



David Lewis's Metaphysics

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David Lewis

Part 1: Fundamental ontology

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§0 Introduction

One of the most interesting and influential analytic philosophers of the 20th century, David Lewis produced a body of philosophical writing that, in four books and scores of articles, spanned every major philosophical area, with perhaps the greatest concentration in metaphysics, philosophy of language, philosophical logic, and philosophy of mind. Despite this astonishing variety, a newcomer to Lewis's philosophy would be best advised to begin with his metaphysics (especially: 1986a, 1986e, 1999). There are several reasons. First, the majority of Lewis's work either concerns, or substantially overlaps, topics in metaphysics. Second, the metaphysical positions Lewis stakes out are strikingly original and powerfully argued. Third, there is a coherence and systematicity to this work that makes it a particularly appropriate object for study, in that one sees trademark Lewisian philosophical maneuvers clearly on display. (Indeed, if one wished to learn how to do philosophy in a Lewisian style, the most efficient way to do so would be to study his work in metaphysics.) Finally, and perhaps most interestingly, Lewis's metaphysics exerted a profound regulating influence on the rest of his philosophy: if some otherwise attractive position on some philosophical problem could not be made to square with his overall metaphysical outlook, then it would have to be abandoned.

I should forestall one possible misunderstanding. You might think that, given what I've just said, the way Lewis would recommend doing philosophy is as follows: First you figure out what your basic metaphysical commitments should be; then you turn your attention to various broad but non-foundational philosophical subject matters (personal identity, mental content, the nature of knowledge, theory of value, etc.), and work out the consequences in each of these arenas of your fundamental metaphysical posits. Nothing could be further from Lewis's preferred methodology. (Well, maybe relying on divine revelation would be further....) What he in fact recommends is a holistic approach: we start with the total body of claims we are inclined to believe—whether on the basis of “common sense” (an oft-invoked category, for Lewis) or of science—and try our best to *systematize* it in accordance with standards of theoretical goodness that are themselves endorsed by common sense and/or science (and so are themselves, to some extent, also up for grabs). A substantial portion of Lewis's overall body of philosophical work can thus be seen as an ex-

tended—and breathtakingly ambitious—attempt at achieving *total reflective equilibrium*. Here is an especially succinct description of this approach:

One comes to philosophy already endowed with a stock of opinions. It is not the business of philosophy either to undermine or to justify these preexisting opinions, to any great extent, but only to try to discover ways of expanding them into an orderly system. (1973b, p. 88)

Still, while Lewis's method of philosophical inquiry is certainly not “bottom-up”, in my opinion it is best to present the *results* of that inquiry in a bottom-up fashion. That is what this essay, and ones to follow, will attempt to do. I will divide the terrain into four parts: Lewis's fundamental ontology; his theory of metaphysical modality; his “applied” metaphysics (covering such topics as laws of nature, counterfactuals, causation, identity through time, and the mind); and Lewisian methodology in metaphysics. I'll explain these distinctions shortly, but be advised that the present essay will almost exclusively address the first of these four topics; subsequent articles will take up the remaining three.

Unsurprisingly, limitations of space make for a serious problem of balancing coverage with depth; I have tried to finesse this problem by linking, where appropriate, to supplementary documents that provide more detailed treatments of selected issues.

§1 Lewisian metaphysics: an overview

On a traditional conception, metaphysics aims to answer, in a suitably abstract and fully general manner, two questions:

What *is there*?

What is it (that is, whatever it is that there is) *like*?

Lewis fully endorses this conception: for him, metaphysicians are not in the business merely of analyzing our “conceptual scheme” (except insofar as doing so is an effective *method* for finding answers to metaphysical questions), nor need they pay any heed to the perennial philosophical calls for the abolition of their subject. They are, rather, engaged in an unproblematically factual inquiry into the nature of reality—one whose recognizable epistemological pitfalls provide no grounds for doubting its legitimacy:

Once the menu of well-worked-out theories is before us, philosophy is a matter of opinion. Is that to say that there is no truth to be had? Or that the truth is of our own making, and different ones of us can make it differently? Not at all! If you say flatly that there is no god, and I say that there are countless gods but none of them

are our worldmates, then it may be that neither of us is making any mistake of method. We may each be bringing our opinions to equilibrium in the most careful possible way, taking account of all the arguments, distinctions, and counterexamples. But one of us, at least, is making a mistake of fact. Which one is wrong depends on what there is. (Lewis 1983a, p. xi)

We can begin to get a handle on Lewis's audacious and comprehensive answers to our two overarching questions by distinguishing three components to his metaphysical program:

First, he offers an account of what the *fundamental ontological structure* of the world is. Is, and *must* be—although as we'll see, that qualification turns out to be in a certain sense trivial. This account of fundamental ontology of course presupposes that the word “fundamental” *means* something, and in particular manages to cleanly distinguish a certain central core of one's ontological commitments from the rest. Suppose these commitments take the form of views about what entities (or “particulars”) there are, and what properties and relations they stand in. Then we can distinguish two questions. Are some entities more fundamental than others—with, perhaps, an elite group of entities being the most fundamental? Are some properties/relations more fundamental than others—again, with, perhaps, an elite group being the most fundamental? You might find a “yes” answer to both questions attractive. (E.g., chairs exist, but they are not fundamental-level entities—though perhaps quarks are. Likewise, some chairs have the property of *being made of oak*; but this is not a fundamental-level property—though perhaps the property of having such-and-such electric charge is.) As for Lewis's own views, with respect to the second question they are fairly unambiguous: He is quite clear that a proper ontology must include not just particulars but also properties and relations (see especially 1983b); he is equally clear that it is a perfectly objective and determinate matter which of these properties/relations are more fundamental (or, in his terminology, more “natural”) than others (*ibid.*); he is officially agnostic about whether some properties/relations are *most* fundamental, or *perfectly* natural (1986f). His views on the first question are, to my eyes at least, more difficult to discern—but for reasons that, in the final analysis, probably do not matter. ([Here's why.](#)) What's more, to a very great extent he takes it that the route to a proper theory of fundamental ontology is by way of a priori philosophical inquiry. (An important qualification will be noted shortly.)

Second, he offers an account of *modality*, his famous “realism” about possible worlds. Lewis, like many philosophers, takes talk of possibility and necessity to be best explicated as disguised quantification over possible worlds (and possible inhabitants thereof), and he was endlessly ingenious at showing how to use the resources provided by a theory of “possibilia” to produce analyses of a host of modal locu-

tions. But his realism about possible worlds consists in much more than inclusion of such entities into his ontology; indeed, it would probably be better to call Lewis a “reductionist” about modality—reductionist in a way that distinguishes him from virtually every other philosopher of modality. For a typical believer in possible worlds will, if asked to explain what they are, give an account that *uses modal notions* at some crucial point. Perhaps she will say that possible worlds are maximal *consistent* sets of sentences (in some appropriate language); or perhaps she will say that they are certain kinds of maximal properties that reality as a whole *could have* instantiated. Lewis says no such thing: he offers a characterization of possible worlds—and thus of modality generally—in *explicitly non-modal terms*. This complete subordination of the modal to the non-modal gives his philosophy of modality a quite radical character, and also sheds light on some of his seemingly independent views about the modalities involved in such concepts as causation, law of nature, and chance. (For example, Lewis rejects philosophical accounts of laws of nature that rely on any primitive modal notions.)

Third, Lewis offers an account of how facts about everything else *reduce* to the sorts of facts laid out in his accounts of fundamental ontology and modality. (Note that given the remarks in the last paragraph, these reductions ultimately rest on facts about fundamental ontology *alone*; no unanalyzed modal notions are involved in them.) Better: he offers an assortment of distinctive approaches for constructing such reductions, of which there are many examples but no single, canonical exposition. At this point I wish to make just three observations about these strategies. First, they can be seen to be directed at providing answers to a distinctively metaphysical kind of question, of the form, “What is it for such-and-such a fact to obtain?” Examples will pin down the idea:

Question: What is it for an object to persist through time? Lewis's answer: It is for that object to be constituted by three-dimensional, instantaneous time-slices that exist at different times. (Lewis 1988)

Question: What is it for an object to have a certain property essentially? Lewis's answer: It is for every one of that object's counterparts in other possible worlds to have that property. (Lewis 1968)

Question: What is an event? Lewis's answer: It is a certain kind of property of spacetime regions. (Lewis 1986d)

Question: What is it for one event to be a cause of another? Lewis's (preliminary) answer: It is for the second event to counterfactually depend on the first, in the sense that had the first not occurred, the second would not have.¹ (Lewis 1973a, 1986b)

¹ A significant oversimplification of Lewis's actual view, as will be apparent in the (forthcoming) article on Lewis's applied metaphysics.

Question: What is an explanation of some event? Lewis's answer: It is a quantity of information about that event's causes. (Lewis 1986c)

And so on. It is this kind of question—albeit not always phrased in this way, and accompanied by definite views about what constitutes a philosophically appropriate answer—that animate what we might call Lewis's “applied metaphysics”: the application of his basic positions in ontology and modality to a range of perennial metaphysical topics. Note that the *reductionist* character of his approach comes out when we pursue the obvious follow-up questions: For example, what is it for one event to counterfactually depend on another? Roughly, it is for the closest possible world in which the second does not occur to be a world in which the first does not occur. What is it for one world to be closer to actuality than another? We'll skip the answer for now—but rest assured that it and the answers to subsequent follow-up questions are designed to hang together in such a way as to collectively display how facts about what causes what ultimately reduce to facts about fundamental ontology. And so it goes, for personal identity, free will, the mind, knowledge, ethics, laws of nature, you name it.

The second observation is that remains far from clear whether we can dispense with the notion of “reduce to” (or “determined by”, “fixed by”, etc.) in favor of some philosophically more sanitized alternative; [here's why](#).

