

On the Plurality of Grounds

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Recent metaphysics has contained a good deal of discussion about the notion of *ground*.¹ The notion is intuitive enough: for example, it is sometimes said that Europe's being at war in 1939 was grounded in the actions of its citizens, meaning (something like) that it was in a state of war "in virtue of" the actions of its citizens, or that those actions are what "made it the case" that it was at war, or that its being at war is to be "explained in terms of" those actions. Regardless of whether this claim about the war's ground is true, we have a reasonably strong pre-theoretic grasp of what it means. Much of the recent literature on ground has been concerned not with particular claims about what grounds what, but with the nature of ground itself. It is not hard to see why this commands such attention, for once the notion of ground is brought into clear view it is tempting to think that many of the central issues in metaphysics, and perhaps philosophy more generally, should be stated in its terms.

One aim of this paper is to argue that ground is *irreducibly plural*: there are cases in which a plurality of facts or entities taken together are grounded in some underlying facts or entities even though none have a ground on their own. To be sure, it is widely recognized that something's ground is often a plurality of facts or entities; indeed, Europe's being at war in 1939 is a good example of something that is presumably grounded in a multitude of facts concerning the actions of its many citizens during that time. *Those* facts together *are* what explains its being at war, even though none of them is a sufficient explanation when taken individually. But the literature uniformly assumes that what is grounded is in each case a single fact or entity. Here I disagree and argue that what is grounded is sometimes a plurality too: sometimes *they*, the members of a plurality, *are* explained in terms of more fundamental facts or entities, but none admit of explanation on their own.

Recognizing the mere *possibility* of pluralities that are grounded together is enough to have a significant impact on a number of debates in

¹See Fine [8], Rosen [18], Schaffer [21] and Sider [19] for starters.

metaphysics. For one of the central aims of contemporary metaphysics is to establish which aspects of the world are fundamental and which are merely derivative, and the canonical strategy of arguing that a given aspect is fundamental is to argue that it has no ground. But if aspects are sometimes grounded only together as a plurality then this line of argument is invalid. For in that case something may have no ground but nonetheless be part of a plurality that together have a ground, in which case it would be a mistake to conclude that it is fundamental.

But far from being a mere possibility, I believe that there are actual cases in which a plurality of facts are grounded together. For example, consider the individualistic facts, i.e. facts that concern particular individuals such as

Saul Kripke is a philosopher

Barack Obama is president

This very book (pointing at the book on my table) is interesting

I believe that these facts together are (plurally) grounded in the purely qualitative nature of the world, even though none of them has a qualitative ground when taken on its own. For another example, consider the set of all facts about mass in kilograms, such as

The president is 75 kgs

The laptop on the table is 2 kgs

The book next to the laptop is 1/2 kg.

Once again, I believe that these facts are (plurally) grounded in the mass relationships between things, even though none of them has such a ground when taken alone. The result is a *structuralist* conception of individuals and kilograms respectively, since an account of any one member of the group is inevitably an account of them all. The second aim of this paper is to motivate these structuralist views. So the paper has two distinct topics—the nature of ground in general, and the metaphysics of individuals and kilograms in particular—but each topic will inform the other.

I start in Section 1 by clarifying the notion of ground. Then in Section 2 I turn to the case of individuals and motivate the structuralist view just outlined. Actually, I do not argue for structuralism *per se* because the view makes a substantial claim that there is no space to motivate here, namely that the world is fundamentally qualitative. So instead, I argue for the conditional claim that *if* the world is fundamentally qualitative, we should be structuralists and think that individualistic facts are plurally grounded

in the qualitative. In Section 3 I argue for an analogous claim in the case of kilograms: that conditional upon an assumption about the fundamental nature of the world, we should be structuralists and think that kilogram facts are plurally grounded. In Section 4 I respond to objections to both structuralist views and to plural grounding in general.

Sections 2–4 do not establish that ground is in fact irreducibly plural since they only contain arguments for the conditional claims just mentioned. Nonetheless, they do motivate the *possibility* that ground is irreducibly plural, and in Section 5 I argue this possibility is enough to have a significant impact on a number of debates in metaphysics.

1 More on Ground

Ground is an explanatory notion: to say that X is grounded in Y is to say that Y explains X. But the kind of explanation being given is of a distinctively metaphysical sort. To illustrate, imagine asking what explains Europe’s being at war in 1939. A causal answer might describe events during the preceding 50 years that led, say, Chamberlain to declare war on Germany. But there is another kind of answer that would try to say *what it is* for Europe to have been at war in the first place. Regardless of what caused Chamberlain to declare war in 1939, someone in search of this second answer wants to know what it was about the continent that *constituted* its being in a state of war. An answer of this second kind is a statement of what grounded Europe’s being at war in 1939.

Since ground is an explanatory notion we should distinguish between full and partial explanations. One man’s firing a gun might be part of an explanation of what it was for Europe to be at war, but it does not fully explain it. By something’s ground I mean its full explanation.

What is the logical form of a claim about grounds? Some take ground to be a sentential connective while others take it to be a relation between entities, and the latter group is split between those who take it to relate facts, states of affairs, propositions, objects, properties, or some combination of the above. Officially, I follow the first group and treat ground as a sentential connective, though nothing turns on this choice. Treated like this, the logical form of a claim about grounds is standardly taken to be

S because Δ

where S is a sentence, Δ is a list of sentences, and ‘because’ is read in the metaphysical rather than causal sense.² Informally, the sentences in Δ describe those aspects of the world that together explain its being the

²Here I am following Fine [9].

case that S . It is important that Δ is a list and not a conjunction: we would like to make sense of the plausible view that conjunctions are grounded in their conjuncts, but if Δ were a conjunction this would collapse into the view that a conjunction is grounded in itself. So ‘because’ above differs from its ordinary English cousin, since the latter takes two sentences as arguments while the former takes a sentence and a list of sentences.

Now, this logical form presupposes what I call a *singularist* view of ground, according to which any aspect of the world that admits of explanation can be explained on its own. Much of this paper will argue that singularism is wrong and that sometimes a plurality of aspects taken together can be explained even though none of them can be explained when taken alone. But this *pluralist* view of ground makes no sense given the above logical form, so the pluralist will instead take the logical form to be

Γ because Δ

where both Γ and Δ are lists of sentences.³ Informally, the aspects of the world described by the sentences Γ are explained, when taken together, by the aspects described by the sentences in Δ , even though there is no presumption that each sentence in Γ describes something that can be explained on its own. From the pluralist’s perspective, the singularist mischaracterized the logical form by generalizing from special cases in which the number of sentences in Γ is one. Since the singularist logical form became orthodox, it is no surprise that pluralism has been overlooked.

While I officially treat ground as a sentential connective, it will often be convenient to reify and treat it as a relation between facts. I will not assume much about what facts are—in particular, I will not assume that they are structured entities like Russellian propositions—but I will assume that they are reasonably fine-grained and that logically equivalent facts can be distinct. When treated as a relation between facts, a singularist will take the logical form of a claim about grounds to be

X is grounded in Y

where X is a singular variable and Y is a plural variable, both ranging over facts. Thus, the claim is that the fact X is explained by the facts Y .⁴ But the pluralist will instead let X be a plural variable and replace ‘is’ with ‘are’. Thus she claims, of the many X , that *they are* grounded in the Y , with no presumption that each X has a ground on its own.

I make two assumptions about ground. The first is that the grounded is metaphysically necessitated by its grounds. More formally, I assume the following scheme:

³I should say that in both logical forms we allow that the lists can be infinite.

⁴See for example Rosen [18].

