience that they have in our world. For example, there are possible worlds where the relevant modal and metrical structure exists, but in which the structure does not cause experiences, or have the power to cause experiences, or support non-trivial counterfactuals of the form "if such-and-such experiences were to occur, such-

[29] Maudlin calls this "Maudlin's Non-Humean Package": see (Maudlin, 2008, 182).

[30] Theodore Sider argues for a realist analysis of matter that it takes some effort to fit into the classification introduced here. Sider's analysis eschews primitive natural modality and spatiotemporality in favor of a primitive second-order property of "carving Nature at the joints" or "structuring."(Sider, 2011, 1-9, 266-91) Sider's explication of "structuring" relies heavily on physical and phenomenal examples, but these examples aren't supposed to suggest that structuring is physical or mental. Rather, Sider says that the meaning of his structure-talk is fixed by his use of "structure" and related terms; i.e., in effect, by a Ramsey-Lewis definition of "structure" based on a Ramsey sentence sourced from Sider's discussion of his theory. (Sider, 2011, 9-10) Since his discussion makes no reference to primitive kinematic or dynamic properties or relations, it seems the only way Sider's analysis can satisfy the Concreteness and Realist requirements is by reducing the physical to concreteness together with various abstract properties and relations. Thus Sider's theory appears to be a kind of bare realism.

and-such other experiences would occur," and in which there are no non-trivial truths of the form, "the probability of such-and-such mental state of affairs given such-and-such other mental state of affairs = x."

There are also worlds structurally indistinguishable from ours in which the relevant structure *does* have and exercise experience-causing powers, *does* support non-trivial counterfactual conditionals related to experience, and in which there *are* non-trivial probabilities of the aforementioned form, but where the relevant powers, counterfactuals, and probabilities are radically unlike those that characterize our world. For example, there's a world W structurally indistinguishable from ours, but characterized by experience-related powers, experience-related counterfacts, and experience-related probabilities that give the inhabitants of W as much reason to believe they live in a physical world like J.R.R. Tolkien's Middle Earth as we have to believe that we live in the world that we take ourselves to inhabit.

What should we say about W? That it is physically indistinguishable from our world, and its inhabitants mistaken in believing otherwise? Or that, despite being structurally indistinguishable from our world, it differs from our world physically in many ways, such as by containing Ents and mithril, but not Chesapeake Bay Retrievers or margarine?

Realists are committed to saying the former. Yet, there are good reasons to think that the latter is true.

First: over time, there have been many changes of received opinion about the structure of what explains various regularities of experience (including the regularities that are our ultimate reason for positing a physical world). People used to think it had the structure of various blends of the "four elements"; later, they thought it had the structure of Democritean atoms whizzing around in a void; later yet, they thought it had the structure of Daltonian atoms arranged in successive time-slices of Euclidean space; still later, they thought it had the structure of events in a relativistic Riemannian spacetime, or of quantum-mechanical states of a high-dimensional Hilbert space.

These shifts of opinion about the structure of the grounds of our experience did not occasion corresponding waves of external world skepticism. All along, people believed that there were chairs, tables, mountains, etc. This suggests that our belief that there are (e.g.) mountains is a belief about how experience tends to occur in our world, rather than about a supposed structure that has no essential relationship to experience or its tendencies. After all, it's the experiential tendencies that have remained the same through all the historic changes of opinion about the physical world's underlying structure.

Second: we can imagine that our experience arises from a realist structure (bare, kinematic, dynamic, or traditional), but that it's a different realist structure from one moment to the next. We can imagine that the realist structure constantly changes, but that there is no change in the experiences that the constantly changing structure has the power to cause,

no change in what experience-related counterfactuals the constantly changing structure supports, no change in experiential probabilities—no change in any fact related to experience. If you were to learn that this is how things actually are, would you conclude that no physical thing ever persisted from one moment to another—e.g., that the teeth you brushed before going to bed last night weren't the teeth you brushed after breakfast this morning? If not, you should be skeptical of realist reductionism.

Third: combining the preceding thought-experiments, we can imagine a change whereby the parts of our world's realist structure that previously grounded the experiential regularities associated with clams now ground the experiential regularities associated with trees and vice versa, without any change in what experiences occur or are apt to occur. Would you say that the result is a scenario where people eat tree chowder and relax in the shade of clams? If not, you should again be skeptical of realist reductionism.[31]

6 Mentalist analyses of matter

The hallmark of realist analyses of matter is that they reduce physical reality to a state of affairs that has no metaphysically necessary implications related to anything mental. In the realist view, the relationship between experience and the physical world is purely contingent: the physical world could exist with precisely the physical features it has, even if there were no experience, no powers to cause experience, and no non-trivial counterfactual truths or probabilities related to experience.[32]

According to mentalist analyses of matter, physical facts *do* have metaphysically necessary mental implications. The exact nature of the implications differs, depending on the particular mentalist analysis. According to some, the existence of physical things necessitates the existence of actual minds and experiences (namely, minds that have experiences of physical things); according to other mentalist analyses, the existence of physical things does not ne-

[31] Note that these objections to realist reductionism are not among those that contemporary panpsychists raise against realist reductionism. Elsewhere, I have argued that the panpsychists' objections fail: see Pelczar (2022).

[32] With the caveat that *physicalist* realists must say that the physical states they identify with mental states metaphysically entail the existence of the metnal states that they ostensibly are. Combining a realist analysis of matter with physicalism tends to blur the relationship between realism and mentalism. Suppose a physicalist realist holds that physical entities essentially possess their powers to bring about physical effects (a kind of power essentialism). Since all macroscopic physical entities have the power to cause experiences, a physicalist power essentialist realist must hold that all macrophysical entities depend for their existence on having experience-causing powers. If we now combine physicalist power essentialist realism with the view that there are no non-macroscopic physical phenomena (a kind of scientific antirealism), we get a view in which physical things can't exist absent things with experience-causing powers. Yet, it seems odd to call this a mentalist theory of matter. Maybe it's best to think of it as a limiting case where realism and mentalism converge.

cessitate the existence of any occurrent mental phenomena, but only mind-related modalities that can exist without any manifestation in the form of actual minds or experiences.

There are four main types of mentalist analysis, associated with the metaphysics of Leibniz, Berkeley, Kant, and Mill. I describe each type in detail below, but first let's conduct a preliminary survey of the mentalist terrain.

As noted earlier, realists and mentalists agree that experience is ultimately our sole source of information about the physical world. But where realists take this as no more than a contingent fact about the physical world, mentalists see it as the clue to a proper analysis of the physical.