The third observation I wish to make at this point is that Lewis is strongly motivated by a desire for theoretical economy—both with respect to ontology and with respect to ideology. His quest for ontological economy shows up in the austerity of the *kinds* of fundamental entities he admits into his ontology (he neither shows, nor cares to show, any economy with respect to their *number*). His quest for ideological economy shows up in several places, but perhaps most notably in his utter rejection of *any* unanalyzed modal notions, and—something that hasn't been mentioned yet—in his attempted reduction of set theory to mereology and plural quantification. More on this in the (forthcoming) article on his applied metaphysics, as well as other examples of his focus on ideological parsimony at work.

Let's take a somewhat closer look, now, at Lewis's account of fundamental ontology.

§2 Fundamental ontology: A simplified version

It will be useful to start with a view that is almost Lewis's—almost, but not quite, as it is more opinionated than he would be comfortable with. Stating the view takes but a few lines; providing the needed commentary will take longer. Thus, Almost-Lewis says the following:

The only *fundamental entities* that are *particulars* are spacetime points.

What these particulars *are like* is given by what perfectly natural monadic properties they instantiate, and what perfectly natural relations they stand in to one another.

And that's it. That is, the facts about what fundamental particulars there are, and what perfectly natural properties and relations they instantiate, determine all other facts. Yes, even modal facts, as the (forthcoming) companion article explains. Almost-Lewis (and Lewis) believes, of course, in *other* particulars besides spacetime points; it's just that these particulars are not fundamental: what it is for them to exist is to be explained, somehow, in terms of facts about the fundamental entities. (More on this, in the forthcoming companion article on Lewis's applied metaphysics; also, [see here](#) for some qualifications about Lewis's position.)

Notice one consequence: If the facts about what fundamental particulars there are, and what perfectly natural properties and relations they instantiate, determine *all* other facts, then there is no reason to suppose that composite particulars—particulars that have other particulars as proper parts—ever instantiate perfectly natural monadic properties. (Of course, they can perfectly well instantiate the very-but-not-perfectly natural property of having *parts* that instantiate such-and-such a perfectly natural *relation*.) Thus, if, for example, my laptop has a mass of 3 kg, that is so only in a slightly derivative sense: the laptop is composed of parts whose masses add up to 3 kg.

As noted, the position of Almost-Lewis is not that of Lewis, and shortly we will need to review the key respect in which, by Lewis's lights, it overreaches. But first we need to elaborate and clarify the content of Almost-Lewis's position, by means of some commentary.

Four questions demand attention: What are “perfectly natural” properties and relations? What does it come to to say that the fundamental particulars are *spacetime* points? What does it come to to say that they are spacetime *points*? Finally, what is the relationship between the fundamental ontology posited by Almost-Lewis and Lewis's own celebrated thesis of Humean Supervenience? Let's consider these topics in turn.

§3 Perfectly natural properties and relations

Remember that laying out the foundations of one's ontology requires two things: to say what, fundamentally, *there is*; and to say what it *is like*, presumably by stating some *facts about* the fundamental entities. But not just any facts matter. For example, it may be true of some of the fundamental entities that they coexist with at least one pig; but saying so does nothing to help articulate the *fundamental structure* of reality. To do that, Lewis thinks, one needs a *distinction* among the properties and relations: some are special, in that it is *their* pattern of instantiation among the fundamental en-

tities that constitutes the fundamental structure of reality—the “joints” along which nature is to be ultimately carved. These special properties and relations are the “perfectly natural” ones.

(There are a variety of other uses to which Lewis puts the notion of “natural” properties, some of which show that what he needs is a distinction that admits of gradations, with the *perfectly* natural properties at one extreme. Many of these additional uses will be mentioned in the (forthcoming) article on his applied metaphysics; but see [here](#) for an overview.)

It is not enough merely to *appeal* to such a distinction; for metaphysics to do its job properly, it must also provide an *account*. Now, one way to proceed would be to provide a theory of what properties and relations are, in which it is stipulated that all such things are to count as “perfectly natural”. On such an approach, while there may well be a property corresponding to the predicate “has mass 5 kg” (for example), there will almost certainly be no property corresponding to the predicate “is green” (let alone that familiar gerrymander, “is grue”). Lewis favors a different approach. Given his commitment to set theory, he *already* believes in things that, by his lights, deserve to be called the property of being green, and indeed the property of being grue: these are merely certain *sets*—sets of actual and possible objects. (See the companion article on his theory of modality, and [here](#).) The question for him, then, is how to *distinguish* among these sets those that are perfectly natural. Here I will present Almost-Lewis as being, almost like Lewis, agnostic as between four broad alternatives. (Almost, because Lewis eventually decided that the first alternative, according to which natural properties and relations are Aristotelian universals, is unworkable; see his 1986f for the reasons.)

- One could adopt a *theory of universals* of the kind developed by David Armstrong (1978a,1978b): “...we could call a property [viz., set of actual and possible objects] *perfectly* natural if its members are all and only those things that share some one universal.” (1999 p. 13)

- One could treat “natural” as a *primitive* predicate of sets of actual and possible objects: “...a Nominalist could take it as a primitive fact that some classes of things are perfectly natural properties; others are less-than-perfectly natural to various degrees; and most are not at all natural. Such a Nominalist uses ‘natural’ as a primitive predicate, and offers no analysis of what he means in predicating it of classes.” (1999, p. 14)²

- One could define “natural” in terms of a suitably complex, and primitive, notion of *resemblance*: “Alternatively, a Nominalist in pursuit of adequacy might prefer to

² Note that all Lewis means by “Nominalist” here is one who denies the existence of universals.

rest with primitive objective resemblance among things. ...Then he could undertake to define natural properties in terms of the mutual resemblance of their members and the failure of resemblance between their members and their non-members.” (1999, p. 14)

- One could adopt an ontology of *tropes*—roughly, property-instances, entities that occupy a sort of ontological halfway house between particulars and properties. (See Lewis 1986f, Williams 1953, Campbell 1990.)

Returning now to Almost-Lewis's fundamental ontology, the options seem to be these: It might be that a spacetime point (or sequence of points) instantiates a perfectly natural property (respectively, relation) by instantiating a universal, in the sense of Armstrong. It might be that it has it by having as one part a certain kind of trope, in roughly the sense of Williams. (Whence we must amend slightly, and take these *tropes* to be the fundamental entities.) It might be that it has it by belonging to a special sort of set of (actual and merely possible) spacetime points—special either on account of the resemblances that unite its members and distinguish them from non-members, or on account of simply *being perfectly natural*. Regardless of which one chooses, Lewis thinks, one's theory of natural properties and relations ought to respect four philosophically-motivated constraints:

First, an adequate theory should be *minimal*, in the sense that it posits just enough perfectly natural properties and relations for their distribution among the fundamental particulars to fully and determinately fix the nature of all of reality: “The guiding idea, roughly, is that the world's universals should comprise a minimal basis for characterizing the world completely. Universals that do not contribute at all to this end are unwelcome, and so are universals that contribute only redundantly.” (1999, p. 12) It is clear from the surrounding text that Lewis takes this constraint to govern the various alternatives to a universals account of naturalness.³

Second, perfectly natural properties and relations are, Lewis thinks, *non-modal*. What, exactly, this means will need to come in for more discussion in the (forthcoming) companion article on Lewis's applied metaphysics, where we discuss his views about laws of nature and related nomological concepts. For the moment, we can take it to mean roughly this (though trouble for this characterization quickly arises): the instantiation of a perfectly natural property by one (fundamental) particular, or of a relation by several, places absolutely no constraints of a logical or metaphysical kind

³ Phillip Bricker has pointed out (personal communication) that this constraint injects “a kind of arbitrariness into logical space. For example, if there are perfectly natural asymmetric relations (such as “is earlier than”), the converse of such a relation (“is later than”) could not also be perfectly natural.” As Bricker further notes, Lewis seems not to have noticed this consequence.

on the instantiation of any other perfectly natural property or relation by that or any other particular or particulars.

Third, they are *intrinsic* to the particulars that instantiate them—which, all too roughly, means that they characterize what those particulars are like, independently of what any other distinct particular is like. More: The intrinsic nature of any particular is exhausted by what perfectly natural properties it instantiates.⁴ This assumption also allows a theory of natural properties and relations to yield, in a fairly simple way, a definition of “perfect duplicate” applicable to any possible objects *x* and *y* (not necessarily inhabiting the same possible world): *x* and *y* are perfect duplicates iff they share exactly the same perfectly natural properties.⁵ A definition of “intrinsic” follows: a property *P* is intrinsic iff any two duplicates *x* and *y* (taken from any possible worlds) either both have *P* or both fail to have *P*. Of course, what we really have here is a tight circle that puts on display how the expressions “intrinsic”, “perfect duplicate”, and “perfectly natural” can be interdefined, with the help of the modal notion of metaphysical possibility. (See Lewis 1983c and Langton & Lewis 1998 for discussion of various strategies for breaking out of this circle.)

The fourth constraint is purely negative: it is that it should be left to the empirical sciences to fill in the details about *which* perfectly natural *monadic properties* there are (at least, in actuality: *philosophy* might teach us, or at least give us some reason to believe, that there are, in other possible worlds, so-called “alien” properties, perfectly natural properties not instantiated in the actual world). Not just any empirical science will do: given, in particular, the first of the four theses, it is really the job of fundamental physics to fill in these details. The special sciences get no say.

What about perfectly natural relations? Here matters are less clear. Lewis certainly thinks that spatiotemporal relations are perfectly natural; what is less obvious is whether, by his lights, physics could rationally lead us to *reject* this claim. For now I will simplify, and have Almost-Lewis add a *fifth* constraint—one that is in tension at least with the spirit of the fourth, and that the real Lewis certainly rejects. It is this: not only are spatiotemporal relations perfectly natural, they are the *only* perfectly natural relations. (The only *possible* ones—though remember that given Lewis's reductionism about modality, that is an idle addition.)

⁴ A bit more carefully, its intrinsic nature is exhausted by the perfectly natural properties it instantiates, together with the perfectly natural properties and relations instantiated by its *parts*. Of course the simpler formulation will do if we are talking about *fundamental* particulars, as they have no proper parts.