If Γ because Δ , then necessarily if $\wedge\Delta$ then $\wedge\Gamma$

where $\wedge X$ is the conjunction of the sentences in the list X . This assumption is standard and plausible: if Europe's being at war in 1939 was grounded in the actions of its citizens at that time, then those actions are *what made it the case* that Europe was at war, and are that *in virtue of which* it was at war. But if so, it would appear to be impossible for those citizens to have acted in those ways and yet for Europe to have been at peace. I do not assume the reverse since there can be necessary connections without grounds. For example, it is necessarily the case that if Obama has big ears then $2+2=4$, but it is not the case that $2+2=4$ *because* Obama has big ears. Nor do I assume that the grounded necessitates its ground, for a disjunction with a true and a false disjunct may be grounded in the true one even though the disjunction does not necessitate it. This case also shows that claims about ground are often contingent: even though the false disjunct does not in fact explain the disjunction, it would do if it were true.

My second assumption is that all parts of an explanation must be explanatorily relevant. This is a natural assumption in the case of causal explanation: if the oil spill in the gulf is causally explained by BP's negligence then it is not causally explained by BP's negligence and the size of Obama's ears, for surely the latter is entirely irrelevant to the matter. In this case we think that adding irrelevant information defeats the initial explanation. I assume the same for ground. I take it that the notion of relevance is reasonably intuitive and that we can often recognize irrelevancies when we see them, but I will not offer a definition.

Those are my assumptions about ground. I do not assume that ground is transitive, but we will have occasion to speak of the transitive closure of ground so let us call it "derivative ground" for future reference. Finally, I do not assume anything about the status of claims about ground. One might adopt a Humean view of ground, according to which facts about what grounds what are themselves derivatively grounded in whatever grounds everything else (e.g. physical facts, if one is a physicalist). Or one might adopt an Anti-Humean view of ground, according to which facts about what grounds what are not derivatively grounded in whatever grounds everything else.⁵ I remain neutral between these two views in what follows.

⁵Sider [19] is a Humean, since he understands claims about what grounds what as semantic claims and therefore thinks that such claims are grounded in whatever grounds semantics in general. Rosen [18] does not explicitly defend Anti-Humeanism, but much of what he says is naturally interpreted along those lines.

2 Structuralism About Individuals

Individualism vs Qualitivism

Having put pluralism on the table, let us now motivate it with the case of individuals. It will help to start with some terminology. Let an *individualistic fact* be a fact that concerns a particular individual. I gave some examples above, but in general they are facts of the form

a is F, b is G, a bears R to b , $a \neq b$

where a and b are individuals. These are to be contrasted with qualitative facts. To explain what these are, say that a property is *qualitative* if it does not concern any particular individual. For example, the property of wearing a green sweater, the property of having a sister, and the property of having two sisters are all qualitative: even if my having these properties implies the existence of other individuals, they do not concern any particular individual. These contrast with what we might call *individualistic properties* such as the property of being Kripke and the property of being Obama's sister, which concern the particular individuals Kripke and Obama respectively. A fact is *qualitative*, then, if it concerns how the world is just with respect to the distribution of qualitative properties.

For example, qualitative facts include all the facts that can be expressed in predicate logic with identity but without constants, such as

$(\exists x)Fx, (\exists x)(\exists y)(Fx \ \& \ Gy \ \& \ x \neq y), (\forall x)(Fx \supset Gx)$

so long as F and G express qualitative properties. If you think that there are facts about how qualitative properties are bundled together, as a bundle theorist would, then these would also be qualitative facts. One might well ask how the distinction between the individualistic and the qualitative is to be defined in more detail, but we understand it well enough to be getting on with so I will not discuss that here. I would only add that I do not count tropes as qualitative properties.⁶

The world appears to be replete with both individualistic and qualitative facts, but how are they related? *Individualism* is the view that the individualistic is prior to the qualitative, in the sense that qualitative facts are all derivatively grounded in individualistic facts. If ground were transitive, individualism would imply that the qualitative is grounded (and not just derivatively grounded) in the individualistic, but without assuming

⁶Note that while the individualistic facts above are all expressed with referring terms, qualitative facts may be expressed with referring terms too so long as they do not refer to particular individuals but (say) to qualitative properties.

transitivity the view is that starting with the qualitative facts and following the chain of grounds down, one eventually bottoms out in individualistic facts.⁷ In contrast, *qualitavism* is the view that individualistic facts are all derivatively grounded in qualitative ones. Qualitavists may disagree on what kind of qualitative facts one finds in those derivative grounds: a traditional bundle theorist will say that they concern which properties are compresent, while other qualitavists might insist that they are existentially generalized facts or even some other sort of qualitative fact not outlined here, but these in-house disagreements will not concern us here.⁸

I have not mentioned views that eliminate individualistic or qualitative facts altogether. This is because the recent interest in ground is largely driven by the vision that the benefits of eliminativist views can be enjoyed by more plausible views about what grounds what. For example, the hope is that those impressed by arguments for the view that numbers do not exist need not actually accept that radical conclusion but instead see those very same arguments as motivating the view that numbers are grounded in the material world. Similarly, someone with an aversion to individualistic facts will, if she grants the notion of ground, wish to derivatively ground them in the qualitative rather than eliminate them altogether. Since we are taking the notion of ground for granted, it makes sense for us to ignore eliminativist views.

Individualism is at first glance an attractive position. We naturally think, for example, that the qualitative fact that *someone* is the president is grounded in the individualistic fact that *Obama* is the president. More generally, we naturally think that facts about how qualitative properties are distributed throughout the world are grounded in their being instantiated by a domain of individuals. However, I favor qualitativism. My reason is that individualistic facts are dispensable from our best scientific explanations of all observable phenomena and so for Occamist reasons should not be considered part of the world's fundamental nature.⁹ But my aim in this section is not to argue for qualitavism but instead to argue that for the thesis that *if* qualitavism is true, individualistic facts must be grounded in the qualitative plurally, rather than one by one.

⁷The individualist may wish to modify her view a little and allow that the basis of facts that derivatively ground the qualitative includes a "Totality" fact, which states (something like) that a certain collection of individuals or facts are *all* the individuals or facts there are. But this complication will not matter to us here so I will ignore it in what follows.

⁸A qualitavist view of this latter sort is motivated and defended by Dasgupta [5]. Other qualitavist views of this latter sort are explored in Hawthorne and Sider [11].

⁹This line of argument is developed by Dasgupta [5].

Finding Obama in a Qualitative World

To clarify my thesis, recall that the qualitatist says that individualistic facts are all *derivatively* grounded, though perhaps not grounded, in the qualitative nature of the world. Still, this implies that there is a set S of individualistic facts that are grounded, and not just derivatively grounded, in the qualitative. If ground is transitive then S is the set of all individualistic facts, while if it is not then it may be a proper subset; but for our purposes all that matters is that S is not empty. I will argue, first, that one runs up against significant problems when attempting to find a qualitative ground for any one member of S taken alone; and, second, that these problems dissolve if we plurally ground them together. This suggests that if qualitatism is true then some individualistic facts are plurally, and not singularly, grounded in the qualitative nature of the world.

It will be useful to work with an example. To this end, let us suppose that S contains the fact

Barack Obama exists

though nothing will turn on my choice of fact here. Our opponent thinks that this fact when taken alone is grounded in some set Q of qualitative facts. But what could Q possibly be? To see the difficulty, note that Q could be more or less wide-ranging. At one extreme Q might contain facts about the distribution of qualitative properties throughout the entire cosmos, while at the other extreme Q might contain facts about the distribution of qualitative properties in a restricted region of space-time roughly coinciding with the region filled by Obama. I will argue that if Q is too restricted it will fail to *necessitate* Obama's existence, while if Q is too wide-ranging it will contain *irrelevant* information. In the case of Obama's existence, then, my two assumptions—that a ground both necessitate and be relevant to what it grounds—pull in opposite directions and it is implausible that they can be jointly satisfied.