Imagine that our universe is thickly populated with conscious beings who perceive without being perceived, and who have no effect on the physical world; call them the *Ideal Observers,* or Observers, for short. Suppose no physical feature of our world escapes their notice: collectively, the Observers perceive every physical object, event, and process that exists in our world at any time or place; indeed, there are so many Observers that every region of spacetime has its physical contents observed by multiple Observers, including physical contents too brief or small for any actual (e.g., human) observer to perceive.

Various groups of Observers have experiences that relate in the way that human experiences typically relate when they occur in human beings simultaneously perceiving the same thing. What this relationship comes to in detail is beyond the scope of this study, but it plausibly has a qualitative as well as a modal dimension; for example, when two people are watching a tennis match from different locations in the stands, the phenomenal geometry of their visual experiences overlaps like footage of the match taken by cameras filming it from different angles, and the phenomenal changes that take place in each person's experience correlate with those that take place in the other's in non-accidental ways, which we can describe in terms of counterfactual or probabilistic interdependencies. It will be useful to have a term for this relationship; I'll call it *cohesion*.[33]

Each Observer has experiences that relate to the totality of all Observers' experiences in the way that your present experiences relate to all the other experiences you've had, rather than (for example) the way that the experiences you've had in dreams relate to the rest of your experiences. The exact details of this relationship are hard to spell out, but our confidence that there is such a relationship is implicit in our habit of distinguishing waking experience from (e.g.) dream experience. Call the relationship *coherence*.[34]

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[33] For more on cohesion, see (Pelczar, 2023, 73-98).

[34] The difficulty of sharply defining the relevant coherence relation seems to be what G.E. Moore is getting at when he writes, "I have, no doubt, conclusive reasons for asserting that I am not how dreaming; I have conclusive evidence that I am awake: but that is a very different thing from being able to prove it. I could not tell you what all my evidence is; and I should require to do this at least, in order to give you a proof." (Moore, 1939, 149)

The Ideal Observers are a fiction, but it's at least possible for there to be experiences just like theirs, related to one another in just the same ways. For any possible physical world, we can imagine a network of experiences that would exist if that world were thickly populated with Ideal Observers. Call any such network of experiences an *Ideal World*.

Very roughly, Berkeley identifies physical reality with a totality of experiences that collectively constitute an Ideal World, Kant identifies physical reality with an entity (or entities) with the power to generate experiences that collectively constitute an Ideal World, Leibniz identifies physical reality with a propensity for minds (or "monads") to have experiences that collective constitute an Ideal World, and Mill identifies physical reality with the circumstance that a certain possible Ideal World is the one that would exist, if there were an Ideal World. Let's take a closer look at these theories now.

6.1 Classic idealism: the Berkeleyan analysis

In Berkeley's analysis, physical things reduce to combinations of experiences:

> Thus, for example, a certain colour, taste, smell, figure and consistence having been observed to go together, are accounted one distinct thing, signified by the name apple; other collections of ideas constitute a stone, a tree, a book, and the like sensible things . . .[35]

> [A]ll sensible qualities are alike *sensations,* and...the objects of sense are nothing but those sensations, combined, blended, or (if one may so speak) concreted together . . .[36]

Though Berkeley doesn't elaborate on the nature of the "concreting together" he alludes to, it's clear that he has in mind cohesion, as characterized above. In Berkeley's view, every physical thing is a cohesive group of experiences. However, not every cohesive group of experiences is, in Berkeley's view, a physical thing. If we're all wearing reality augmentation goggles running the same software on the same remote server, we might have cohesive experiences of a Pokemon character standing on a street corner; if we're all under the influence of the same drug and the same regime of post-hypnotic suggestion, we might have cohesive experiences of a unicorn grazing in a park. Despite their cohesion, these experiences would not, in Berkeley's view, constitute physical things (a Pokemon, or a unicorn).[37]

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[35](Berkeley, 1710/1901, §1).

[36](Berkeley, 1710/1901, §99).

[37]According to Berkeley, many physical things consist entirely of divine experiences. It seems best to interpret Berkeley as thinking of such things as cohesive groups of divine experiences: experiences that, though occurring in only one mind (God's), relate to each other in the sort of ways that different created beings' experiences relate when they concurrently perceive the same physical thing; see (Berkeley, 1713/1901, 424-25), (Berkeley, 1710/1901, §3, §6, §48, §90), and (Winkler, 1989, 204-237). There is a debate about whether Berkeley really thinks of God as having perceptual experiences: according to some scholars, such as Mabbott (1931), God apprehends physical things only in a non-perceptual way.

To be a physical thing, the experiences in a cohesive group must satisfy some further condition. What this condition is emerges from Berkeley's discussion of the difference between veridical experiences and cohesive but non-veridical experiences, such as those that occur in dreams and hallucinations:[38]

> *Hylas:* But, according to your notions, what difference is there between real things, and chimeras formed by the imagination, or the visions of a dream—since they are all equally in the mind?
>
> *Philonous:* . . . [T]he visions of a dream, . . . though they should happen to be never so lively and natural, yet, by their not being connected, and of a piece with the preceding and subsequent transactions of our lives, they might easily be distinguished from realities. In short, by whatever method you distinguish *things* from *chimeras* on your scheme, the same, it is evident, will hold also upon mine. For, it must be, I presume, by some perceived difference; and I am not for depriving you of any one thing that you perceive.[39]

Berkeley doesn't tell us exactly how an experience must relate to other experiences to count as part of a physical thing, but he says that it's whatever relationship guides our actual judgements about which of our experiences are veridical and which aren't. That we do judge an experience veridical or not based on how it relates to other experiences follows, Berkeley argues, from the fact that such relations are all we ultimately have to go on in making such judgements.

There is an obvious connection between the Berkeley's analysis of physical things and his account of veridical experience. In Berkeley's view, a physical thing is a cohesive group of experiences that cohere with all the world's other experiences, and a veridical experience of a physical thing is just an experience that belongs to such a group.

Not all analyses of matter in the Berkeleyan mold follow Berkeley's own analysis in all respects.

For one thing, it's unnecessary to identify unobserved physical things with complexes of divine experiences; a non-theistic idealist can identify them with experiences that, though not occurring in any embodied being, do not occur in the mind of God or any other person-like entity. You can accept a broadly Berkeleyan analysis of matter without committing yourself to theism.