⁵ Again, a bit more carefully: *x* and *y* are perfect duplicates just in case they and their parts can be put into a one-to-one correspondence that preserves the facts about which perfectly natural properties and relations are instantiated.

The picture that emerges is this: Reality consists of a multitude of spacetime points. Each of these stands in spatiotemporal relations to some others (though not to *all* others: see the companion article on Lewis's theory of modality). Each instantiates various perfectly natural, non-modal monadic properties. That is all there is; anything putatively “extra”—facts about laws of nature, or about persisting macro-objects, or about causation, or about mentality, or about ethics, or about sets, etc.—must somehow reduce to that stuff. For Almost-Lewis, this picture captures a fundamental truth about the nature of existence. It is roughly right that it is also a *necessary* truth—a status that would seem to fall out automatically, given Lewis's reductionist account of modality. (We will see, in the companion article, reasons for thinking that he is better off simply *dismissing* any questions about the modal status of his theses about fundamental ontology.) The only unfinished *philosophical* business is to work out the right theory of natural properties and relations, and to work out the details of the reduction for particular cases.

§4 Spatiotemporal relations and spacetime points

The foregoing Almost-Lewisian thesis about spatiotemporal relations is too strong to be tenable: we now have reasonably good reasons, drawn from quantum physics, for holding that even in the actual world, there are perfectly natural relations other than the purely spatiotemporal ones. (Roughly: the relations—whatever exactly they amount to—coded up in the quantum mechanical wave-function.) Two points in its defense are, however, worth brief mention: First, seemingly obvious counterexamples—involving such basic physical relations as *being more massive than*—in fact *aren't* counterexamples, since Lewis can deny that they are genuinely fundamental or *perfectly* natural, on the basis that facts about their obtaining reduce to facts about the distribution of monadic perfectly natural properties. (Still, they will certainly turn out to be *very* natural.) Second, if we could at least maintain, as a *contingent* thesis, that the only perfectly natural relations are spatiotemporal ones, then we could plausibly settle an unresolved and deeply vexed question about the content of physicalism (the doctrine, to put it rather too crudely, that all there is to the actual world is physical stuff), as explained [here](#).

At any rate, the thesis that spatiotemporal relations are at least *among* the perfectly natural relations allows us to clarify and simplify Almost-Lewis's position. Specifically, we can say that all that it comes to to say that the fundamental entities are *spacetime* points is that they stand in perfectly natural spatiotemporal relations to one another. ([More.](#)) To say that they are spacetime *points*, finally, is to say that they have no proper parts.

One upshot is that my original statement of Almost-Lewis's ontology needs an amendment: for it was misleading to say that according to him, the fundamental particulars are *spacetime* points. That's true, but it wrongly suggests that he is making a choice of one fundamental *kind* of particular, distinguished from other possible choices by the essential nature of its members. Not so. It is more accurate to describe his fundamental ontology thus:

There are particulars.

They are, or are wholly composed of, *simples*—particulars have no other particulars as proper parts.

These simples have various perfectly natural monadic properties.

They stand in various spatiotemporal relations to one another.

And that is all.

§5 Humean Supervenience

Almost-Lewis's theses about what fundamental ontology comprises, and how all other facts reduce to facts about it, bears a very close relationship to Lewis's celebrated thesis of Humean Supervenience (hereafter: "HS"). But they are not the same, and the differences are worth keeping track of. Here is a typical statement of HS (slightly stronger, as we'll see, than the version Lewis officially endorses): No two possible worlds differ with respect to what is true at them, without differing with respect to the geometrical arrangement of their spacetime points, or with respect to which perfectly natural properties are instantiated at those points.⁶ (Note that so stated, HS is automatically metaphysically *necessary*.) Thus, HS is a *supervenience* claim, logically weaker than Almost-Lewis's claim of reduction. It is also a claim that—for some good reasons and some bad reasons—Lewis accepts only in a weaker form that is metaphysically *contingent*. More significantly, it is no part of HS that facts about possible worlds *themselves* reduce to anything else; whereas both Almost-Lewis and Lewis are explicit in their commitment to this further claim. Having said all this, it will be worth remembering in what follows that Almost-Lewis's position (which, re-

⁶ As Phillip Bricker has pointed out, this statement needs a qualification. For Lewis considers it an open epistemic possibility that there are two (or more) metaphysically possible worlds that are perfect duplicates of each other. And he holds that propositions simply *are* sets of possible worlds. If the given epistemic possibility in fact obtains, then there will automatically be propositions—the unit-sets of duplicate worlds—that vary in truth value between two worlds, which worlds themselves do not differ with respect to the geometrical arrangement of their spacetime points, or with respect to which perfectly natural properties are instantiated at those points. So Lewis needs a way to slightly restrict the scope of the thesis. He does not always notice this need. For example, discussing Humean Supervenience in his 1994, he writes, without qualification "I claim that all contingent truth supervenes just on the pattern of coinstantiation..." (P. 474)

member, incorporates Lewis's modal realism) *entails* HS. So, any doubts about HS will carry over to Almost-Lewis's fundamental ontology.

§6 Lewis v. Almost-Lewis

Let's consider now the most salient ways in which Lewis's own positions about fundamental ontology diverge from those of Almost-Lewis.

First, Lewis takes the lessons quantum physics teaches seriously enough to withhold endorsement of Almost-Lewis's fifth thesis, that the only perfectly natural relations are spatiotemporal relations.

Second, Lewis is agnostic as to whether, in addition to spacetime points, there might be (in this, or other possible worlds) fundamental entities that are *occupants* of such points. But agnosticism on this score is probably a bad idea: the proposed possibility is not clearly intelligible, nor it is clear what its motivation could be. ([More](#).)

Third, on a plausible story about what *non*-fundamental entities there are, it will turn out that on Almost-Lewis's view, everything that exists is composed of simples (parts, that themselves have no proper parts). Lewis is also agnostic on this score: he takes it to be at least an epistemic possibility that there is "gunk": something, every proper part of which itself has a proper part (see for example Lewis 1991). Lewis says relatively little either about the status of this possibility (in particular, is it more than merely epistemic?), or about its potential ramifications for his various positions in metaphysics. To keep things simple, I will discount it for the remainder of this main essay.

Fourth, Lewis holds that his thesis of Humean Supervenience is, at best, only *contingently* true. Of course, given that he recognizes the (metaphysical) possibility of perfectly natural, non-spatiotemporal relations, he *should* treat HS as at best contingent. But he advances reasons for doing so of a quite different sort. They are not particularly good reasons, and so we will pass them by; but see [here](#) for discussion.

§7 Some criticisms

What, finally, should we make of Lewis's conception of fundamental ontology? A complicated question; I will limit discussion to just two important worries. Let's begin by noting the obvious influence of a certain scientifically-informed conception of the world in shaping Lewis's picture of reality. Lewis himself is quite explicit about this influence:

The picture is inspired by classical physics. Humean Supervenience doesn't actually say that physics is right about what local qualities there are, but that's the case to keep in mind. But if we keep physics in mind, we'd better remember that physics isn't really classical. ...The point of defending Humean Supervenience is not to

support reactionary physics, but rather to resist philosophical arguments that there are more things in heaven and earth than physics has dreamt of. (1994, p. 474)

But there is a less acknowledged influence, I think, of first-order predicate logic—an influence that is not entirely salutary. It is undoubtedly tempting, for philosophers steeped in the use of first-order logic as a clarifying tool, to assume that the proper representation of the ultimate structure of reality must be by means of some (interpreted) first-order language—a language whose various *predicates* could be taken to express the various *fundamental properties and relations* that characterize reality at its most basic level. But if we look to physics instead—as we surely ought to—we find that the basic representational tools are *variables*, that correspond to *physical magnitudes*. Taking seriously the picture of fundamental ontology suggested by these representations turns out to matter quite a bit: in particular, there are reasons to think that none of the first three theses about natural properties and relations—that they are minimal, non-modal, and intrinsic—is tenable without some modification. This issue—which we will mostly pass over in what follows, except where it matters—is explored in more detail [here](#).

The second significant source of concern about Lewis's conception of fundamental ontology is the role—or rather lack thereof—that *modal* notions have in it. This concern has two aspects. First, one might hold that some, at least, of the fundamental properties and relations that characterize reality have modal aspects that are ontologically basic. Consider *mass*: one might hold that it is metaphysically impossible for there to be a world containing just two massive particles, accelerating away from each other—and that this impossibility somehow flows from the nature of mass itself. We will take up this issue in more detail in the companion article on Lewis's applied metaphysics.

Second, one might hold that it is one thing to state a thesis concerning what the fundamental structure of reality *in fact* happens to be; but that it is *another*, separate matter to state how reality *could* be. Indeed, most metaphysicians, I suspect, take it to be just blindingly obvious that these are conceptually distinct tasks. Granted that one's views on what there is, and what it is like, will have ramifications for one's views on what there *could* be and what it *could* be like (most obviously, because things *could* be the way they *are*; but there may be more interesting and subtle connections as well); still, the project of laying out the former views does not *automatically* complete the project of laying out the latter.

Of course there is a sense in which Lewis agrees: he takes it as obvious, after all, that he must supply an account of modality. But the strikingly reductionist character

of that account shows that such agreement as there is is mighty thin. The next article (forthcoming) will help clarify this quite radical aspect to Lewis's metaphysics.⁷

§8 References

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⁷ Many thanks to Phillip Bricker for extraordinarily acute and helpful comments on an earlier draft of this entry.

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Supplement on "reduction"

Consider a pair of reductive claims, one scientific, the other more philosophical:

Facts about whether a physical object is *alive* reduce to facts about its chemical structure.

Facts about *what causes what* reduce to facts about what happens, together with facts about the fundamental laws of nature that govern what happens.