Let us start with the case in which Q is restricted. If Q were to contain facts concerning the existence of something with only a few of Obama's qualitative properties such as being born on a small island and being well educated, it would clearly not be sufficient to ground Obama's existence since it is intuitively possible for someone to have those qualities and yet for Obama not to exist. Is there then a more plausible candidate set of qualitative facts Q ? There is a general reason to think there is not.

To see why, let R be a bounded region of space-time roughly coinciding with that filled by Obama, and let Q_R be the set of facts characterizing the intrinsic qualitative nature of R in its entirety. We now argue that Q_R does not necessitate Obama's existence. To start, note that it is, intuitively, pos-

sible for there to be a region of space-time R^* disjoint from R which agrees with R in all intrinsic qualitative respects—i.e. in which all the facts in Q_R obtain—but which contains different individuals. It might help to imagine (though this is not crucial to the argument) that R^* is spatio-temporally far removed from R : perhaps R^* is many light-years away from R , or perhaps the possibility in question is one in which there is eternal recurrence and R^* is simply part of another epoch. Moreover it is, intuitively, possible for there to be such a region R^* and yet for R to differ in such a way that Obama never existed: perhaps all we need to suppose is that his mother's egg was fertilized by a different sperm. Since all the facts in Q_R would obtain in this possibility, it follows that Q_R does not necessitate Obama's existence and hence does not ground his existence either.

This is not to say that there are no facts at all about the nature of R that could explain his existence. Essentialists about origins might explain his existence by the fact that a particular sperm fertilized a particular egg within R . Others might explain his existence by the existence (and perhaps arrangement) of the particular fundamental particles within R that compose him. I have no objection to these explanations, but neither is available to the qualitatist since they both appeal to individualistic facts. What the argument above shows is that nothing about the *qualitative* nature of R could ground Obama's existence.

Notice that our initial region of space-time R could have been much larger than the region filled by Obama. It could have been the region filled by our galaxy for it would still, intuitively, be possible for there to be a distinct region identical in all intrinsic qualitative respects and yet for Obama to never have existed. So the argument shows that even if Q contains qualitative facts characterizing a very large region of space-time around Obama, it would still not explain his existence. Moreover, our argument did not depend on our choice of individual: had we asked for an explanation of the existence of a particular fundamental particle or of a given table, the argument would go through just the same.

Let us turn, then, to the case in which Q contains a complete qualitative specification of the entire cosmos. Does this fare any better? One might complain that this would still not necessitate Obama's existence, but this complaint is not persuasive. To be sure, I do not have a clear intuition that it *does* necessitate his existence, but neither do I have a clear intuition that it does not. So let us concede that, so defined, Q would indeed necessitate Obama's existence. Instead, the trouble is that Q would contain explanatorily irrelevant information. For example, it contains facts about the existence of electrons 10 million light-years away and, intuitively, these are completely irrelevant to an explanation of what it is for Obama to exist.

What is it for part of a putative explanation to be irrelevant to the explanans? Fortunately we do not need to answer this question, for we are good at recognizing cases of irrelevance without an analysis in hand. It is intuitive and commonsensical that the size of Obama's ears is irrelevant to a *causal* explanation of what triggered the oil spill in the gulf, even if we lack an analysis of causal relevance. Similarly, it is intuitive and commonsensical that electrons 10 million light-years away are irrelevant to a *metaphysical* explanation of Obama's existence, even if we lack an analysis of metaphysical relevance.¹⁰

I put weight on intuitions about explanatory relevance, but I do not claim that they are sacrosanct. I can imagine empirical discoveries that would lead me to think that the size of Obama's ears is relevant to a causal explanation of the oil spill after all (we might discover that he went diving, that his ear got caught in some underwater machinery...). Similarly, if I had good theoretical reasons to be a qualitivist and good reasons to think that the *only* way to then make sense of Obama's existence is to ground it in facts about the entire cosmos, I would consider believing the surprising result that the entire cosmos is relevant to Obama's existence after all. Still, our intuitions of irrelevance show that both cases would involve a significant revision of pretheoretic belief. As we will see, the advantage of taking ground to be irreducibly plural is that no revision is needed: we can make sense of Obama's existence in a qualitative world without revising our pretheoretic belief that the entire cosmos is explanatorily irrelevant.

I have argued that if Q contains facts concerning the intrinsic qualitative nature of a restricted region R around Obama it does not necessitate Obama's existence, and that if Q contains facts about the distribution of qualitative properties throughout the entire cosmos it contains irrelevancies. Is there some intermediary set of facts that is both wide-ranging enough to necessitate Obama's existence and yet restricted enough to include no irrelevancy? We have already done enough to answer in the negative, for we saw that the restricted region R could be that filled by our entire galaxy and its intrinsic qualitative nature would *still* not necessitate Obama's existence. Adding any further facts about the qualitative nature of the cosmos outside R would intuitively amount to adding irrelevancies.

As a last resort, one might let Q_W be the entire qualitative nature of a given possible world W and propose that Q is the disjunction of the

¹⁰In particular, we should not assume that a putative explanation contains an irrelevancy just in case it contains a fact which, if deleted, would still yield an explanation. For a monist might suggest that Obama's existence is grounded in the single fact that the entire cosmos instantiates a particular property, but while deleting this fact would leave us with no explanation this should not detract us from objecting that the putative explanation contains irrelevant information. For more on monism see Schaffer [20].

Q_W for any W in which Obama exists.¹¹ Q will then necessitate Obama's existence by construction, and one might try to argue that it contains no irrelevancies by virtue of its disjunctive nature. But this is madness: intuitively, such a disjunction provides no *explanation* of Obama's existence at all! This disjunctive approach might work if one's project is simply to provide necessary and sufficient conditions for Obama's existence, but when explaining his existence it is a non-starter.¹²

The Inter-Dependence of All Things

I have argued that the qualitativist faces serious difficulties if she tries to ground Obama's existence in the qualitative nature of the world. For singularists about ground these problems are *ipso facto* problems for qualitativism. But if one allows that ground is irreducibly plural the qualitativist might concede that Obama's existence has no qualitative ground on its own and yet insist that individualistic facts nonetheless have a qualitative ground when taken as a plurality. How might this be cashed out in detail? One proposal is this to let I be the set of all individualistic facts and let Q be the set of all qualitative facts, and say that the members of I are (plurally) grounded in Q . Call this a *structuralist* view of individuals.

There are many details to argue about. Some might argue that the qualitative ground should include only certain kinds of qualitative facts such as existential generalizations or facts about how properties are bundled together. Others might insist that only a subset S of individualistic facts (e.g. facts about the fundamental particles) are plurally grounded in the qualitative and that other individualistic facts are grounded singularly in S . Still others might note that structuralism so defined is just a claim about what actually grounds what, and they might argue that the thesis should be strengthened to say that, *necessarily*, individualistic facts are plurally grounded in the qualitative. But these arguments are in-house debates between theorists all of whom deserve to be called 'structuralists' and the differences between their views will not matter here.

The chief advantage of structuralism is that it avoids the difficulties we faced when trying to ground Obama's existence on its own. For one thing, Q contains no irrelevancies when it comes to explaining the members I . To be sure, Q does contain irrelevancies when explaining Obama's existence, such as qualitative facts about electrons 10 million light years

¹¹This is discussed by Adams [1] as the most plausible interpretation of Leibniz's view.