For another, it's unnecessary to accept Berkeley's views on causation, or, in particular, his view that the only true causes are minds. An idealist with more mainstream views on causality

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[38] This is the account of coherence from *Three Dialogues between Hylas and Philonous*. Berkeley gives a different account in the earlier *Treatise Concerning the Principles of Human Knowledge,* where he suggests that the distinctive feature of experiences that constitute real things is that they are "excited by the will of another and more powerful Spirit" than the mind having the experiences. (Berkeley, 1710/1901, §33). One problem with the earlier account is that it doesn't apply to God's own experiences, which in Berkeley's view constitute the (many) physical things that no created being perceives.

[39] (Berkeley, 1713/1901, 452). (Philonous speaks for Berkeley.)

can say that physical things stand in causal relations without the experiences constituting the things being caused by minds, or a divine Mind. Combined with a move away from theism, this leads to a neo-Berkeleyan idealism in which physical reality reduces to a system of combinations of experiences standing in causal relations unmediated by an intelligence that orchestrates the relations from outside the system.[40]

6.2 Noumenalism: the Kantian analysis

To a decent first approximation, Kant's analysis of matter is a modalized version of Berkeley's. Roughly, Kant reduces physical reality to the power of something—further nature unknown—to bring about the kind of experiential state of affairs that Berkeley identifies with the physical world.

Here is the basic Kantian picture: there are entities with the power to give us experiences; the only thing we can know about these entities, which Kant calls "noumena," is that they have such powers. While the noumena exert some of their experience-causing powers on actual minds, they have those powers regardless of whether they exert them, and regardless of whether there are any minds to exert them on. The existence of a physical thing—say, a tree—reduces to the circumstance that if the noumena *did* exercise all of their experience-causing powers, then the sum-total of all resulting experiences would include cohesive combinations of tree-ish experiences that cohered with all other experiences.[41]

The main similarity between Kant's analysis and Berkeley's is the central role that experience plays in both. In the Berkeleyan analysis, the physical world reduces to coherently related groups of cohesively related experiences; in the Kantian analysis, the physical world reduces to powers to cause coherently related groups of cohesively related experiences. For Berkeley, a veridical experience is one that belongs to a cohesive group of experiences that cohere with all actual experiences; for Kant, a veridical experience is one that would belong to such a group, if the noumena produced all the experience they have the power to produce.

There are many differences between Kant's analysis and Berkeley's. In Berkeley's view, God is the cause of the experiences that constitute physical things; in Kant's view, the cause of experience is something about which we can know nothing besides that it has, and sometimes exercises, various experience-causing powers. In Berkeley's view, causation is limited to

[40] For Berkeley on causation, see (Berkeley, 1710/1901, §§25-29; §§50-53) and (Berkeley, 1713/1901, 50-55). For neo-Berkeleyan analyses of matter, see Smithson (2017), Smithson (2021), Yetter-Chappell (2017), and Yetter-Chappell (2025). Other modern Berkeleyans cleave closer to the original Berkeleyan line: see Foster (1982), Foster (2008), Robinson (1982), and Robinson (2022).

[41] See (Kant, 1781/1998, B xxvi; A26/B42-A28/B44; A249-255; A277/B333; A288/B345) and (Kant, 1783/1997, §§14-17; §32; Remark II (Ak. 289-90)). The use of the plural "noumena" in this context is conventional: strictly speaking, in Kant's view, we can't know whether what has experience-causing powers is one entity or many. My reading of Kant follows Langton (1998); there are, of course, other readings.

mental exertions of will; Kant's views on causation are a topic of scholarly debate, but they certainly do not coincide with Berkeley's.

However, the most important difference between Kant's analysis of matter and Berkeley's is that unlike Berkeley, Kant does not reduce physical things to actually existing experiences. Rather, he reduces them to the existence of entities with powers to cause experiences. It is the existence of such entities that explains the regularity of experience, and is physical reality.

Kant's analysis has the advantage of not implying that physical things depend for their existence on actual minds or experiences. Unlike Berkeley, Kant allows that the Moon could exist even if there were no minds.[42]

6.3 Monadology: the Leibnizian analysis

Leibniz was the first to give a mentalist analysis of matter. In his view, the fundamental building blocks of the universe are conscious minds, which he calls "monads." Each monad has a sequence of experiences that unfolds according to what is, in effect, a computer program that takes phenomenal states of the monad as inputs, and gives phenomenal states of the monad as outputs.[43] No monad has any effect on other monads, but the monads' internal input-output routines dispose them to have experiences that are, collectively, the sort you would expect to occur in a population of conscious beings who collectively perceived the same physical world in complete detail (i.e. the sort of experiences that occur in Ideal Observers). The existence of the physical world, in Leibniz's view, reduces to the monads' propensity to have experiences that collectively constitute an Ideal World:

> *Philarète:* There are even good grounds for doubting whether God made anything other than monads or substances without extension, and whether bodies are anything other than the phenomena [i.e., experiences] resulting from these substances. My friend [Leibniz], whose opinion I have just related, gives enough evidence that he leans in this direction, since he reduces everything to monads, or to simple substances and their modifications [experiential states], along with the phenomena that result from them, phenomena whose reality is indicated by their interconnections, something that distinguishes them from dreams.[44]

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[42] At least, this is true on one interpretation of Kant. If Kant commits himself to a mind-dependent account of the physical, it's by combining the basic account described above with additional elements (e.g., to do with the nature of space) that a broadly Kantian analysis of matter need not incorporate. A qualified example of a Kantian analysis that does not entail a mind-dependent account of the physical is Chalmers (2010)—qualified, because unlike Kant, Chalmers requires the noumena to have the same causal structure as the physical world they subvene: (Chalmers, 2010, 490-91).

[43] Leibniz describes monads as "very exact immaterial automata": (Leibniz, 1998, 206).

[44] (Leibniz, 1715/1989, 265). See also (Leibniz, 1704/2013, 307): "Moreover, matter and motion are not so much substances or things as they are the phenomena of perceivers, the reality of which is located in the harmony of perceivers with themselves (at different times) and with other perceivers."

—where by the "interconnections" among some experiences that distinguish them from dreams, Leibniz means causally unmediated relations of cohesion and coherence among different monads' experiences.