Both claims are plausible (the first overwhelmingly so). But that pesky verb "reduce" might prompt concern. You might worry that, left unanalyzed, the notion of "reduction" is too unclear and slippery to be put to serious philosophical work. And if you are Lewis, you will have an additional worry, since you wish to see no unanalyzed *modal* notions appear as primitives in your system (and you have the reasonable suspicion that "reduction" is a modal notion). So we should consider whether there is a way to analyze "the X-facts reduce to the Y-facts" that will dispel these worries.

Start with the obvious strategy: state the thesis in question as a *supervenience* claim—to wit, the claim that the X-facts supervene on the Y-facts—and proceed to define "supervenience" in the usual modal terms, e.g. by saying that the X-facts supervene on the Y-facts iff no two possible worlds differ with respect to the X-facts without differing with respect to the Y-facts. (See e.g. Lewis 1986e, chapter 1; and Stalnaker 1996.) In that way, it might seem, we can avoid unexplained talk of "reduction": the core idea would now be that no two possible worlds differ at all without differing in their fundamental structure. (And note that for Lewis, talk of possible worlds can itself be analyzed away in non-modal terms.)

That won't do, for three reasons. The first reason is well-known: the notion of reduction we want is, logically speaking, *asymmetric*, whereas the foregoing notion of supervenience isn't. This problem subdivides. Begin with a purely conceptual point: we would like our understanding of "reduce to" to be such that it is a purely logical or analytical consequence of, for example, the claim that facts about tables reduce to facts about spacetime points, that facts about spacetime points do *not* reduce to facts about tables. There is nothing in the logic of supervenience that guarantees this con-

sequence. Now, we might respond to that problem simply by analyzing reduction as *asymmetric* supervenience. But successful though that maneuver is at handling the purely conceptual problem, it runs afoul of a more substantive point, which is that there are cases where we would like to say there is reduction, but in which supervenience is symmetric.

As an artificial example, consider a square grid of pixels, each of which can be dimmed or lit. Stipulate that the total number of pixels N is odd. The relevant space of “possibilities” will simply be the 2^N possible distributions of lit and dimmed pixels. Consider the N propositions each of which states, for a given pixel, that that pixel is lit; let the Y-facts be the facts about which of these propositions are true. Consider the $N(N-1)/2$ propositions each of which states, for a given *pair* of pixels, that those pixels are in the same state (both lit or both dimmed). Consider the $N+1$ propositions, the first of which states that no pixels are lit, the second of which states that exactly one pixel is lit, etc. Let the X-facts be the facts about which propositions of these latter two sorts are true. It would seem natural to say that the X-facts *reduce to* the Y-facts: the fact, concerning any pair of pixels, as to whether they are in the same state is surely nothing over and above the particular facts about those pixels' states; the fact, concerning the totality of pixels as a whole, is surely nothing over and above the particular facts about each pixel's state.⁸ And we quite obviously have *supervenience* of the X-facts on the Y-facts: there could be no difference with respect to which pixels were in the same state, and what the total number of lit pixels was, without *some* difference with respect to which individual pixels were lit. But we also have, almost as obviously, supervenience in the *other* direction. To see this, observe that if we are given all the X-facts aside from the facts about how many pixels are lit, we can quickly deduce that the grid as a whole must be in one of two possible states: Begin with pixel 1. From the assumption that it is lit, the state of every other pixel follows from the X-facts; likewise from the assumption that it is dim. But given that N is odd, these two states must differ as to how many pixels are lit. So the remaining X-facts pin down the state exactly. So there can be no difference with respect to the Y-facts (i.e., with respect to which pixels are lit), without a difference with respect either to which pixels have the same state, or to what the total number of lit pixels is. But the fact that we have supervenience—indeed, of a particularly strong kind, given that the derivation of the Y-facts from the X-facts is purely *logical*—does nothing to suggest that we *don't* have reduction of the X-facts to the Y-facts (and, of course, no such reduction running in the other direction).

⁸ Together, perhaps, with a “totality” fact to the effect that these are *all* the pixels.

Just as we can have reduction without asymmetric supervenience, so too we can have asymmetric supervenience without reduction. I will offer three examples. First, suppose the fundamental physical laws of our world are deterministic. Let the X-facts be the facts about the state of the world at some specific future time t ; let the Y-facts be the facts about the state of the world at some early time t_0 , together with the facts about the fundamental laws. Given determinism, no world could differ from ours with respect to its t -state without differing with respect to either its t_0 -state, or the laws. But a world could easily differ with respect to the Y-facts without differing with respect to the X-facts: such a world might have a different t_0 -state, together with different laws—ones that allow that early state to evolve into the *actual* t -state. So we have asymmetric supervenience of the X-facts on the Y-facts. But this does absolutely nothing to show that the facts about our world's t -state somehow *reduce to*, or are *nothing over and above*, the facts about its t_0 -state and laws.

One might complain that we have the wrong kind of supervenience here: while it is true that no world could differ from *ours* with respect to its t -state without differing with respect either to its t_0 -state or laws, it doesn't follow—and seems clearly false—that no *two worlds* could differ with respect to their t -states without differing with respect to either their t_0 -states or laws. Perhaps this stronger supervenience claim holds the key to understanding reduction.

The next two examples suggest otherwise. The first begins with a controversial assumption: that the fundamental laws of our world are *metaphysically necessary*, so that metaphysical possibility coincides with nomological possibility. Assume, as before, that these fundamental laws are deterministic. This time, let the X-facts be extremely partial facts about the t -state of the world (e.g., whether there are two particles moving at a relative speed greater than such-and-such a threshold, or something like that). Let the Y-facts be facts about the complete physical state of the world at time t_0 . Given our controversial assumption, we can now say that no two worlds differ with respect to the X-facts without differing with respect to the Y-facts. But given that the X-facts are, as it were, extremely informationally impoverished, it won't be the case that no two worlds could differ with respect to the Y-facts without differing with respect to the X-facts: two distinct t_0 -states could have, for example, the same consequences with respect to certain broad and not-very-informative claims about goings on at time t . So now we have asymmetric supervenience of the strong kind, without reduction.

Should we blame the controversial assumption about metaphysical possibility? I think not: Those who hold that metaphysical and nomological possibility coincide do not thereby *deprive* themselves of a perfectly coherent grasp of the notion of “reduction” (according to which, *inter alia*, facts about the future *do not* reduce to facts

about the past); nor is it particularly plausible that they are working with a conception of reduction fundamentally *different* from their opponents'. At any rate, the third example skirts this issue. It is this:

Consider four spatial points, A, B, C, and D. Let the distance $AB = 5$ (in whatever units); $BC = 5$; $CD = 5$; and $AD = 15$. By the triangle inequality, $AC \leq AB + BC = 10$. Suppose that $AC < 10$. Then (again by the inequality) $AD \leq AC + CD < 15$, so $AD < 15$, which is a contradiction. So $AC = 10$. Observe what we have shown: the facts about the AB, BC, CD, and AD distances *fix* the facts about the AC distance. So no world could differ from this one with respect to the AC distance without differing with respect to at least one of the other distances. But the fact that $AC = 10$ does not *reduce to* the facts about the other four distances.

As before, we have the weaker form of supervenience—no world could differ from *this one* in such-and-such a respect without differing in such-and-such other respect—but not the stronger. We can fix that problem at the cost of only a minor complication. Consider the totality of facts about distances between *every* pair of points, *except* the pair AC. Let these facts be the Y-facts; let the fact about the AC distance be the sole X-fact. Then no two worlds differ with respect to the X-facts without differing with respect to the Y-facts. From a logical standpoint, that does indeed show that the X-facts are in a certain sense redundant. But it emphatically does *not* show that they are “nothing over and above” the Y-facts.

We should hold out no hope for an analysis of reduction *purely* in terms of supervenience. But it does not follow that there is no analysis, nor indeed that there is no analysis *partly* in terms of supervenience. And, in fact, Lewis's own metaphysical commitments suggest an obvious candidate.⁹ Lewis believes in a metaphysical hierarchy of properties and relations. A property or relation gets its place in the hierarchy depending on how “natural” it is. So he could happily say that reduction is supervenience of the *less* natural on the *more* natural: the X-facts reduce to the Y-facts just in case the X-facts supervene on the Y-facts, and the properties and relations the Y-facts concern are more natural than those that the X-facts concern.

That's an attractive idea, but how successful it is will turn squarely on how illuminating an account can be given of the “more natural than” ordering on properties and relations. There is some room for doubt here: couldn't it turn out that our grasp of this ordering derives from our *prior* grasp of such notions as “reduce to”, “holds in virtue of”, “is grounded in”, etc.? (Thus, properties and relations of one kind are more natural than properties and relations of another if the facts about how the latter are instantiated reduce to the facts about how the former are instantiated.) A

⁹ Though, in an earlier version of this essay, I managed to completely overlook it, its obviousness notwithstanding. Thanks to Phillip Bricker for pointing it out to me.

provisional verdict, then: if Lewis wishes to do without a primitive notion of reduction, then his best bet is to complete a bit of unfinished business, producing an explicit account of the “more natural than” ordering on properties and relations. (See the supplement on uses for the natural/non-natural distinction for more discussion.)

One final comment. As noted, Lewis is a reductionist about modal facts themselves. For example, he holds that facts about which propositions are *contingent* and which *non-contingent* reduce to facts about the truth or falsity of propositions at different worlds—where the question of what worlds *are*, and what it comes to for a proposition to be *true at* a world, can both be answered in non-modal terms. But if we say that modal facts reduce to non-modal facts, then we cannot mean merely that modal facts supervene on non-modal facts more “natural” than those modal facts. The worry is not one of circularity: for Lewis can define the apparently modal expression “supervene on” in non-modal terms. It is rather that supervenience, in this case, is utterly trivial. Consider the modal facts about which propositions are contingent. For Lewis, no two possible worlds differ with respect to whether a given proposition *P* is contingent. A fortiori, no two worlds differ in this respect without differing in... *any other respect you care to mention*. So it is quite empty to say that the modal facts about which propositions are contingent supervene on some more natural, non-modal facts. Thus, for Lewis's reductionist claim about modality to be genuinely informative, it must be understood in some other way. See the (forthcoming) article on Lewis's modal metaphysics for more discussion. (And see also Lewis 1986e, esp. pp. 86ff.)