¹²Moreover, given the plausible thesis that disjunctions are grounded in their true disjuncts and the assumption that ground is transitive, the suggestion implies that Obama's existence is grounded in the actual qualitative state of the cosmos, which we have already rejected.

away; but since *I* contains individualistic facts about those very electrons the qualitative facts about them are perfectly relevant when explaining *I*'s members! And as we saw earlier, it is not implausible that *Q* necessitates all the individualistic facts. The problems we faced when trying to ground Obama's existence on its own therefore dissolve when we instead ground individualistic facts plurally.

Moreover, the structuralist can nicely explain why individualism has traditionally been the more popular doctrine. For as we have seen, we have strong intuitions suggesting that an individualistic fact like Obama's existence is not grounded in the qualitative nature of the world, and the structuralist and the individualist both agree to take these intuitions seriously. The individualist's mistake, diagnoses the structuralist, is just to take this lack of qualitative grounds to imply that the individualistic fact is fundamental, when the correct conclusion is instead that it only has a qualitative ground when taken along with the plurality of all individualistic facts. The individualist's mistake is thus understandable, but a mistake nonetheless.

Of course, none of these points imply that structuralism is the best form of qualativism, but they are significant marks in its favor. I discuss some other advantages of the view in Section 4.¹³

Structuralism differs radically from more traditional versions of qualativism that attempt to make sense of each individualistic fact on its own. For example, the bundle theorist will see a certain set of compressent properties and declare 'Here is Obama!' But there is a sense in which the structuralist does not make any qualitative sense of *Obama's* existence at all: according to the structuralist, his existence is certainly not fundamental but nor is any part of the underlying qualitative world responsible for it. The structuralist can of course locate the existence of *every individual taken together* in the world's qualitative nature, but when it comes to *Obama himself*, the structuralist finds that his existence has melted away into nothing more than a "node" in a web of facts.

¹³It might be worth noting that structuralism is not the view that the conjunction of the members of *I*—call this conjunction *&I*—is grounded in *Q*. For this latter view is a claim about a single fact, *&I*, to the effect that *it is* grounded in *Q*; while structuralism is a claim about a large number of facts, the members of *I*, to the effect that *they are* grounded in *Q*. To be sure, if ground is transitive and if conjunctions are grounded in their conjuncts, then structuralism implies that *&I* is grounded in *Q*. Noticing this, one might be tempted to replicate the virtues of structuralism just mentioned without plural grounding by simply saying that *&I* is grounded in *Q* without the detour through its members. But while this view does indeed share the virtues of structuralism, it is untenable because it violates the plausible principle that a conjunction is grounded in its conjuncts. In order to enjoy structuralism's virtues, one needs to embrace the idea that ground is an irreducibly plural relation.

Thus, on the structuralist picture I am sketching there is a sense in which all things are inter-dependent: I literally would not be who I am were it not for you! But this form of inter-dependence is significantly more attractive than others that have been suggested in the literature. For example, some have claimed that numbers are inter-dependent in the sense that the existence of any number is grounded in the existence of all the others.¹⁴ But this view implies that there are infinite descending chains of ground; and if ground is transitive it also implies that each number is part of an explanation of its own existence, violating the plausible principle that nothing can partially explain itself. With plural grounding, we capture a sense in which all things are inter-dependent without incurring such costs. Therefore, those attracted to the idea that numbers are inter-dependent should be interested in whether pluralism about ground offers them a more plausible way of cashing out their view.

3 Structuralism About Quantities

An analogous structuralist view can be motivated with similar arguments about what is on the surface a very different case, namely that of quantities like mass, charge, energy, temperature, length, and so on. I will focus on the case of mass, but the discussion generalizes to all quantities.

Absolutism vs Comparativism

To start, we need to distinguish between two views about mass. The property of having mass is a determinate, but what are its determinates? It is natural to think that something with mass has a determinate *intrinsic* property, a property it has independently of its relations to other material bodies. But it is also natural to think that things with mass stand in various determinate *mass relationships* with one another. Some of these relations are ratios, such as the relation of x being twice as massive as y ; others are merely ordinal, such as that of x being more massive than y .

How are the intrinsic masses and the mass relations related? *Absolutism* is the view that the intrinsic masses are prior to the mass relationships. The absolutist does not deny that things with mass stand in determinate mass relationships, she just insists that those relationships, along with all facts about the masses of material bodies, are derivatively grounded in facts about the particular intrinsic mass had by each body.¹⁵ In contrast,

¹⁴Shapiro [22] and Resnik [17] have defended this sort of view about mathematical objects.

¹⁵Along, perhaps, with facts about how the intrinsic masses themselves are related to

comparativism is the view that all facts about the masses of material bodies are derivatively grounded in facts about how they are related in mass to one another. Some comparativists will say that the most fundamental mass relations are ratio relations while others will insist that they are merely ordinal, but this in-house dispute will not concern us here.

I favor comparativism. My reason is that facts about which intrinsic mass is possessed by each material body are dispensable from our best scientific explanations of all observable phenomena and so for Occamist reasons should be dispensed with.¹⁶ However, my aim in this section is not to argue for comparativism but to argue that *if* comparativism is true, then certain facts about mass must be grounded plurally in mass relationships rather than one by one. The facts I have in mind are facts we state with a numeral and a scale like ‘kilograms’, such as that my laptop is 2 kilograms. These kilogram facts clearly concern the masses of things, so the comparativist must say how they are grounded in mass relationships. I will argue, first, that the comparativist runs up against significant difficulties if she attempts to ground each kilogram fact in turn; and, second, that these difficulties evaporate if she plurally grounds them together. Therefore, if comparativism is true then kilogram facts are plurally, rather than singularly, grounded in mass relationships.

Before we start, it will help to note that the absolutist has no problem making sense of kilogram facts: she can say that my laptop’s being 2 kgs is identical to, or else grounded in, its having a certain intrinsic mass. One might object that this ignores the central role that the standard kilogram in Paris plays in the kilogram scale. But the absolutist can respond by appealing to the standard Kripkean theory that we use expressions of the form ‘ r kilograms’ with the stipulation that they refer to the mass that is r times that of the standard kilogram. She can then concede that the standard kilogram plays a central role in the kilogram scale, namely in explaining why the sentence ‘My laptop is 2 kgs’ states the particular fact it does. But she can insist that when it comes to explaining that particular fact of my laptop’s being 2 kgs, no reference to the standard kilogram is required: it is either identical to, or else grounded in, my laptop’s having a certain intrinsic mass.

one another. The details of the view can be cashed out in many different ways, but these differences will not matter in what follows. See Armstrong [3], Bigelow and Pargetter [4] and Mundy [14] for more on this issue.

¹⁶This line of argument is developed in Dasgupta [6].

Finding Kilograms in a Comparative World

So the absolutist easily makes sense of kilogram facts. What about the comparativist? So long as she tries to ground each kilogram fact in turn, she faces serious difficulties. To see this, take as an example the fact

(K) *My laptop is 2 kilograms*

and let us suppose that our comparativist tries to ground this fact alone in mass relations. Her challenge, then, is to find some set R of facts about the mass relationships between my laptop and other things that explains (K). But what could R possibly be? To see the difficulty, note that R could be more or less wide-ranging. At one extreme, R might contain a fact about my laptop's mass relationship to just one other item; while at the other extreme, R might contain facts about its mass relationships to all bodies in the entire cosmos. As before, I will argue that if R is restricted then it will fail to necessitate (K), while if R is too wide-ranging it will contain irrelevant information. Once again, we have a case in which we cannot jointly satisfy our two constraints that the ground both necessitates and is relevant to the grounded.