Like Berkeley, Leibniz holds that God is the ultimate cause of all minds and experience, but God plays a less important role in Leibniz's metaphysics than in Berkeley's, at least insofar as the purpose of their metaphysics is to give an analysis of matter. For Leibniz, the physical facts of our world reduce to facts about monadic experience; that God is ultimately responsible for the fact that monads have the experiences they do is something that explains why there is a physical world, but not part of what it is for there to be a physical world:

> Finally, you ask, "Why are these appearances produced in me or any other true substance?" I say that subsequent appearances are produced from those preceding them in accordance with metaphysical and mathematical laws of eternal truth. But the reason why there are any such appearances at all is the same as the reason for the existence of the universe [viz., God's choice to create the best of all possible worlds]. For you can easily see that simple substances can be nothing other than the sources, i.e., the principles, and at the same time the subjects, of just as many series of perceptions unfolding themselves in order, expressing the same universe of phenomena with the greatest and most orderly variety.[45]

Leibniz, like Berkeley, identifies physical things with actual experiences occurring in actual minds (or monads). In Leibniz's view, the monads collectively possess a whole Ideal World's worth of experience. However, unlike Berkeley, Leibniz's theory does not really commit him to identifying physical things with actual experiences. He might instead have identified them with propensities for monads to have experiences that, were the monads to have them, would relate to each other in suitably cohesive and coherent ways. He might have said that the physical world's existence reduces to the fact that there is a particular Ideal World that monads' experiences would constitute, if the monads had enough experience to constitute an Ideal World—and he might have said this without saying that the monads actually have an Ideal World's worth of experience, or any experience.[46]

However, even if Leibniz had taken this line, he would still have been committed to saying that our world's physical contents depend for their existence on the actual existence of minds. For, if there were no minds (monads), then there would be nothing disposed to have experiences constituting a certain Ideal World conditional on their collectively having an Ideal World's worth of experience. Like Berkeleyan analyses of matter, the Leibnizian analysis entails a mind-dependent account of physical reality.

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[45](Leibniz, 1705/2013, 325).

[46]Leibniz's reasons for not taking this line have to do with his view that the actual world must be the best possible, and therefore, in his view, packed with the maximum amount of experience; see the last passage quoted above.

6.4 Phenomenalism: the Millian analysis

Just as Kant's analysis of matter is, to a decent first approximation, a modalized version of Berkeley's analysis, so Mill's analysis of matter is, to a decent first approximation, a modalized version of Leibniz's. Mill famously describes physical things as "possibilities of sensation":[47]

> The conception I form of the world existing at any moment, comprises, along with the sensations I am feeling, a countless variety of possibilities of sensation: namely, the whole of those which past observation tells me that I could, under any supposable circumstances, experience at this moment, together with an indefinite and illimitable multitude of others which though I do not know that I could, yet it is possible that I might, experience in circumstances not known to me. These various possibilities are the important thing to me in the world.[48]

Although Mill never explicitly defines the relevant kind of possibility, his text suggests an intimate connection between possibilities of sensation and counterfactual conditionals of the form:

> *If such-and-such experiential state of affairs existed, then such-and-such other experiential state of affairs would exist.*

—where an experiential state of affairs is one that's fully describable in experiential and topic-neutral terms. Such conditionals are what John Skorupski calls *sensation conditionals*.[49]

Possibilities of sensation, as Mill understands them, are states of affairs expressed by true sensation conditionals; for a certain possibility of sensation to exist is for certain sensation conditionals to be true. Though Mill does not go into much detail, it seems fair to say that in his view, physical things are possibilities of sensation expressed by sensation conditionals reporting that there would be certain coherently related groups of cohesively related experiences, if there were a totality of experiences that constituted an Ideal World.

In effect, Mill's analysis of matter moves Leibniz's minds into the antecedent of the relevant conditional. Instead of the Leibnizian reduction of the physical facts of our world to:

> There are minds such that if they had an Ideal World's worth of experiences, their experiences would include such-and-such coherently related groups of cohesively related experiences.

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[47] Mill also speaks of "permanent possibilities of sensation," "certified possibilities of sensation," "guaranteed possibilities of sensation," and "potentialities of sensation," distinguished from "mere vague possibilities, which experience gives no warrant for reckoning upon": (Mill, 1979/1865, 179-84), (Mill, 1871/1978, 459, 464). Despite its pleasing alliterative quality, "permanent possibility of sensation" is the least fitting of these labels, since, as others have noted, Mill doesn't mean to identify impermanent physical things—soap bubbles, electrical discharges, etc.—with permanent possibilities of sensation: see (Skorupski, 1989, 231) and (Hamilton, 1998, 148).

[48] (Mill, 1979/1865, 179-80).

[49] (Skorupski, 1989, 231), (Skorupski, 1994, 114).

we have the Millian reduction to:

> If there were minds that had an Ideal World's worth of experiences, their experiences would include such-and-such coherently related groups of cohesively related experiences.

As we'll see below, the Millian analysis requires amendment, in order to address questions arising from the possibility of different populations of minds existing in the same world. That said, an immediate advantage of Mill's approach over Leibniz's is that it avoids committing us to a mind-dependent conception of physical reality. In Mill's view, actual minds have experiences that partially realize various possibilities of sensation, but those possibilities would exist even if there were no minds to realize them. In this regard, Mill's possibilities of sensation resemble Kant's noumenal experience-causing powers, which also exist whether or not there actually are any minds or experiences.

Mill's analysis is known as phenomenalism. Other phenomenalist analyses of matter include those of C.I. Lewis, A.J. Ayer, and, most recently, Michael Pelczar. All these analyses stay close to Mill's original, departing from Mill mainly in how they understand the conditionals in terms of which possibilities of sensation get defined. One notable innovation is the introduction of a probabilistic element into this understanding. For example, Lewis replaces Mill's sensation conditionals with probabilified conditionals of the form:

> *If such-and-such experiential state of affairs existed, then probably such-and-such other experiential state of affairs would exist.*[50]

—where "probably" denotes an appropriately high likelihood. Pelczar goes farther in the same direction, replacing sensation conditionals with conditional probabilities of the form:

> *The probability of such-and-such experiential state of affairs existing, conditional on such-and-such other experiential state of affairs existing, is x.*[51]

Whether we understand possibilities of sensation in terms of sensation conditionals, probabilified sensation conditionals, or conditional probabilities concerning experience, the general phenomenalist picture is the same: for there to be a physical world with the physical features our world has, it is metaphysically necessary and sufficient for certain conditional states of affairs related to experience to exist, where these states of affairs can exist regardless of whether there are any actual minds or experiences.

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[50] See (Lewis, 1946, 203-53). In addition to having the advantages that Lewis claims for it, this understanding of possibilities of sensation avoids Alan Hájek's arguments for the falsity of (most) unprobabilified counterfactuals: see Hájek (2014).

[51] See (Pelczar, 2023, 4, 100-110). Ayer sticks closer to Mill, construing possibilities of sensation as the truth-makers of sensation conditionals: see Ayer (1946-1947).