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Supplement on uses for the natural/non-natural distinction

Lewis's “New Work for a Theory of Universals” (1983b) contains by far his most extensive treatment of both the nature of and need for a distinction between perfectly natural properties and relations, and less-than-perfectly natural properties and relations. Presupposing his realism about possible worlds, Lewis argues that for *any* set of actual and possible objects (fundamental or not), there is a property, namely the property an object has just in case it is a member of the given set. Likewise, for any set of ordered pairs of actual and possible objects, there is a two-place relation; and so on. (Note that since the objects can *themselves* be sets, the position automatically makes room for higher-order properties and relations.) In fact, he goes further, taking properties and relations simply to *be* such sets.

This position is roughly analogous to the position that to every predicate, no matter how oddly defined, there corresponds a property or relation; and likewise to the position that to every method we might conceive of for classifying objects (or object-tuples), no matter how unprincipled, arbitrary, and gerrymandered, there corresponds a property (or relation). The analogy breaks down only because our linguistic devices and conceptual resources are far too limited to encompass all the classifications (i.e., sets of *possibilia*) there are. (And also because some of our predicates are logically pathological, so that there is no such thing as the set of *possibilia* that satisfy them. Consider the old standby, “— is a set that is not a member of itself”.) Properties and relations, on this conception, are abundant—to put it mildly.

Lewis argues that properties and relations, on this abundant conception, are well-suited to play the roles of semantic values in formal linguistics, and contents for mental states. But even if he is right, it would be a mistake to see him as offering here an argument for *believing in* the sorts of things that, on the abundant conception, are to be called “properties” and “relations”. It’s not that he’s averse to arguing that we should believe in X’s because doing so will make our theoretical lives easier. (See the forthcoming article on his theory of metaphysical modality for discussion of his most famous (or notorious!) such argument, in support of his modal realism, presented most comprehensively in his 1986e.) It’s rather that his realism about possible worlds, combined with his realism about set theory, makes it *inevitable* that he is committed to the existence of these entities. The issue for him is a rather more modest one: he already believes in certain entities, which he finds, happily enough, will do a certain sort of theoretical work for him; given the work in question, he finds it appropriate to call these entities “properties” and “relations”. Observe that matters are quite otherwise for those metaphysicians who don’t believe in Lewis’s possible worlds; endorsing the abundant conception will, for such a philosopher, likely *require* carving out room in her ontology for them. (See Plantinga 1976 for an example of one who makes use of the abundant conception against a quite different ontological background from Lewis’s.)

Now for the crucial point: the central argument of “New Work” is that the abundant conception is badly inadequate, for a wide range of theoretical tasks for which properties and relations are needed. To cite two of the most obvious, suppose we wish to say that an object *changes* over a given time interval just in case it either gains or loses a property in that interval; or that two objects are *similar* to the extent that they share properties. Equipped only with the abundant conception, we will be left with the trivializing conclusions that everything always (and necessarily) changes, and that any two objects are just as similar as any other two. That seems wrong: it seems, by contrast, that these accounts of change and of similarity must presuppose

a much more discriminating conception of what counts, in the relevant sense, as a *property*. Lewis's statement of the point is characteristically elegant:

Because properties are so abundant, they are indiscriminating. Any two things share infinitely many properties, and fail to share infinitely many others. That is so whether the two things are perfect duplicates or utterly dissimilar. Thus properties do nothing to capture facts of resemblance. ...Likewise, properties do nothing to capture the causal powers of things. Almost all properties are causally irrelevant, and there is nothing to make the relevant ones stand out from the crowd. Properties carve reality at the joints—and everywhere else as well. If it's distinctions we want, too much structure is no better than none. (1999, p. 13)

“New Work” goes on to extend the list of jobs for which the abundant conception is inadequate: Lewis argues that his accounts of supervenience, lawhood, causation, events, and mental content all provide essential work for a theory of properties and relations that conceives them as vastly more *sparse* than does the abundant conception.

For present purposes, it will pay to focus on an additional, and central, piece of “work” (not singled out for attention in “New Work”; though see Lewis 2001). It is the basic job-description articulated in the main text, the one highlighted by our two foundational metaphysical questions: What is there? What is it like? Almost-Lewis, remember, answers the first by saying that what exists (fundamentally) are spacetime points. But it seems that it will not do to say that what they are *like* is entirely settled *merely* by the various sets that can be composed out of them. Tim Maudlin has put the point nicely: “if there are no objective facts about the comparative character of objects, we must fall back into the unpalatable position that the only real structure of the universe is its cardinality.” (1997, p. 84) Rather, what they are like—in the relevant and *fundamental* sense—is settled by what perfectly natural properties and relations they instantiate.

Two additional points deserve mention. First, Lewis's account of modality provides *him*, at least, with an additional and crucial piece of “work” for a theory of natural properties and relations. For he holds that reality as a whole divides into chunks that deserve to be called “possible worlds”; the central idea behind his reduction of the modal to the non-modal is that modal idioms involve, in a certain systematic way, quantification over these chunks and the things they contain. (See the forthcoming companion article for details.) Some account is needed, then, of how the chunking works—of what it is for two things to belong to the same possible world. Lewis's favored answer appeals to the one species of perfectly natural *relation* that he is sure that there is: spatiotemporal relations. Thus, two things are world-mates, according to him, iff they bear some spatiotemporal relation to each other. (See Lewis 1986e, esp. pp. 69ff.)

The second point concerns the need for a *graded* distinction between more and less natural properties, and what sort of account of natural properties can meet this need. Now, this need does *not* arise from what I have been emphasizing as the foundational role for a natural/non-natural distinction, which is to secure a clear and objective sense in which reality as a whole can be said to have a *fundamental structure*. But for Lewis, it does arise all the same, perhaps most dramatically in his account of how our talk, and especially *thought*, manages to have reasonably determinate *content* (Lewis 1983b, 1984). The companion article on his applied metaphysics takes up this issue in more detail, but for now suffice it to say that an essential part of what makes it the case that we refer, in thought (and hence, for Lewis, in talk) to certain properties and entities, and not to others that in purely formal respects would make equally good candidates, is that the former properties and entities are more *objectively eligible* as candidates for reference than the latter; and this graded distinction of eligibility is in turn to be explained in terms of a graded distinction of *naturalness*.

Given Lewis's reductionist commitments, he therefore needs some account of how the facts about the pattern of instantiation of *perfectly* natural properties make it the case that among those properties that are *not* perfectly natural, some are nevertheless *more* natural than others (whence by extension, we can hope, some non-fundamental entities will count as "more natural" than others). He says very little about this issue, but the account he evidently favors gets hinted at occasionally—for example, here, in "Putnam's paradox":

... physics discovers which things and classes are the most elite of all; but others are elite also, though to a lesser degree. The less elite are so because they are connected to the most elite by chains of definability. Long chains, by the time we reach the moderately elite classes of cats and pencils and puddles; but the chains required to reach the utterly ineligible would be far longer still. (1999, p. 66)

This suggests the following proposal: Property F counts as more natural than property G just in case some predicate expressing F can be defined, in terms of predicates expressing perfectly natural properties, more simply than can any predicate expressing G.

It seems a difficult, important, and entirely open question whether this proposal succeeds—and if not, what else might replace it.

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Supplement on physicalism

It is a much bigger deal than has been recognized that the space of perfectly natural relations must, apparently, encompass more than just the spatiotemporal rela-

tions (and not just in some possible world, but in the actual world). Seeing why will both showcase some of the power Lewis's conception of fundamental ontology has in shaping and clarifying metaphysical debates, and highlight a centrally important question that he has (perhaps unintentionally) bequeathed to us.

Part of Lewis's reductionist aspirations include a rock-solid commitment to *physicalism*—a commitment, of course, that is about as close to a bit of orthodoxy as one will find in contemporary philosophy:

Roughly speaking, Materialism [= physicalism] is the thesis that physics—something not too different from present-day physics, though presumably somewhat improved—is a comprehensive theory of the world, complete as well as correct. The world is as physics says it is, and there's no more to say. [1999, pp. 33-34]

Many questions arise when one tries to make this rough statement of physicalism precise. We'll focus on just one. So suppose that, as a first step towards precision, we take physicalism to entail that the only perfectly natural properties are *physical* properties.¹⁰ (Perfectly natural properties that are *actually* instantiated—the physicalism we are trying to define is meant to be, or least to be allowed to be, a contingent thesis.) Then our question is obvious: What makes a property a *physical* property? Without a substantive answer, physicalism must remain a mere framework for a doctrine—and not something with immediate, and allegedly profound, consequences for the nature of the mind, or of ethics, etc.

It won't do to say that physical properties are those recognized by contemporary physics, since that physics may be wrong—and at any rate, we should hope for broader scope for our thesis than that. Nor is reference of the sort Lewis makes to a physics “not too different from present-day physics” acceptable: in general, to point to the properties recognized by present-day physics and say only that physical properties are “relevantly like those” is, however popular a strategy, nothing more than an abdication of philosophical responsibility.

There is a deeper issue. What, after all, distinguishes the discipline of *physics* from other sciences? Just this: Physics is the one discipline that aims at producing a correct *and complete* theory of the world—complete, not in the sense that it includes chemistry, biology, etc. as parts, but in the sense that it describes those aspects of concrete reality to which all other aspects (hence chemistry, biology, etc.) reduce. It will posit whatever entities, properties, and relations it needs to do the job—including, if necessary, those whose existence a card-carrying “physicalist” would reject.

So physicalism cannot, on pain of triviality, be taken to require that the perfectly natural properties and relations that characterize our world are restricted to those

¹⁰ Lewis provides various reasons for thinking that physicalism involves more than this; we won't go into them.

that would be posited by a successful physics. It must, instead, be viewed as incorporating a *substantive* and *independently specified* constraint on what those properties and relations could turn out to be.