Start with the case in which R contains facts about how my laptop is related in mass to all other bodies in the entire cosmos. One might complain that those relationships do not necessitate my laptop's being 2 kgs, but this complaint is unpersuasive. For R fixes the mass relationship between *any* two bodies, so the complaint must be that the entire cosmos could be exactly as it is in all mass relational respects and yet differ in the mass of my laptop. Personally, I do not have a clear intuition about this. Admittedly, I do not have a clear intuition that R *does* necessitate (K), but nor do I have a clear intuition that it does not.

Let us concede, then, that R would necessitate (K). Instead, the better complaint is that R would contain explanatorily irrelevant information. For example, it would contain facts about the mass relationship between my laptop and electrons in Alpha Centauri and, intuitively, these are completely irrelevant to what makes it the case that my laptop is 2 kgs. Indeed, this intuition is reflected in the attractiveness of the absolutist's account of (K), according to which my laptop's being 2 kgs either is, or else is grounded in, its having a particular intrinsic mass. That this account is so satisfying shows that, intuitively, my laptop's being 2 kgs has nothing to do with electrons 10 million light-years away.

I rest my case on the intuition that certain information is irrelevant to an explanation of (K), but as before I do not consider the intuition sacrosanct. If I had good theoretical reasons to be a comparativist and if the *only* way to then make sense of (K) were to ground it in my laptop's

relationships to all other things, I might consider biting that bullet. But the virtue of taking ground to be irreducibly plural, I will argue, is that no such bullet biting is required.

Let us turn, then, to the case in which R is restricted to a fact concerning my laptop's mass relationship with one other object. The obvious choice of object would be the standard kilogram in Paris, often known as the International Prototype Kilogram (IPK), so the suggestion would be that (K) is grounded in the fact

(I) *My laptop is twice as massive as IPK*

The idea is that even though my laptop's mass relation to a particle light-years away is irrelevant to an explanation of (K), its relation to IPK is not due to the central role that IPK plays in our system of measurement.

There are many problems with this view, but the simplest one is that (I) does not necessitate (K). For note that it is, intuitively, possible for my laptop and IPK to both be twice as massive as they actually are, in which case my laptop would still be twice as massive as IPK and yet would be 4 kgs, not 2 kgs; therefore, (I) does not necessitate (K). This argument should be reminiscent of Kripke's discussion of the standard meter. He argued that it is a contingent fact that the standard meter is 1 meter long since it could have been cut a little longer than it is.¹⁷ But a consequence is that if the standard meter and myself were both a little longer by the same amount, I would still be 1.8 times the length of the standard meter even though I would not be 1.8 meters. The argument here is exactly the same but applied to kilograms instead of meters.

I find this Kripkean argument convincing, but one might resist it. For one thing, it assumed that it makes sense to compare my laptop's mass across possibilities—i.e. when I said it was possible for my laptop to be twice as massive *as it actually is*—and one might object that a comparativist cannot make any sense of such comparisons. A second objection is that it is impossible for IPK to have differed in mass at all: while the lump of metal in Paris could have been more massive, IPK should not be identified with that lump and is instead a co-located yet distinct object that has its mass essentially.¹⁸ Finally, one might tweak the restricted view and say that (K) is grounded in my laptop's being twice as massive as IPK *actually* is, for the Kripkean argument is no objection to this tweaked view.

I do not find any of these responses compelling.¹⁹ But for those readers sympathetic to them there is another reason to reject the view that (K)

¹⁷See Kripke [13].

¹⁸Thanks to Jack Spencer for bringing this objection to my attention.

¹⁹Indeed, in Section 4 I will outline a "mass-counterpart theory" that provides a response to the first one.

is grounded in (I), namely that just as we intuitively found my laptop's relationships to electrons in Alpha Centauri irrelevant to what makes it 2 kgs, we also intuitively find its relationships to objects in Paris irrelevant in the same way. Once again, the intuition is reflected in how satisfying the absolutist's account of (K) was: the fact that my laptop's intrinsic mass—if there were any such thing—would so naturally explain its being 2 kgs shows that, intuitively, its mass relation to *any* other body, including IPK, is simply irrelevant to the issue. Importantly, this intuition tells equally against the tweaked version of the view mentioned in the last paragraph.

I think this intuition is strong, but unfortunately we have been so indoctrinated with the view that IPK is crucial to mass in kilograms that it is easily lost in theory. So let me help bring it out with the following story. Imagine reading in the Times that there is in fact no special lump of metal in Paris and that the French created the illusion of a lump in some perverse attempt at a joke. Or, for a second case, imagine reading that while there is a lump, it turns out that the French have been misleading us into thinking that it is twice as massive as it actually is. In both cases, imagine that the article explains that the illusion was systematic, so that whenever we thought we were using a special lump with certain properties to calibrate measuring instruments, the calibration succeeded even though we were misled about the properties of the lump (about its existence in the first case, or its mass in the second). In the second case, then, the article says that if we were to put IPK on one of the many measuring instruments around the world it would read '500 grams', not '1 kg' as expected.

If we believed these articles, what would we say if asked about my laptop's mass in kilograms? Intuitively, we would say that it is 2 kgs just as we would say before reading the articles. After reading the first article I would say 'My laptop is 2 kgs even though there is in fact no special lump in Paris'; and after reading the second article I would say 'My laptop is 2 kgs, though I just discovered the surprising fact that the standard kilogram in Paris is actually 500 grams!' In both cases, information about the tomfoolery of the French and a putative object 3000 miles away seems entirely irrelevant to my laptop's mass in kilograms. If this is right, the following counter-actual is true: if it turns out that my laptop is not twice as massive as IPK for either of the above reasons, then it will still turn out that (K) obtains. This counterfactual is evidence that, intuitively, we think that my laptop's mass relation to objects in Paris is irrelevant to whether or not it is 2 kgs, and hence should be no part of its explanation.

I said that the counter-actual is *evidence* that (K) is not grounded in (I), not that it *implies* it. It is consistent with the counter-actual that (K) is in fact grounded in (I) but that the discoveries reported in the Times would

simply cause us to revise that opinion. Indeed, this is a natural reaction in some cases. For example, many of us think that a glass' being full of water is grounded in its being full of H_2O , but if we were to discover that the rivers and streams around us (as well as the glass) are full of XYZ, we would continue to believe that my glass is full of water and simply revise our opinion about what water consists in. But the corresponding thesis in the case of kilograms—that (K) is indeed grounded in (I) but the discoveries in the Times would cause us to revise that opinion—is implausible, for what would we revise it too? In the case of water there is a clear candidate, but in the case of kilograms there is not. The best explanation of the counter-actual concerning the discoveries in the Times, I claim, is that we intuitively do not take my laptop's relation to putative objects in Paris to be relevant to explanations of its mass in kilograms.

Interestingly, these cases show that two orthodox theories about the role of IPK—the classical view that 'kilogram' is defined in terms of it, and the Kripkean view that 'kilogram' has its reference fixed in terms of it—are both false, for they both fail to predict that the counterfactual just discussed. Indeed, both views famously imply that there is no possible empirical evidence that IPK is not 1 kg, but I take the second article above to count as such evidence. That both these views have been orthodox at one time or another shows that the importance of IPK to mass in kilograms has been consistently overstated. But when we put orthodoxy down and think about it pre-theoretically, it seems to me that IPK is not very important to kilograms at all; certainly, it is not part of what grounds facts about mass in kilograms. I will discuss what little role it does play in Section 4.