In the phenomenalist analysis, if something grounds or underlies the relevant possibilities of sensation, it explains why there is a physical world, but it is not itself the physical world. The physical world comprises the possibilities of sensation themselves, since these are what explains the regularity of experience: experience occurs in regular ways, because of the constraints imposed on its manner of occurrence by the relevant counterfacts or conditional probabilities. If something explains these counterfacts or conditional probabilities, its relationship to the physical world is akin to God's relationship to the world in classic theistic cosmology.

7 Challenges for mentalism

We can divide the mentalist analyses of matter described above into two cross-cutting categories.

On the one hand, there is the division between analyses of physical states of affairs in terms of actual minds and experiences, and analyses of physical states of affairs in terms of modalities that involve minds and experiences, but can exist whether or not there are any actual experiences or minds. Call the former, which include the analyses of Leibniz, Berkeley, and the neo-Berkeleyans, *categorical analyses,* the latter, which include the analyses of Kant and Mill, *modal analyses*.

On the other hand, there is the division between analyses that require the (actual or potential) minds or experiences to which physical things reduce to have a source distinct from those minds and experiences, and analyses that do not require any such source. Call the former, which include the analyses of Kant and Berkeley, *etiological analyses,* and the latter, which include the analyses of Leibniz, Mill, and the neo-Berkeleyans, *autonomal analyses*.

Earlier, I suggested that a good way to characterize the target of analyses of matter is as whatever explains the regularity of experience. Proponents of categorical mentalist analyses must reject this characterization. In their view, the physical world is not something that explains the regularity of experience: it *is* the regularity of experience, or rather, it is the totality of experiences that exhibit the relevant regularities.[52]

But identifying physical reality with a construction out of actually existing minds and experiences is a mistake. It's possible for many (if not all) actual physical things to exist in the absence of anything mental. Indeed, this is the situation that prevailed for most of the history of our universe. Categorical mentalists must deny these seemingly obvious facts.[53]

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[52] In order to identify physical reality with what explains the regularity of experience, Berkeley would have to identify it with God, like Spinoza: (Spinoza, 1677/1985, I.15).

[53] Some panpsychists argue that a mind-dependent conception of physical reality is acceptable: see, e.g., (Chalmers, 2017b, 28-29). However, it's doubtful that those arguments succeed (see (Pelczar, 2022, 17-19)), and even if they do, they don't vindicate the specific type of mind-dependence that idealist analyses of

Berkeley notoriously thinks he can prove that physical things *do* depend on minds for their existence. This is ground that has been covered many times before, but, briefly: while Berkeley correctly holds that it's impossible to think of an x such that no possible world contains a mind that thinks of x, he incorrectly infers from this that it's impossible for there to be an x that exists in a possible world that contains no mind that thinks of x. Since Berkeley's idealism implies the latter claim, it is that claim that Berkeley needs (but fails) to establish.[54]

Among mentalist analyses of matter, the choice between categorical and modal versions is clear: modal analyses are superior. The choice between etiological and autonomal analyses is less obvious. In the discussion that follows, I'll consider challenges to both modal-etiological analyses (like Kant's), and modal-autonomal analyses (like Mill's). As we'll see, the challenges to the two types of analysis are much the same, as are the best strategies for overcoming them.[55]

7.1 Mentalism and the unobservable

According to so-called scientific antirealists, there are no unobservable physical things, or at least, none that we have any good reason to believe exist. More specifically, scientific realists doubt or deny that there any *nomically unobservable* physical phenomena, by which I mean physical phenomena such that perceiving them would require a violation of natural law. In the scientific antirealist view, talk about quarks and the like is a useful kind of fictional discourse whose utility doesn't depend on its terms referring to things (e.g., quarks) that actually exist.

If scientific antirealism is correct, the task of giving a defensible mentalist analysis of matter is easier than it otherwise would be. However, it is far from obvious that scientific antirealism is correct, and an analysis of matter that assumes that it is places a bet at uncomfortably long odds on the outcome of a live philosophical debate.

To avoid a commitment to scientific antirealism, mentalist reductionists have two options.

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matter entail, namely the dependence of physical things on experiences occurring in perceivers of those things.

[54] See (Berkeley, 1710/1901, §§22-23). Complicating the situation with Leibniz is his view that *all* truth is metaphysically necessary: this is an implication of his "predicate-in-notion" conception of truth; see, e.g., Leibniz (1686/1973). The conceivability of physical things existing in the absence of minds therefore presents no challenge to Leibniz that doesn't already arise *vis à vis* any prima facie contingent truth. But it seems more reasonable to see this as refuting Leibniz's conception of truth, rather than vindicating a mind-dependent picture of physical reality.

[55] From this point on, when I speak without qualification of mentalist analyses of matter, I mean specifically modal mentalist analyses. Fumerton discusses the similarities between noumenalist (or "causal") and phenomenalist analyses in (Fumerton, 1985, 130, 163-73).

One option is to reduce nomically unobservable physical phenomena to powers to cause, or possibilities for, the sort of experiences that are our basis for thinking that such phenomena exist; call this "anthropocentric mentalism." The other option is to reduce nomically unobservable physical phenomena to powers to cause, or possibilities for, nomically impossible (but metaphysically possible) experiences; call this "catholic mentalism."

Anthropocentric mentalism is hard to develop in a plausible way. The experiences that lead us to posit quarks provide us a basis for believing that there are such things as quarks, but it's not clear that they provide a basis for believing, of any particular quark, that that quark exists. Nomically possible experiences can give us evidence of quarks *en masse,* but not, it seems, evidence of any individual quark. Yet, quarks can hardly exist *en masse* unless there exist individual quarks. Even if we decide to use "quark" as a mass term rather than a count noun, there must still be a least amount of quark, just as there is a least amount of water. Yet, it seems impossible to reduce this least amount to any potential for nomically possible experience.

Catholic mentalism seems to be the more promising approach. Its only obvious drawback is the inclusion of nomically impossible experiences in its reduction base. This drawback may be more apparent than real, however. If we think that there really are quarks, it's presumably because, or to the extent that, we think that there is some possibility of observing a quark, under some conceivable, albeit nomically impossible, circumstances. If we doubted this, it's hard to see why we would insist that there were quarks, as opposed to useful but non-referential quark-talk; there would be nothing to stop us from classifying quarks together with other in-principle unobservable entities (or, as the case may be, non-entities) like numbers and fictional characters, none of which belong to physical reality. (To put it the other way around: if we thought that the laws of physics were the only thing preventing us from observing Sherlock Holmes or the square root of 2, we would presumably be inclined to think of Sherlock Holmes and the square root of 2 as physical phenomena.)