To illustrate the point, imagine a vitalist who defends her view as physicalistically respectable in the following way: “Yes, I believe that living things differ from non-living things in a fundamental, irreducible respect. And I am no epiphenomenalist about this difference: that something is *alive* matters tremendously to, for example, *how it moves*. But I am still a physicalist in good standing. For I believe that every concrete thing, living or non-living, is exhaustively composed of particles, and that its intrinsic state at any moment is completely specified by specifying the state—the *physical* state—of this system of particles. It is just that it is possible to have two systems of particles in different physical states, even though there is a one-one mapping $f(\bullet)$ from the particles in one system to the particles in the other such that (i) for every particle p in the first system, p and $f(p)$ are in the same (single-particle) physical state; (ii) for every sequence of particles $\langle p_1, \dots, p_n \rangle$ taken from the first system, $\langle p_1, \dots, p_n \rangle$ and $\langle f(p_1), \dots, f(p_n) \rangle$ instantiate exactly the same spatiotemporal relations. In the language of ‘perfectly natural properties and relations’, I can put the point in this way: I believe in perfectly natural relations among particles that are not spatiotemporal relations. (So I am still just as much of a metaphysical reductionist as Lewis, for I too hold that all facts about the world are determined by the pattern of instantiation of perfectly natural properties and relations among the fundamental particulars.) My vitalism consists precisely in the thesis that some particles can be related in a way that is not determined by the monadic, perfectly natural properties these particles instantiate, together with their spatiotemporal relations to one another. I call this being related *lifewise*.”

Why isn't vitalism, so understood, perfectly compatible with physicalism, as understood by the legions of contemporary philosophers who subscribe to it? Not because our vitalist believes in *non-physical* properties or relations; for if she is correct, and physics does its job right, then physics will come to recognize, *and develop theories of*, these properties or relations: doing so, after all, is just part of its writ. Nor can it be said that she denies that facts about life reduce to (or supervene on, if you like) *microphysical* facts. This complaint might seem apt, if she insists on characterizing life as a perfectly natural *property*, typically had only by *sums* of particles; one might then suspect that she posits irreducible facts that are not facts about particles (but rather about particle-sums). But she has deftly avoided this complaint by insisting that it is an irreducible fact *about particles* that some of them are related lifewise.

If Almost-Lewis had been right to put forth the fifth thesis—that the only perfectly natural relations are spatiotemporal ones—as a *necessary* truth, then we would

have had a ready answer to vitalism: it is, at least as set forth above, necessarily false. And even if we had *not* wished to side with Almost-Lewis—because, specifically, we considered vitalism to be merely *contingently* false—we might have hoped to use his position as inspiration for the needed substantive characterization of physicalism: Physicalism, so the story might have gone, entails that the only perfectly natural relations instantiated in *our* world are spatiotemporal ones (never mind that *other* worlds feature additional perfectly natural relations). *That* characterization is clear and substantive enough to do real philosophical work, while respecting the typical physicalist's desire to be seen as putting forth a *contingent* thesis.

In fact, however, we face a dilemma. For, as noted, quantum mechanical entanglement pretty clearly establishes that Almost-Lewis's position is false. But as far as I know, *no one* takes it to establish that physicalism is false—certainly, Lewis himself did not. But then one wonders what the content of Lewis's (and everyone else's) physicalism really is. At all events, here is a proposal: Physicalism should be construed as entailing a constraint on what perfectly natural relations there are. (For if it doesn't, then as we have seen it will be too weak even to rule out vitalism.) Taking it as non-negotiable that spatiotemporal relations are perfectly natural, the question then becomes this: What *other* sorts of relations can be admitted as perfectly natural, without violating physicalism? Almost-Lewis provided the simplest answer: *No* others. That won't do, and so we need a fallback answer. I take it to be an important piece of unfinished business in Lewis's metaphysical program—important even for those who do not subscribe to that program—to figure out what that fallback answer should be.

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Supplement on spacetime points

Almost-Lewis says that the fundamental entities are spacetime points. Lewis expresses agnosticism, allowing that the fundamental entities may, for all he knows, include spacetime-point-sized particulars that are not themselves spacetime points, but merely occupy such points: "Humean Supervenience ... says that in a world like ours, the fundamental relations are exactly the spatiotemporal relations: distance relations, both spacelike and timelike, and *perhaps also occupancy relations between point-sized things and spacetime points.*" (1994, p. 474.) I think, though, that there is much less of a difference here than meets the eye, and that Lewis would have been better off explicitly adopting the more opinionated view of Almost-Lewis.

To see why, we need to focus closely on just what, by Lewis's lights, the "dualist" position comes to. Here is Lewis's characterization:

There are three different conceptions of what the spatiotemporal relations might be. There is the dualist conception: there are the parts of spacetime itself, and there are the pieces of matter or fields or whatnot that occupy some of the parts of spacetime. Then the spatiotemporal relations...consist of distance relations that hold between parts of spacetime; relations of occupancy that hold between occupants and the parts of spacetime they occupy; and, derivatively from these, further distance relations between the occupants, or between occupants and parts of spacetime. (1986e, p. 76.)

It's tempting to think that the "dualist conception", properly glossed, comprises these theses:

1. There are two fundamentally different kinds of (fundamental) particulars.
2. Particulars of the first kind have a nature that renders them capable of entering into spatiotemporal relations with one another; particulars of the second kind do not, and in fact cannot enter into spatiotemporal relations with anything.
3. Particulars of the second kind have a nature that renders them capable of instantiating perfectly natural monadic properties; particulars of the first kind do not.
4. There is a special, perfectly natural, asymmetric relation that particulars of the second kind can bear to particulars of the first kind (but not vice versa; nor can particulars of the same kind bear it to each other). This is the occupancy relation.

But this picture can't make any sense, for Lewis. The reason is worth emphasizing, as it highlights yet another distinctive feature of Lewis's metaphysics, which is its thoroughgoing anti-essentialist character. What I have in mind is this: Many philosophers will wish to distinguish between fundamentally different *kinds* of particulars by way of some sort of doctrine of *essences* or *essential natures*. As noted, such a doctrine is highly tempting in the present case: that is, what distinguishes spacetime from stuff *in it* is that spacetime is a kind of substance with a different essential nature than its occupiers. For example, one might hold that it is part of the essence of a spacetime point that it be part of a manifold of such points, whereas it is no part of the essence of an electron (or electron-time-slice, if you prefer) that it coexist with any other electrons.

But Lewis's official positions in ontology stand squarely in opposition to any such approach to distinguishing particulars. It is not that he lacks any resources to distinguish kinds of particulars: obviously, they can be distinguished by what perfectly natural properties and relations they in fact instantiate. But he cannot go further, and explain *why* they instantiate the perfectly natural properties and relations they do

by appeal to some *further* distinguishing feature (e.g., their essential natures). Nor can he distinguish them by the *manner* in which they instantiate properties or relations. For example, he cannot say that what distinguishes spacetime points A and B as such is that they *necessarily* instantiate whatever spatiotemporal relations they do—as opposed to point-sized occupiers C and D (which, one might grant, instantiate these very same relations, but only *accidentally*). And that is because, at the level of fundamental ontology, such modal distinctions simply have no place. There is nothing for them to be grounded in.

That is not to say that Lewis cannot make room for *de re* modal ascriptions; of course he can. We'll see in the companion article how he does so. But we'll also see that he does so in, surprisingly, a thoroughly anti-essentialist manner. To foreshadow: Lewis could, if he liked, say of two spacetime points A and B that they necessarily instantiate the spatiotemporal relations they do; but that would amount to nothing more than a decision to *call* spacetime points in some *other* possible world “counterparts” of A and B only if those other points instantiated the same relations as A and B. Such *de re* modal ascriptions are grounded, according to Lewis, in the way our thought and talk happens to pick out certain counterpart relations among the vast profusion of logically possible ones. As such, they latch onto nothing ontologically deep—certainly, nothing deep enough to be of use in imposing structure on Lewisian fundamental ontology.

So Lewis needs to understand dualism about spacetime and the stuff it contains in a more prosaic manner, e.g. as follows:

1. There are simple particulars.
2. Some of them bear spatiotemporal relations to others of them; call any such simple particulars—i.e., any that enter into spatiotemporal relations—“spacetime points”.
3. Some of them bear a different perfectly natural relation, the “occupancy” relation, to others of them; call any of these—i.e., particulars that bear the occupancy relation to something else—“occupants”.
4. No simple particular is both a spacetime point and an occupant.
5. Only occupants instantiate perfectly natural monadic properties.

But even in this toned down form, the view is up to its ears in metaphysically mysterious necessary connections of the kind that Lewis seems at pains to reject, given his broadly combinatorial conception of possibility. (Though the exact sense in which Lewis is a combinatorialist about metaphysical possibility is more subtle than this comment suggests; see the companion article on his modal metaphysics.) The

occupancy relation is just a completely different perfectly natural relation from any spatiotemporal relation. So why can't we simply mix and match the two? Why *can't* something be both an occupant and a spacetime point?

Furthermore, solutions to these puzzles will likely still leave it mysterious what possible *motivation* there could be for Lewis to admit that in addition to spacetime points, there might be things that occupy them. *Physics* surely needs no such distinction. And compare a manifestly bizarre view, which says that where we ordinarily say that there is a single electron, there are in fact two entities: one with mass (and no charge), and one with charge (and no mass); it is simply an extra "law" that this pair of entities must remain together, as long as they exist. Whatever virtue there is in remaining agnostic where possible, surely it does not suggest that we take *this* view seriously. Why, then, ought Lewis to take seriously the parallel view about spacetime points and their occupants? (Though see [here](#) for one motivation, together with reasons to think it is not nearly strong enough.)