Structuralism Redux

I have argued that the comparativist faces serious obstacles if she tries to ground my laptop's being 2 kgs in its mass relationships. For singularists about ground these problems are *ipso facto* problems for comparativism. But if we allow that ground is irreducibly plural, the comparativist may concede that my laptop's being 2 kgs has no relational ground on its own and yet insist that kilogram facts do when taken as a plurality.

How might the view be spelt out in detail? Here is one proposal. Let K be the set of all kilogram facts and let R be the set of all facts about mass-relations that the comparativist regards as fundamental (either ordinal mass relations or mass ratios, depending on the comparativist). Then the comparativist may propose that the members of K are plurally grounded in R . Call this a *structuralist* view of kilograms. As before, one might wish to strengthen the thesis and say that, *necessarily*, kilogram facts are plurally grounded in the comparativist. It is easy to see how

structuralism generalizes to other scales and quantities such as pounds, miles, seconds and so on.

On this view kilograms facts are all interdependent. For if we consider my laptop's being 2 kgs on its own, we see that while it is not fundamental there is nonetheless no aspect of the world responsible for it. Its being 2 kgs, when considered alone and out of view of other kilogram facts, is in some sense nowhere to be found. The structuralist can of course make sense of all the kilogram facts together in terms of the mass relational nature of the world, but when it comes to my laptop's mass in kilograms the structuralist finds that it has melted away into nothing more than a node in a complex web.

Once again, the advantage of structuralism is that it avoids the difficulties we faced when trying to ground my laptop's being 2 kgs on its own. For one thing, R contains no irrelevancies when it comes to explaining the members of K . Sure, R contains irrelevancies when explaining my laptop's being 2 kgs such as mass relationships concerning electrons in Alpha Centauri, but since K contains kilogram facts about those very electrons the relationships concerning them are perfectly relevant when explaining K 's members! And as we saw earlier, it is not implausible that R necessitates K . Thus, the problems we faced when trying to ground my laptop's being 2 kgs on its own dissolve when we instead ground kilogram facts plurally.

Moreover, structuralism explains the initial attraction of absolutism. For as we have seen, we have a strong intuition that my laptop's being 2 kgs is not grounded in its relationships to other material bodies (including IPK), and the absolutist and the structuralist both take this intuition at face value. According to the structuralist, the absolutist's mistake is just to take the lack of relational grounds to imply that my laptop's being 2 kgs must be grounded in its intrinsic nature, when the correct conclusion is that it only has a relational ground when taken along with the plurality of all kilogram facts. The absolutist's mistake is therefore understandable, but a mistake nonetheless.

Of course, none of these advantages implies that structuralism is correct, but they count as points in its favor. Other advantages of the view will be discussed in the next section.

4 Objections and Replies

So far I have motivated two structuralist views by arguing that they avoid troubles that plague their competitors. One might agree but argue that they should be nonetheless be rejected since they face troubles of their own. To allay such fears, let us respond to three objections along these

lines. I will focus on the case of kilograms, but I intend the discussion to carry over to the case of individuals.

A Language of Convenience

One might object to either structuralist view on linguistic grounds. In the case of kilograms, the idea would be that reflection on the expression 'kilograms' shows us that sentences like 'My laptop is 2 kilograms' do not express facts that are plurally grounded in mass relationships. On the assumption that kilogram facts are the sorts of facts expressed by those sentences, it follows that structuralism about quantities is false.

How might one establish that such sentences do not express plurally grounded facts? Well, suppose that reflection on 'kilograms' confirmed the Kripkean theory that we use 'kilograms' with the reference-fixing stipulation that if it refers to anything, it refers to the mass of IPK. Then one might argue that if comparativism were true the term 'kilograms' would fail to refer since there would be no such thing as the mass of IPK and therefore sentences like 'My laptop is 2 kgs' would not state facts at all, *ipso facto* not facts that are plurally grounded in mass relationships.

But the objection is misguided in many ways. For one thing, I argued in the last section that the Kripkean theory is false. And for another thing, the assumption that there would be no such thing as the mass of IPK if comparativism were true begs the question, for the structuralist will insist that there would be a fact of the matter as to the IPK's mass that is grounded plurally, along with facts about the masses of other things, in the underlying mass relationships. So I do not think that reflection on the expression 'kilograms' shows that structuralism is false.

On the contrary, I believe that reflecting on 'kilograms' provides evidence that structuralism is true! I will discuss this in some detail since it will lend more plausibility to structuralism. I will first describe a community of speakers who use 'kilograms' in such a way that they plausibly express plurally grounded facts, and reflection on our own use will then show that it is sufficiently similar to theirs for the conclusion to carry over.

Imagine, then, a community living in a comparativist world who lack the expression 'kilograms'. The only expressions they have to talk about mass are predicates of the form ' x is r times more massive than y ' for some positive real r . They could express all the fundamental facts about mass, but they soon realized that even basic tasks were surprisingly time consuming. When one of their citizens, Patrick, had a pot luck dinner, he wanted everyone to contribute the same amount of rice. But the only way to make his request was to say 'Please could everyone bring a portion of rice equal in mass to the portion in my cupboard'. Each guest had to visit

Patrick before the party to measure out the right amount.

Struck by this inefficiency, Patrick had an idea. ‘Look’, he told his friends, ‘what would be nice is a way of attributing mass to things one by one, so that you could all have determined the right quantity of rice at home. The important thing is that these attributions should be coordinated so that they imply the mass relational descriptions we are really interested in. But this is easily accomplished by utilizing the properties of the real numbers!’ His guests looked puzzled, but he pushed on. ‘Say that a function m from material bodies to positive real numbers represents mass ratio just in case the following holds: $m(x) = r.m(y)$ iff x is r times more massive than y . This morning I proved a *representation theorem* stating that, necessarily, there is a function that represents mass ratio. There will be many such functions, but I also proved a *uniqueness theorem* stating that given any m that represents mass ratio, (i) $r.m$ also represents mass ratio for any positive real r , and (ii) every function that represents mass ratio can be written as $r.m$, for some positive real r .’²⁰

‘If we coordinate ourselves properly’, he continued, ‘we can use one of these mappings to represent the underlying mass ratios. Each object will be assigned a number, and in order to work out the mass ratio between them we simply calculate the ratio between the numbers assigned and follow the left-to-right direction of the representation theorem.’ His guests agreed it was a great idea, but an argument erupted as to which was the proper number to assign the portion of rice in Patrick’s cupboard. ‘It does not matter’, said Patrick, ‘so long as the numbers we assign to other things are coordinated; and the uniqueness theorem implies that whichever real number we give that portion of rice, we will be able to coordinate our assignments of numbers to other things. So do not worry about which particular number that portion of rice gets.’

‘Instead, let us proceed as follows. To signify that our numbers are coordinated, we will use the expression ‘kilograms’ and introduce 1-place predicates of the form ‘ x is r kilograms’, one for each positive real r . Let us then stipulate that our use of these predicates is to be governed by the following inference rule:

a is r kilograms

b is s kilograms

Therefore, a is r/s times as massive as b

²⁰Patrick was simplifying. He actually proved analogous theorems for an underlying relational language that contained just two predicates: ‘ x is greater or equal in mass than y ’ and a predicate for material composition. For more details see Krantz *et al* [12].

Go forth, my friends, and apply these predicates as you please. Your *only* constraint is that whenever you apply one you ensure, as far as possible, that it coordinates with your other applications in such a way that following the above rule yields truths about mass ratios.'