Like all physical phenomena (or alleged phenomena), quarks are explanatory posits. The disageement between scientific realists and antirealists is over what *kind* of explanatory posit they are. Are they fictional posits, like Coriolis forces and the average taxpayer, which exist only as useful bits of make-believe, there being no force or taxpayer answering to the phrase "Coriolis force" or "average taxpayer"? Or are quarks non-fictional posits, like coronaviruses and the center of gravity of the Solar System, which are not just useful bits of make-believe, but the referents of words like "coronavirus" and "the center of gravity of the Solar System"? Since quarks are useful posits either way, it's hard to see what the debate between scientific realists and antirealists is about, if not the question whether quarks, unlike numbers and Sherlock Holmes, are the sort of thing that are capable of being observed, if only by beings with perceptual powers unconstrained by the laws of physics.

So it seems that any reason to believe in quarks is equally a reason to think that there are things with powers to cause experiences of quarks (albeit powers suppressed by natural law), or counterfactual circumstances under which someone would perceive a quark (albeit circumstances that the laws of nature prevent from arising), or non-zero probabilities of perceiving quarks conditional on having various other experiences (albeit experiences that beings subject to the laws of nature can't have). By the same token, any reason to doubt that there are such powers, counterfactual circumstances, or probabilities would equally be a reason to doubt that there were quarks, in which case it would not be incumbent on mentalists to provide an analysis of them.

7.2 Mentalism and objectivity

Physical things are objective, in the sense that more than one observer can perceive the same physical thing (numerically the same, not just the same type of physical thing). If I throw you a frisbee, the frisbee that you see approaching you is one and the same as the frisbee I see receding from me. This is in contrast to your visual experiences of the approaching frisbee, which I do not perceive (and, in some views on the nature of experience, can't possibly perceive); nor do you perceive my experiences of the frisbee.

It is not immediately clear how a mentalist analysis of matter can account for the objectivity of physical things. Even if, as physicalists contend, perceptual experiences are physical things (e.g., brain states), *those* physical things are not the ones we both perceive when we both perceive the same features of our environment (the same tables, mountains, frisbees, etc). If, as mentalists maintain, physical things reduce to powers to cause experiences, or to counterfacts or probabilities concerning experience, how can mentalists account for the possibility for different observers to perceive one and the same physical thing?[56]

At first, Kantians seem to have an easy answer: for two people to perceive the same physical thing is for them to have experiences that (1) belong to the same group of cohesive, coherent experiences, where, (2) their experiences are all caused by the same noumenon (the same possessor of experience-causing power). However, on further consideration, this answer is not available to Kantians. In the Kantian view, the only thing we can know about noumenal reality is that it exists, and has (and sometimes exerts) various experience-causing powers. We do not know how many noumena there are; for example, we don't know whether there's more than one. For all we know, *all* experiences are caused by one and the same noumenon. Thus,

[56]Discussing the challenge this poses for Berkeleyan idealists, Lisa Downing suggests that the key to solving it "is to recall that objects are bundles of ideas. Although two people cannot perceive/have the numerically same idea, they can perceive the same object, assuming that perceiving a component of the bundle suffices for perception of the bundle." (Downing, 2011, 27) But this doesn't solve the problem: it just relocates it. Now the question is: when do different people's experiences belong to the same bundle?

for all we know, your present experiences have the same noumenal cause as the experiences Julius Caesar had when he crossed the Rubicon; but, obviously, we don't want to say that you are perceiving the same physical things that Caesar perceived on that occasion.

This by itself does not undermine the proposed account of objectivity, since Caesar's experiences are not interdependent with yours. The point is just that commonality of cause is not a criterion for co-perception available to Kantians.

Well, why not simply reduce objectivity to the sort of counterfactual or probabilisic interdependencies that hold among the experiences of different people perceiving the same thing? When we're playing frisbee, it's not a coincidence that as my visual images of the frisbee occupy less of my visual field, your visual images of the frisbee occupy more of yours: the probability of your image growing given that mine shrinks is high, as is the probability that mine shrinks given that yours grows (or, in counterfactual terms: my image would grow if yours shrank, and yours would shrink if mine grew). The same cannot be said of my frisbee experiences and those of someone preparing to catch an identical frisbee on the other side of the world: though his experiences grow as mine shrink, it is not the case that the probability of his experiences growing conditional on mine shrinking is high, or that a growth of my experiences counterfactually depends on a shrinkage of his. So maybe we can say that people perceive the same thing when their experiences are concurrent, stand in suitable relations of interdependence, and satisfy all other criteria for cohesiveness and coherence.[57]

Though initially promising, this account ultimately falls short. Suppose two people are watching the same television broadcast on different televisions. Each person's experiences depend on the other's, in the same way they would if they were viewing the program on the same television screen (the experiences don't affect one another, but they stand in relations of counterfactual and probabilistic interdependence). But the people do not perceive the same screen or screen images.[58]

In the case where two people's experiences satisfy the interdependence requirement for observing the same screen, despite not observing the same screen, there is a difference in the spatial locations of the screens they observe. This suggests that to get an adequate account of objectivity, we should supplement the interdependence requirement with a co-location requirement: two people experience the same physical event or process just in case their experiences are suitably interdependent *and* the event or process that each person experiences has the same spatiotemporal location as the event or process that the other experiences.

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[57] This is the approach that Mill takes: see (Mill, 1979/1865, 181-82).

[58] For a more extreme example of this sort, we can imagine that the Big Bang generated a Twin Earth indistinguishable from Earth; our Twin Earthly counterparts' experiences satisfy the proposed criteria for being perceptions of numerically the same things as our experiences, despite clearly not being perceptions of the same things.

The best way for mentalists to accomplish this is by taking a page from the scientific playbook. In the standard scientific understanding of physical spacetime, a physical thing's spatiotemporal location is given by the spacetime coordinates it gets assigned in a comprehensive assignment of coordinates to events that facilitates an explanation of the world's prima facie complexity in terms of a small number of simple natural laws. How we arrived at a system of coordinates for physical events that has this property is a fascinating story from the history of science that there is no space to recount here. The important thing to know is that one discovers such a system by trying out different coordinate schemes, until one hits upon a scheme that has the desired property of being such that when you describe the physical world in terms of it, you describe it as a world thoroughly governed by simple, intelligible laws.[59]

Mentalists can use the same general method to assign spacetime locations to the experiences that make up an Ideal World. They can treat the Ideal World as a phenomenal model of a physical world, and then assign coordinates to the experiences constituting the model in the way that best facilitates a description of the model's properties and behavior in terms of a small number of simple, intelligible laws. This isn't the place to develop this approach in detail, but an analogy will convey the general idea.[60]

Consider a computer running a model of the Milky Way Galaxy. Various states and processes of the computer's hardware model various parts of and changes in the Milky Way (e.g., various stars and planets and their motions). One way to describe the location and timing of these states and processes is with a coordinate system in terms of which we might also describe the contents of the computer lab and the world at large: desks, chairs, pens, coffee mugs, the cars in the parking lot outside, etc. But we could also describe the states and processes of the computer in terms of coordinates that we assign to them based on the roles they play in the astronomical model they instantiate.