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Supplement on the contingency of Humean Supervenience

As soon as one recognizes that there *could* be non-spatiotemporal, perfectly natural relations—so that, if there are none in the *actual* world, then that is a contingent fact—one must recognize that HS (as stated in §5) is false, and can only be resuscitated in a weaker form. Perhaps this one: Among worlds in which are instantiated no perfectly natural relations not *actually* instantiated, no two worlds differ with respect to what is true without differing with respect to the geometrical arrangement of spacetime points, or with respect to which perfectly natural properties are instantiated at those points. (Observe that this form incorporates the thesis that the only *actual* perfectly natural relations are spatiotemporal ones.) That makes HS a contingent thesis, as no doubt it should be. But Lewis sees a second, quite different reason for taking HS to be contingent. It is, I think, a poor reason; but it deserves some scrutiny nonetheless. Here is what Lewis says:

Humean Supervenience is meant to be contingent: it says that among *worlds like ours*, no two differ without difference in the arrangement of qualities. But when is a world like ours? I used to say: when it's a world of the "inner sphere", free of fundamental properties or relations that are alien to our world. Sally Haslanger (forthcoming [1994]) has shown that this answer probably won't do. One lesson of the Armstrong (1980) spinning sphere (also known as the Kripke spinning disk) is that

one way to get a difference between worlds with the exact same arrangement of local qualities is to have things that are bilocated in spacetime. Take two worlds containing spheres of homogeneous matter, unlike the particulate matter of our world; in one world the sphere spins and in the other it doesn't; but the arrangement of local qualities is just the same. These are worlds in which things persist through time not by consisting of distinct temporal parts, but rather by bilocation in spacetime: persisting things are wholly present in their entirety at different times. The difference between the spinning and the stationary spheres is a difference in the pattern of bilocation. No worries for Humean Supervenience, so I thought: I believe that ours is a temporal-parts-world, therefore neither of the worlds in the story is a world like ours. But why assume that things that indulge in bilocation must differ in their fundamental nature from things that don't? Why think that if ours is a temporal-parts-world, then otherworldly bilocated things must have properties alien to our world? No good reason, I fear. Haslanger's point seems well taken. I still want to insist that if ours is a temporal-parts-world, then bilocation-worlds don't count as "worlds like ours", but I think I must abandon my former reason why not. (1994, pp. 474-475)

Lewis's reasoning here involves a bizarre failure of nerve. On inspection, it is quite clear that he has perfectly good metaphysical and methodological grounds for resisting the argument that worries him, thereby preserving the clean statement of HS as a contingent thesis. To see why this is so—and to achieve, thereby, a little more insight into the resources provided by Lewis's conception of fundamental ontology—let us begin by distinguishing two different views one might have about spacetime and its contents (see [here](#) for more discussion).

On a monist view, the only fundamental entities there are are spacetime points—simple particulars that are *called* "space-time points" simply because they instantiate spatiotemporal relations. The world is the way it is, then, in virtue of the spatiotemporal relations instantiated by the simple particulars that constitute it, together with the monadic, perfectly natural properties these particulars also instantiate. (And, perhaps, together with other, non-spatiotemporal relations that they instantiate.) On a rival, "dualist" conception, there are *two* sorts of fundamental entities: simple particulars that instantiate spatiotemporal relations (and are therefore to be called "spacetime points"); and simple particulars that do not instantiate spatiotemporal relations, but *do* bear a different, perfectly natural relation of "occupancy" to spacetime points (call these "occupants"). The world is the way it is in virtue of the spatiotemporal relations instantiated by the spacetime points, together with their pattern of occupancy by the occupants, together with the pattern of instantiation of perfectly natural monadic properties by these occupants. (A variant would allow the spacetime points themselves to *also* instantiate perfectly natural properties; we'll set this aside.)

Suppose you take the second, dualist view. Then the difference between a world in which everything persists through time by consisting of distinct temporal parts, and a world in which at least some things persist through time by being “wholly present” at different moments of time, essentially boils down to this: In the first kind of world, each occupant bears the occupancy relation to just *one* spacetime point. In the second kind of world, this is not the case: some occupants “occupy” distinct spacetime points, located at different times. Now here is the crucial point: *You can have no good reason to deny that worlds of the second type are at least metaphysically possible.* For what could stand in the way of this? Are we to suppose that there is something about the metaphysical nature of the “occupancy” relation that guarantees that, if one particular X bears it to another particular Y, then that is the *only* particular X bears it to? What could that be? What’s more, the metaphysical possibility granted, the epistemic is not far behind: for what could count as empirical evidence that our world is *not* of the second kind?

Now, you could take a *mixed* view, according to which monism and dualism are both *contingent* claims. In some worlds, there are just spacetime points (i.e., bearers of spatiotemporal relations), which also, in those worlds, instantiate perfectly natural monadic properties. In other worlds, there are spacetime points and occupiers thereof. But the conclusions of the last paragraph still stand: you should hold that there are possible worlds in which at least some things persist through time by being wholly present at different times, and you should admit that you have no special reason for doubting the ours is such a world.

As an aside, there is clear textual evidence that Lewis takes the mixed view:

I don't really mean to say that no two possible worlds whatsoever differ in any way without differing in their arrangements of qualities. For I concede that Humean supervenience is at best a contingent truth. Two worlds might indeed differ only in unHumean ways, if one or both of them is a world where Humean supervenience fails. Perhaps there might be extra, irreducible external relations, besides spatiotemporal ones; there might be emergent natural properties of more-than-point-sized things; *there might be things that endure identically through time or space, and trace out loci that cut across all lines of qualitative continuity.* It is not, alas, unintelligible that there might be suchlike rubbish. *Some worlds have it.* And when they do, it can make differences between worlds even if they match perfectly in their arrangements of qualities. (1986a, p. x; italics added)

Here is what I take to be the upshot of our discussion so far: *If* you believe in a fundamental, perfectly natural relation of occupancy, then you *already* have reason enough to accept the conclusion of Haslanger’s argument; thought experiments concerning spinning spheres add nothing. What is of real interest, then, is whether her

argument presents any sort of challenge to a philosopher who—unlike, alas, Lewis—resolutely insists on monism *as a necessary truth*. (In case it's not clear, this is exactly the view I think Lewis *should* have espoused.)

I do not think it does. To see this, let's unpack the troublesome argument.

The first step is to establish—presumably, via an appeal to modal intuitions—that there are possible worlds containing homogeneous matter. Some authors (e.g., Callendar 2001) dispute this step, but I won't. The next step is to argue that two such worlds could differ *only* in that a sphere is spinning in one of them but motionless in the other. The final step is to argue that this difference must consist in different patterns of bilocation. I think the game has been given up at the second step, and will focus my attention there.

We have a world containing homogeneous matter. Presumably, this matter can be in motion, including rotational motion. We should now ask—*before* considering the two worlds that seem to cause the trouble—whether there is any way for HS to accommodate motion of homogeneous matter. And of course there is. But—crucially—the HS-friendly story of *what it is* for homogeneous matter to be in motion will necessarily make reference to the fundamental laws of nature for the given world, either directly or via suitably chosen counterfactuals. For example, what it is for a perfectly symmetrical sphere to be rotating might consist, in part, in the truth of such counterfactuals as “were a dot painted on the sphere at time *t*, the location of the dot at time *t'* would be different in such-and-such a way”. The details don't matter for present purposes; all that is important is that, provided an acceptable, HS-friendly account of laws of nature is available (see the companion article on Lewis's applied metaphysics), and provided there is a suitable account of how laws fix truth-values for counterfactuals, there will be no special difficulty in distinguishing, *within* a world, between rotating and non-rotating spheres. The key move—which will receive much more scrutiny in the companion article, when we turn to Lewis's account of laws of nature—is to view facts about motion of matter *not* as part of the base-level facts about the world which it is the job of laws of nature to govern¹¹, but rather as being in part *facts about the nomological structure of the world itself*.

That may seem an odd perspective to take on motion. So be it; it's a perspective the defender of HS is stuck with *anyway*. For consider a nice, Newtonian world of point-particles, with nary a speck of homogeneous matter to be found. What is it, according to Lewis, for a particle in such a world to be *moving* (relative to a specified frame, say)? More exactly, what makes it the case that *there is a moving particle*, as opposed to its being the case that there is a spatiotemporally contiguous succession of

¹¹ For how *could* you view them as base-level, without already believing in multiply-located particulars—hence, without already abandoning spacetime monism?

points that just happen all to be occupied? It is, very roughly, for the pattern of occupation of spacetime points in the future to counterfactually depend on the pattern of occupation in the past in a certain way. And these patterns of counterfactual dependence will themselves be fixed by the laws.

And now, finally, it must be remembered that a HS-friendly account of laws of nature will insist that the laws of nature in the two worlds in question—the one with the spinning sphere and the one with the motionless sphere—must be exactly the same. And so, since facts about motion must be grounded in these laws, there is no difference in the motion of the spheres, after all. There cannot be.

Intuition will rebel, of course. And one can easily imagine words such as the following, aimed at helping the rebellion along: “Look, you agree that there can be a single world—call it w —containing both a spinning sphere and a stationary sphere. So now just *remove* the spinning sphere. Along with it, remove anything else (other than the stationary sphere) that might serve as a landmark. That gives you world w_1 . Go back to w , and remove the *stationary* sphere, along with any landmarks; that gives you w_2 . Since we’ve removed the landmarks, we cannot say that the spheres in w_1 and w_2 are in different locations (so that we have a difference in the local arrangement of qualities, after all). So, according to HS, they must be exactly the same. But they’re not: in one the sphere is rotating; in the other it isn’t.”

The proper response is to ask whether it has been granted that facts about motion *just are* a certain kind of nomological fact. If not, then the dispute really lies elsewhere—for example, our interlocutor must hold that the defender of HS has *already* made a mistake, in his description of a Newtonian particle world. But if so, then the argument involves a tacit assumption that one can *hold fixed the laws of nature*, while moving from w to w_1 and w_2 . That may be true, on a conception of laws of nature that holds that they are something *more* than mere patterns in the non-modal phenomena. But that is not a conception the defender of HS can endorse. And so again, the real dispute lies elsewhere. The idea that the critic of HS gets some *special* traction from the spinning sphere argument is simply confused. Had Lewis seen this, he could have said that the argument is no stronger than the various direct attacks to be found in the literature on his HS-friendly account of laws of nature. We will leave consideration of those attacks for the companion article; for now, the important lesson is that the only *good* reason we have seen so far to reject HS in its strong form consists in the possibility that nature might admit more perfectly natural relations than the purely spatiotemporal.