Patrick's guests were impressed, but they wondered how different households could coordinate with one another. 'This is easy', explained Patrick. 'For now, let us assign this portion of rice the number 1, and let us each take home a portion of rice of equal mass. Use that portion to coordinate your other applications for the next few days. Once our applications are widespread you may dispose with the rice, for there will be enough other points of agreement to help us remain coordinated. Do not be fooled into thinking that I am defining '1 kilogram' in terms of this portion, or that I am stipulating that it refers to the mass of this portion. The above rule of inference is the only constraint on our use of 'kilogram', the rice is just a practical aid to help coordination and plays no semantic role at all.' They all did as Patrick suggested, and after a few years their predicates were deeply entrenched in the sense that thousands of kilogram sentences were accepted, the large majority of which coordinated in the above way.

I claim that structuralism is true of what Patrick expresses by his kilogram sentences. To see this, take that large majority of accepted kilogram sentences which are coordinated, and then add the as-yet unaccepted sentences that coordinate with that basis. The resulting set of sentences K is a complete representation of mass, in the sense that one could recover the entire mass relational nature of the world from its members by way of the above inference rule. Now imagine Patrick asserting each member of K in turn, and suppose we asked him what it is about the underlying mass relationships that makes it the case that each material body has the mass in kilograms he attributes to it. Given the way that Patrick introduced the sentences, it seems almost irresistible to say, of all the material bodies in question, that *they* have their masses in kilograms in virtue of the underlying mass relationships between them. Put in terms of our logical form of claims about ground, it is plausible to say

k_1, k_2, \dots because R_K

where the k_i are the members of K and R_K is the list of all sentences of the form ' x is r times more massive than y ' derivable from K by way of the above rule. Moreover, if Patrick asserted 'My laptop is 2 kgs' and we asked what it is about the underlying mass-ratios that made that the case, there would appear to be no answer. Given the role of kilogram sentences in Patrick's language, one feels like one asks the wrong question by asking for an explanation of my laptop's mass in kilograms without asking for

an explanation of *everything's* mass in kilograms. This is structuralism through and through.

The final premise of the argument is that our own use of 'kilograms' resembles Patrick's in all relevant respects: the function of our kilogram predicates is to represent underlying mass relationships and they do this by being governed by the above rule of inference; benchmarks such as IPK play no semantic role but are rather practical aids in achieving coordination. In support of this premise, note that it explains the datum (presented in the last section) that if we discovered that the French had misled us about the existence or the mass of IPK, we would not revise our belief about my laptop's mass in kilograms. It explains that datum because it assigns IPK no special role in our use of 'kilograms'. A full justification of this premise would take us too far into the philosophy of language, but this is enough to render it plausible.

If this is right, the original objection was doubly mistaken. Far from refuting structuralism, reflection on our use of 'kilograms' actually provides it with some support. I just focused on the case of kilograms here, but I believe that the same goes for individuals. Just as kilogram predicates are devices of measurement whose function is to represent underlying mass-ratios, so too are the singular terms with which we express individualistic facts "devices of measurement" whose function is to represent the underlying qualitative world. And just as kilogram predicates fulfill their function by being governed by the above inference rule, so too our singular terms fulfill their function by being governed by rules that allow us to infer from sentences containing them to conclusions describing the qualitative nature of the world. The rule of existential elimination is a classic example of this sort of inference. These ideas are developed a little in Dasgupta [5], but I will not expand on them here.

Whither Kilograms?

Grant that our use of kilogram sentences resembles Patrick's in all relevant respects. One might then object that none of his kilogram sentences are true and therefore none state facts; *a fortiori* they do not state facts that are plurally grounded in the mass relational nature of the world.²¹

But why think that Patrick's kilogram sentences are not true? One might argue that his use described above does not determine truth conditions for individual kilogram sentences, and that sentences without truth-conditions cannot be true. More fully, the idea is that while his use fixes truth-conditions stated in terms of mass relationships for plurali-

²¹Thanks to Boris Kment for convincing me that this is a serious worry.

ties of kilogram sentences—*they are* true just in case the mass ratios between objects are those that follow from the sentences by the above rule of inference—his use does not fix truth conditions, stated in terms of mass relationships, for individual sentences taken alone.

In response, we can concede that Patrick's kilogram sentences do not have truth-conditions statable in terms of mass relationships, for this is consistent with their having truth-conditions stated in other terms. For example, we might say that the truth-condition of his sentence 'My laptop is 2 kgs' is that my laptop is 2 kgs, or that it is 4.4 pounds. If Patrick's use of kilograms and pounds were well enough entrenched it would seem entirely appropriate for a linguist to assign his sentences truth-conditions of this kind.

Let us grant, then, that Patrick's sentences have truth-conditions. In order to argue that his sentences are never true, one might instead argue that those conditions are never satisfied. Of course, it is consistent with his use of the sentences that their truth-conditions are never satisfied, and one might argue on independent metaphysical grounds for an "eliminative" metaphysics of kilograms along those lines. But at issue here is whether anything about his use of the sentences would imply that their truth-conditions are never satisfied, and I do not see that there is. If Patrick used a coordinated measuring device and uttered 'My laptop is 2 kgs', it would be natural to say 'What he said is true'.

The charge that his kilogram sentences are never true must therefore be driven by theory, for example by the principle that each true sentence must have a truth-condition statable in fundamental terms. But this would beg the question against the structuralist, since it is exactly this sort of principle that a pluralist about ground is likely to deny.

Finally, the objector might concede that Patrick's kilogram sentences are true but object that they do not state facts and hence that the question of what explains them does not arise. The objection is driven by a "thick" conception of facts on which in order for a sentence to state a fact it is not sufficient that it is true, it must also correspond to the world in some richer sense. But remember, our official regimentation of ground is as a sentential operator, our talk in terms of facts is a mere convenience. As long as it is conceded that his kilogram sentences are true, then, a request for explanation is perfectly in order.

Mass Counterparts

Finally, let us turn to three closely related objections concerning modality.²² The first objection notices that, intuitively, it is possible for my laptop to have been 4 kgs and for everything else's mass in kilograms to have remained the same. The possibility of this sort of "independent variation" is evidence, according to the objection, that my laptop's mass in kilograms has a ground all on its own which can vary independently of the grounds of the mass in kilograms of other objects, *contra* structuralism.

The second objection accuses the structuralist of not being able to make sense of any possibilities concerning mass in kilograms in the first place. To see this, consider the possibility just mentioned of my laptop being 4 kgs instead of 2. Why think that the structuralist can make no sense of this? She can perfectly well make sense of a world *W* that is just like ours with the one exception that the mass-ratio between my laptop and all other things is double what it actually is. But the worry is that on the structuralist's own lights, there is no fact of the matter whether *W* a world in which my laptop is 4 kgs or one in which my laptop is 2 kgs and everything else is half the mass in kgs that they actually are. The worry is perhaps most perspicuous if we consider the strong structuralist who thinks that structuralism is a necessary truth. Since she is a comparativist about kilogram facts at *W*, she must think that something about the mass relationships at *W* fixes whether my laptop is 4 kgs at *W*. But since she is also a structuralist, she denies that my laptop's mass in kilograms at *W* has any mass relational ground on its own. All our structuralist says is that the kilogram facts at *W* (whatever they are) are plurally grounded in the relations, but this leaves it entirely open what those kilogram facts are. The situation is very different for the comparativist who says that, necessarily, something's mass in kilograms is grounded in its relation to IPK. For the mass relationships in *W* include my laptop being four times more mass than IPK, so on this view that would ground my laptop's being 4 kgs. But the structuralist denies that my laptop's mass in kilograms has a relational ground of this sort.