For example, if one machine state models the Sun, and a second machine state models Alpha Centauri, and a third models a star *S* that occurs twice as far from the Sun as Alpha Centauri, we can assign the machine states coordinates in such a way that the Euclidean difference between the first state's coordinates and the third state's coordinates is twice the difference between the first state's coordinates and the second state's coordinates. We could do this even if the Milky Way galaxy didn't exist, and there were no galaxy answering to the computer model.

Even if there were no galaxies at all, we could look at the model itself, and study it as a phenomenon in its own right. One way to make sense of the model's behavior is by assigning its constituent machine states and processes the same coordinates that we would assign to

[59] For a good explanation of mainstream scientific thinking about time and space, see Geroch (1978).

[60] For detailed mentalist accounts of time and space broadly along the lines sketched here, see Nicod (1924/1950), (Foster, 1982, 253-94), and (Pelczar, 2023, 76-90, 185-93).

various features of a galaxy answering to the model, if we were to assign coordinates to that galaxy's features in a way that made sense of the galaxy's behavior in terms of the laws of physics. In practice, it might never occur to us to coordinate the machine states and processes this way if we didn't think of them as features of a galactic model, but such a coordination is one we *could* hit upon even if we had no notion of galaxies or physics.

We can think of an Ideal World as a phenomenal model of a physical world. Just as we can assign coordinates to machine states in a way that makes sense of the complexities of a computational model they constitute, we can assign coordinates to phenomenal states in a way that makes sense of the complexities of a phenomenal model they constitute. We can do this, regardless of whether there is any physical world answering to the phenomenal model.

Mentalists can say that ideal spacetime is the spacetime in which experiences have the coordinates they get assigned in a sense-making coordination of a certain phenomenal model. For Kantians, the model in question is the Ideal World that would exist, if noumena exercised all their experience-causing power; for Millians, it is the Ideal World that would exist, if there were an Ideal World. Then Kantians and Millians can say that for two people to perceive the same physical thing is for their experiences to have the same coordinates in the relevant phenomenal model (i.e., the relevant Ideal World). This is a condition that the experiences of different people attending the same tennis match might satisfy, but that the experiences of people watching a broadcast of the match on different televisions do not.

7.3 Mentalism and perceptual relativity

When comparing Mill's analysis of matter to that of Leibniz, I said that an advantage of Mill's analysis is that it doesn't imply that there must actually exist minds in order for there to be anything physical. This is because Mill reduces the existence of physical things to the truth of suitable sensation conditionals, which could be true even if there were no minds. (Phenomenalist analyses in terms of experiential probabilities have the same advantage.)

However, I also suggested that Mill's analysis has a problem related to the possibility of different populations of minds. The problem really arises for any modal mentalist analysis, including Kantian analyses in terms of experience-causing powers. It arises from the following fact: which coherently-related groups of cohesively-related experiences are apt to occur, or which such groups noumena are apt to cause, may depend on the natures of actually existing minds, and there might be different populations of actual minds that are apt to have (or to be caused to have) different such groups of experiences.

This is what's known as the problem of perceptual relativity. An example will make it vivid.[61]

[61] The problem of perceptual relativity originates with Chisholm (1948); for a detailed and insightful discussion of the problem, see (Fumerton, 1985, 141-50).

A common trope of modern science fiction is the computer-generated virtual world, such as the one depicted in the *Matrix* movies. It's not obvious that such virtual worlds are confined to the fictional realm: according to Nick Bostrom, there is a decent chance that we actually inhabit such a world.[62]

Suppose that computer scientists have built a computer and programmed it to cause the sort of experiences that would be apt to occur in J.R.R. Tolkien's Middle Earth universe, if such a universe existed. The computer contains sentient beings with mental lives sustained by computational processes, and it causes these beings to have some, but far from all, of the experiences that it has the power to cause in them. The computer has (let's suppose) the power to cause experiences that collectively constitute an Ideal World corresponding to a fully detailed physical realization of Tolkien's Middle Earth universe: an Ideal World in which cohesive experiences of a city with the properties Tolkien attributes to Minas Tirith cohere with all other experiences.

The computer just described poses a problem for modal mentalists. For Kantians, the problem is that in a universe that contains such a computer, there is no such thing as the Ideal World that things with experience-causing powers would generate, if the things with experience-causing powers exercised all of their experience-causing powers. In a universe that contains the described computer, the result of a maximum exercise of experience-causing power is a totality of experiences that includes (at least) two worldlike subsets: one subset that constitutes an Ideal World corresponding to Middle Earth, and another constituting an Ideal World corresponding to the "real" world that includes the computer, the lab in which it exists, the people who programmed it, etc. (By a "worldlike" totality of experiences, I mean a totality of experiences that collectively constitute an Ideal World.) But, in the Kantian view, Rome exists only if a maximum exercise of experience-causing power would result in an Ideal World that included cohesive and coherent experiences of Rome. In a world containing the Middle Earth simulator, there are no such experiences, since the totality of *all* experiences that the noumena can cause is not worldlike. So the Kantian analysis of matter wrongly implies that if the described computer exists, Rome does not.[63]

For Millians, the problem is slightly more nuanced, but basically the same. On the one hand, if the computer is more likely than the "real" world (or any other part thereof) to generate an Ideal World's worth of experience, then we must say that if there were minds that had an Ideal World's worth of experiences, their experiences would include cohesive, coherent ex-

[62] See Bostrom (2003).