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Supplement on physical magnitudes

Lewis looks to science—really, to physics—to tell us what perfectly natural properties there are. But observe that he presupposes that the things about which physics will inform us are *properties*—and that is a category that physics has not used for several centuries. Rather, physics trades in *physical magnitudes*. This is not a mere terminological quibble. Consider mass. On Lewis's conception, *having mass 5 kg* and *having mass 7 kg* should be viewed as distinct perfectly natural properties, or so one would naturally assume. They are also to be understood as non-modal. That would seem to mean, among other things, that whether a particular has mass 5 kg places no logical or metaphysical constraints on whether it has mass 7 kg. But that seems crazy: it seems, quite to the contrary, that the claim that a given particular has mass 5 kg *logically implies* that it does *not* have mass 7 kg. At the very least, we should be suspicious of a philosophical position that automatically forbids us from understanding the logical relations between these claims in this way.

The same point emerges in a more dramatic fashion when we turn to spatiotemporal relations—or, to keep things simpler, just spatial relations. Several authors (e.g. Bricker 1993; Maudlin 2007a) make the following observation: spatial relations obey the triangle inequality, and appear to do so as a matter of at least metaphysical—and, plausibly, *logical*—necessity. If the distance between points A and B is x , and the distance between B and C is y , then the distance between A and C cannot be more than $x + y$. But why should this constraint hold, if the spatial relations between A and B, and B and C, on the one hand, place no constraints on the spatial relations between A and C, on the other?

There is also trouble for the minimality thesis. Suppose that point A is 5 meters from point B, B is 5 meters from C, C is 5 meters from D, and A is 15 meters from D. It *follows* that A is 10 meters from C. So, in order to include just enough information to completely characterize these points, we do not need to mention that A is 10 meters from C: doing so would introduce an unwanted redundancy. Consider then a set of spatial relations that simply *left one such relation out*—say, the relation *being 10 meters from*. For the reason just indicated, this set will contain enough spatial relations for their distribution among the fundamental particulars to fully and determinately fix the spatial nature of reality. But it surely cannot follow that while some spatial relations deserve the elite status of “perfectly natural”, others don't. After all, which ones could those be?

Finally, an argument advanced by Maudlin (2007a; see also Bricker 1993) reveals trouble for the thesis that perfectly natural properties/relation are *intrinsic* to the par-

particulars that instantiate them. We should, Maudlin points out, ask *why* the triangle inequality holds. It could, of course, be accepted as a bare metaphysical posit. But there is another answer, which is to treat distance as a *derived* relation, defined thus: the distance between points A and B is the length of the shortest continuous path through space that connects them (where the *spatial metric* integration over which yields length along a path can be treated as a primitive feature of the space). This definition yields the triangle inequality as a trivial consequence—which seems a point in its favor. Notice, however, that distance relations so understood are *not* intrinsic to the points that exhibit them: for “paths” are certain kinds of sets (or sums—it doesn’t matter which) of spatial points, so to say that A is such-and-such a distance from B is to *imply* that there are points other than A and B. That violates one aspect of the traditional conception of “intrinsic”, since the instantiation by some particulars of some intrinsic relation is, according to this conception, supposed to be entirely independent of whatever else exists. (See for example Langton & Lewis, 1998.)

Maudlin extends this argument to other physical magnitudes, showing that a certain kind of path-dependence characterizes magnitudes familiar from modern physics. A quick sketch of the argument must suffice: Suppose that particle A has a certain value of a physical magnitude, and particle B likewise has a value for that physical magnitude. Now, many magnitudes that appear in contemporary physical theories are *vector-valued*, let that be the case with this example. Given the traditional conception of intrinsicness, it should—if the possession by A of its value for the magnitude is intrinsic to it, and the possession by B of *its* value for the magnitude is intrinsic to *it*—be fully determinate whether A and B have the *same* value for the magnitude. But in the case of vector-valued magnitudes¹² this is simply not so. It amounts to saying that it must be fully determinate whether A’s and B’s vectors are *pointing in the same direction*. That will be true, *provided* that space is Euclidean. But not, in general, otherwise.

What has gone wrong? I do not have anything like an adequate answer to that question, but there does seem to be a significant error built into the conception of natural properties that Lewis and many others are working with—traceable, as hinted earlier, to the undue influence of first-order logic. Recall a muddle that Wittgenstein gets himself into in the *Tractatus*. All implication, he thinks, must at bottom be truth-functional implication. Well, what about the implication from “A is red all over” to “A is not green all over”? (He could have used, as a much cleaner example, the implication from “A has mass 5 kg” to “A does not have mass 7 kg”.) Wittgenstein claims, bizarrely, that *on analysis* this will turn out to be a truth-functional implication.

¹² Along with many others: e.g., Maudlin considers magnitudes whose values are represented by fiber bundles.

Nonsense. A vastly more sensible reaction is to recognize that the logic Wittgenstein saddles himself with is not built to handle this kind of implication. How, after all, *would* first-order predicate logic handle it? Only by introducing a relation “—has mass — kg”, along with *non-logical axioms* such as “ $\forall x \forall y \forall z ((x \text{ has mass } y \ \& \ x \text{ has mass } z) \rightarrow y = z)$ ”.

I do not really mean to suggest that logic itself needs reform. But what *does* need reform is a tendency to think that the basic kinds of implication captured in the logic with which we are familiar must exactly mirror the basic *metaphysical* connections that characterize the structure of our ontology. It would, that is, be a bad mistake to reason in the following way: “The fundamental ontological structure of the world must be fully describable by some first-order language, whose names will therefore correspond one-one with the fundamental particulars (or: whose variables will therefore range over the fundamental particulars), and whose predicates will correspond one-one with the fundamental properties and relations. What’s more, since any two atomic sentences of this language will be logically independent of one another, it follows that the facts to which these sentences correspond must be *metaphysically* independent of one another. Hence, whether a given particular has a given property places no metaphysical constraints on whether that or any other particular has any other property.” That line of reasoning leads, as we’ve seen, to a conception of fundamental ontology that cannot properly accommodate the lessons of modern physics. It is, finally, reasonably clear where Lewis’s sympathies lie, with respect to this conflict (and even if he was not properly aware of their significance): on the side of physics.

So a certain amount of reform is necessary in the conception Lewis works with of perfectly natural properties and relations—a reform we might signal by saying that this should *really* be a conception of perfectly natural *magnitudes* (some monadic, some dyadic, etc.). Switching our focus from properties and relations to physical magnitudes removes the silly worry we saw above about the minimality thesis: for we can now view that thesis as requiring that there are just enough *magnitudes* for the distribution of their values across all particulars to fix the nature of reality. And it allows us to maintain that these magnitudes are non-modal, in the sense that the value possessed by one particular for one magnitude places no constraints of a logical or metaphysical kind on either (i) the value possessed by that particular for any *other* magnitude, or (ii) the value possessed by any other particular for any magnitude.

But once these reforms are carried out, we’re still not done: there remains the problem Maudlin highlights for thinking of possession of a value for a magnitude as something *wholly intrinsic* to the possessor. Here it is much less clear to me how to proceed, and I will simply flag this as an interesting and important open question.

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Supplement on fundamental entities¹³

There are two obvious routes Lewis could have taken to a view according to which some particulars are most fundamental.

First route: Lewis holds that all entities, of whatever ontological category, can stand in mereological relations. Thus, a chair is *composed of* its atoms; it has each atom as a *part*; two rooms might *overlap* by having one wall as a common part, etc. He further holds that the relation of parthood is antisymmetric: x is part of y and y is a part of x only if $x = y$. That allows for a definition of a *simple*: an entity that has no *other* entities (i.e., entities not identical to it) as parts. Lewis could then hold that the most "fundamental" particulars are exactly those particulars that are simples. More generally, a particular x might count as more fundamental than particular y if x is part of y but y is not part of x . (But of course that doesn't cover the case of particulars, neither of which is part of the other.)

Second route: Suppose Lewis held that some properties/relations are most fundamental (something he seemed inclined to believe likely of our world, albeit only contingently). Then he could hold that the most fundamental particulars are exactly those that instantiate (or perhaps: are capable of instantiating) the most fundamental properties and relations.

On either approach, a commitment to fundamental particulars will, for Lewis, have to remain at least somewhat tentative. For suppose it turned out that our world is infinitely complex: molecules are composed of atoms, which are composed of protons, neutrons, and electrons, which are composed of quarks, which are composed of strings, which are composed of... with no end. And suppose that at each level, the physical properties instantiated by particulars at that level are more fundamental than those instantiated by particulars at higher levels. Then on neither criterion will it be the case that they are most fundamental particulars. (Nor will there be most fundamental properties and relations.)

More importantly, it's not clear that there is any work to be done within Lewis's system by a notion of a fundamental particular. He has the distinction between more and less natural properties/relations. He has the mereological distinction between part and whole. Again and again, in the accounts he offers of metaphysically interesting topics (laws of nature, causation, persistence through time, etc.), he makes free use of these distinctions. But appealing to the distinction between more and less

¹³ Thanks, here, to Phillip Bricker for valuable help; several of the points in this section are his.

fundamental entities doesn't look like it will enhance his ability to carry out these projects.

Having said all that, there are some interesting questions in the vicinity that Lewis does not address, having to do with how the mereological hierarchy and the metaphysical hierarchy of properties and relations line up with each other. For example, could it be that a composite particular (a particular that has some other particulars as proper parts) instantiates some perfectly natural property? More generally, could it be that some composite particular instantiates properties more natural than any properties instantiated by its parts? Could a simple particular be extended in space? I know of no extended discussion Lewis gives to any of these questions. But it does seem to me that his metaphysical work presupposes a negative answer, in each case.

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