[63] It's no use pointing out on Kantians' behalf that we have no reason to think that there actually is a computer such as the one described. The question whether such a computer actually exists should be irrelevant to the question of whether there is a physical world; as it stands, the Kantian analysis implies that the former question is directly relevant to the latter.

periences of Minas Tirith; in that case, a phenomenalist has to say that Minas Tirith exists as an actual physical city. On the other hand, if the computer is just as likely as the "real" world to generate a worldlike totality of experience, then it is false that if there were an Ideal World, it would include cohesive, coherent experiences of Rome; in this case, a phenomenalist has to say that Rome doesn't exist. Only if the imagined computer is *less* likely than the "real" world to generate an Ideal World's worth of experience can the phenomenalist avoid these implications. But we can stipulate that the computer is not less likely than the "real" world to generate such a totality. The problem, for phenomenalists, is that their analysis commits us to saying that stipulating this entails stipulating that either Minas Tirith exists or Rome doesn't.

How can a noumenalist overcome the problem of perceptual relativity? Perhaps the best approach is to say that the computational people in the Middle Earth simulator speak truly when they utter the sentence, "Minas Tirith is a real physical city": it's just that what they mean by that sentence is different from what we (or the people who built the simulator) mean by it. What the people in the simulation mean by it is that if the possessors of experience-causing power caused a worldlike totality of experiences *that included their own actual experiences,* the totality would include cohesive experiences of Minas Tirith *that cohered with their own actual experiences,* as well as with the rest of the totality; this is true. What *we* mean if we utter the same sentence is that if the possessors of experience-causing power caused a worldlike totality of experiences *that included our own actual experiences,* the totality would include cohesive experiences of Minas Tirith *that cohered with our own actual experiences,* as well as with the rest of the totality; this is false.

By the same token, if someone in the simulation were to say, "Rome is a real physical city," he would speak falsely, since what he'd mean by this is that if the possessors of experience-causing power caused a worldlike totality of experiences that included his own actual experiences, the totality would include cohesive experiences of Rome that cohered with his experiences (as well as with the rest of the totality). But if one of us outside the simulation says "Rome is a real physical city," she speaks truly, since (we assume) if the possessors of experience-causing power caused a totality of experiences that included her actual experiences, the totality would include cohesive experiences of Rome that cohered with her own experiences (as well as with the rest of the totality).

The most promising phenomenalist solution to the problem of perceptual relativity is much the same. Instead of analyzing "Rome exists" as:

> If there were a worldlike totality of experiences, it would include cohesive and coherent experiences of Rome.

a Millian should analyze it as:

> If there were a worldlike totality of experiences that included our actual experiences, it would include cohesive experiences of Rome that cohered with our experiences and with the worldlike totality to which they belonged.

Similarly, a phenomenalist who understands possibilities of sensation in terms of probabilities instead of counterfactuals should analyze "Rome exists" as:

> The worldlike totality T of experiences that is most likely to exist, conditional on our actual experiences belonging to a worldlike totality, includes cohesive experiences of Rome that cohere with T and our experiences therein.

rather than as:

> The worldlike totality of experiences that is most likely to exist, conditional on there being a worldlike totality of experiences, includes cohesive and coherent experiences of Rome.

While the revised modal analyses overcome the problem of perceptual relativity, this might look like a case of out-of-the-frying-pan, into-the-fire. The big problem with categorical mentalist analyses was their implication that our world's physical contents couldn't possibly exist in the absence of actual minds and experiences. By incorporating a reference to our own actual experiences into their analyses, don't noumenalists and phenomenalists also commit themselves to a mind-dependent account of the physical?

No. The revised modal analyses assume that there are metaphysically possible Ideal Worlds that include our actual experiences, and that one of those possible worlds is more likely than the others to be actual (conditional on one of them being actualized). But the metaphysical possibility of the relevant Ideal World does not entail the *actual* existence of our experiences, or any experiences. The relevant Ideal World would have been metaphysically possible, even if our experiences had never actually existed. In the same way, the existence of possible worlds where Richard Nixon belongs to the American Communist Party doesn't depend on Nixon's having actually existed (that is, having existed in our, actual, world). It might have been impossible for us to refer to such worlds if Nixon had never actually existed, but the existence of a metaphysical possibility doesn't depend on our being able to refer to it.

Here is something that noumenalists don't say, but if they did would commit them to saying that the Moon is a mind-dependent entity:

> The Moon exists $\leftrightarrow$ $(\exists x)(\exists y)$(x = our experiences & y = the metaphysically possible Ideal World that would exist and include x, if all experience-causing power were exercised & cohesive experiences of the Moon that cohere with x and y occur in y).

But all that the noumenalist analysis really commits us to is:

> $(\exists x)(\exists y)$(x = our experiences & y = the metaphysically possible Ideal World that would exist and include x, if all experience-causing power were exercised & (the Moon exists $\leftrightarrow$ cohesive experiences of the Moon that cohere with x and y occur in y)).

This does not imply that the Moon depends for its existence on our having experience, or on there existing any minds at all. Similarly, phenomenalists would commit themselves to a mind-dependent account of the Moon, were they to say:

> The Moon exists $\leftrightarrow$ $(\exists x)(\exists y)(x$ = our experiences & y = the x-including metaphysically possible Ideal World most likely to exist, conditional on there being an Ideal World that includes x & cohesive experiences of the Moon that cohere with x and y occur in y).

But all that the phenomenalist analysis really commits us to is:

> $(\exists x)(\exists y)(x$ = our experiences & y = the x-including metaphysically possible Ideal World most likely to exist, conditional on there being an Ideal World that includes x & (the Moon exists $\leftrightarrow$ cohesive experiences of the Moon that cohere with x and y occur in y)).

Like the noumenalist analysis, this does not imply that the Moon depends for its existence on there actually being minds or experiences (ours or anyone else's).

8 Conclusion

The analysis of matter is strangely neglected in contemporary philosophy. Unlike the analysis of mind, value, justice, knowledge, causation, or meaning, the analysis of matter has long been relegated to the sidelines of the broader analytical enterprise.

It wasn't always so. Until the mid-20th century, the analysis of matter was a topic of lively mainstream debate. Today, realist analyses are the province of a relatively esoteric branch of the philosophy of science (which rarely advertises itself as offering reductive theories of the physical at all), and apart from the offerings of a handful of enterprising contrarians, mentalist analyses have been largely displaced by panpsychists' brute identification of fundamental physical phenomena with experiential or proto-experiential phenomena.[64]

I've made no effort to disguise my own mentalist leanings, but my purpose here hasn't been to sell any particular analysis of matter. It has been to persuade you that the analysis of matter is a pursuit as worthy as any in analytic philosophy, not least of all for its connection with some of the boldest ideas of our profession's most original thinkers. If the present study sparks renewed interest in this half-forgotten endeavor, it will have served its purpose.

[64] For contemporary panpsychism, see Strawson (2006), Hassel Mørch (2014), and Chalmers (2017b) and Chalmers (2017a).

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