So the second objection is that the structuralist cannot make sense of modal claims about how the masses in kilograms of things might have differed. The third objection follows close on the heels, and argues that for this reason the strong structuralist view cannot be coherently stated. To see this, note that while I initially described it as the view that, necessarily, kilogram facts are grounded in the comparative, this is just a shorthand. Stating the view using ground as a sentential operator, it becomes

²²Thanks to Richard Chappell and Brad Weslake for helping me appreciate the force of these objections.

Necessarily, if all the facts about kilograms are that k_1 , that k_2, \dots , then k_1, k_2, \dots because R_k .

where each k_i is a sentence of the form ' x is r kilograms', and R_k is the list of all sentences of the form ' x is r times more massive than y ' derivable from the k_i by way of the above inference rule. But this statement contains kilogram sentences within the scope of a necessity operator, and we just saw that this makes no sense by the strong structuralist's own lights. The objection is therefore that the view is somehow incoherent.

The crucial objection is the second. If the structuralist can make sense of possibilities concerning mass in kilograms after all, she can then happily state her view using kilogram sentences in the scope of modal operators, *contra* the third objection. Moreover, if the way that she makes sense of such possibilities implies that it *is* possible for my laptop to be 4 kgs instead of 2 after all, then that possibility is not evidence in favor of structuralism's competitors, *contra* the first objection.

So, can the second objection be answered? I believe so. One response is to be a modal realist and say that the fundamental facts about the world are really facts concerning a plurality of worlds. The comparativist may then think that the fundamental facts concerning mass relationships include how objects in different worlds relate to one another in mass. On this view W was underspecified: there are many worlds that agree on the mass relationships internal to W but disagree on the mass relationships between its objects and those in other worlds. To determine whether my laptop is 4 kgs at W we need to be told how it relates in mass to my laptop in the actual world.

But one might find the idea of inter-world mass relations repugnant, so let me outline another response that does not appeal to them. This response accuses the argument of using an incorrect model of how a possible world represents my laptop's mass, and introduces a better model that allows her to make sense of the possibility in question. First, how does a possible world represent something *de re* of my laptop in the first place? Lewis famously said that it does so not by containing my laptop itself but instead by containing one of its counterparts. It does not matter for our purposes whether he was right about this, but let us assume that he was so that we have a working model of *de re* representation in play. Given this assumption, the world W introduced above can be re-described as a world containing counterparts of my laptop and every other material body x such that if my laptop is r times as massive as x , my laptop's counterpart in W is $2r$ times as massive as x 's counterpart in W . Now, note that my laptop differs from its counterpart in W systematically with respect to *all* its mass relationships. But every other object differs from its coun-

terpart in *W* only with respect to *one* mass relationship: for example, my printer's mass relationship to all bodies other than my laptop is exactly the same as its counterpart's mass relationships to theirs. So my printer's mass role is very similar to the mass role of its counterpart in *W*, but my laptop's mass role is systematically different from that of its counterpart. The structuralist might therefore say that it is in virtue of this asymmetry that *W* represents my laptop as being 4 kgs and everything else as having the same mass in kilograms that they actually have, rather than my laptop as being 2 kgs and everything else having half the mass in kilograms that they actually have.

In effect, the structuralist just introduced a "mass-counterpart" relation in addition to the ordinary, Lewisian counterpart relation. Since my printer and its counterpart in *W* resemble one another with respect to their mass role, let us call them mass-counterparts. And, the idea is, because my printer's counterpart at *W* is also its own mass-counterpart, *W* represents my printer as having the same mass in kilograms as it actually is. Here the mass-counterpart relation is doing somewhat analogous work to Lewis' counterpart relation: just as the latter is not identity but instead stands in for it when determining what a world represents *de re*, the mass-counterpart relation is not the same-mass-as relation but instead stands in for it when determining what a world represents about mass. And like Lewis' counterpart relation, we can allow that which aspects of an item's mass-relational profile are important to determining its mass-counterparts will depend on the conversational context. With a bit of conversational coaxing, then, we might engineer a lax enough context in which my laptop's counterpart in *W* is also its own mass-counterpart; and relative to this mass-counterpart relation, *W* will represent my laptop as being 2 kgs and everything else as having half the mass in kilograms that they actually have!²³

In this way, the structuralist can make sense of possibilities concerning how my laptop might have differed with respect to its mass in kilograms, answering the second objection. As a result, the structuralist can say that kilogram sentences within the scope of modal operators—including those used in the statement of her view—should be evaluated in this way, answering the third objection. And we just saw that this mass-counterpart theory implies that it is possible for my laptop to have been 4 kgs even while all other things have the same mass in kilograms that they actually have, so that possibility is not evidence in favor of structuralism's competitors *contra* the first objection.

²³I develop this mass-counterpart theory in more detail in Dasgupta [6].

5 On the Very Possibility of Pluralism

Sections 2 and 3 motivated each structuralist view conditional upon an assumption about the fundamental nature of the world: qualitavism in the case of individuals and comparativism in the case of kilograms. Section 4 then responded to objections. For qualitavists and comparativists, this amounts to advice on how to develop their views as well as an argument that there are actual examples of plural grounding. For other theorists, though, I have at best shown that plural grounding is a possibility. Still, even this weaker claim has a significant impact on metaphysics.

For one thing, there is a form of argument that pervades the metaphysics literature but which is invalid if plural grounding is possible. For when philosophers ask whether the moral is grounded in the natural, or whether the mental is grounded in the physical, or whether the nomic is grounded in the categorical, it is not uncommon for someone to argue in the negative by considering a particular moral or mental or nomic fact and showing that it has no ground of the required type. But if plural grounding were a possibility inferences of this form would be invalid, for it would be possible that no mental fact taken alone has a physical ground and yet for them to be plurally grounded in the physical when taken together.

A similar mistake pervades recent discussions of the fundamental. The fundamental facts are those that derivatively ground everything else, and a central question in metaphysics is what the fundamental facts (if any) are. A principle often used to guide that discussion is that a fact is fundamental just in case it has no ground, and with this principle in hand one might naturally argue that a given fact is fundamental by arguing that it has no ground.²⁴ But if plural grounding is a possibility, the principle is false since a fact may have no ground and yet be part of a plurality of facts with a ground, in which case it would be a mistake to call it fundamental. The principle should therefore be restated as stating that a fact is fundamental just in case it is not a member of a plurality with a ground, and if that is the correct principle then in order to argue that a given fact is fundamental it is insufficient to argue that it has no ground.

I therefore take it to be an important project to identify occurrences of these sorts of mistakes in the metaphysics literature. To make a start I will examine one popular argument against qualitavism and show that it is invalid if plural grounding is possible. The first premise of the argument states that it is possible for there to be just two sphere's of iron located 2 miles apart which share all their qualitative properties (they are of exactly the same mass, color, shape, etc). This possibility is often called a Max

²⁴See for example Schaffer [21], who explicitly states and makes use of this principle.

Black world after its first descriptor. The second premise is that the qual-
itavist cannot make sense of this possibility. I will argue that the second
premise is false if plural grounding is possible.

To see this, we need to ask how the second premise is best justified. It
is easy to show that the traditional bundle theorist cannot make sense of
the Max Black world: on that view each sphere is *identical to* the collection
of its qualitative properties, and since both spheres share their qualitative
properties it follows that they are identical. But the bundle theory is only
one kind of qualitavism, so how is the second premise to be justified in
general? One might try to argue that when any qualitavist tries to de-
scribe the Max Black world in qualitative terms, she ends up describing
a world in which there is just one sphere rather than two. But this is not
true, for some qualitavists think that the fundamental qualitative facts are
existentially general facts which can be expressed in predicate logic with
identity but without constants, in which case the Max Black world can be
described as follows:

$$(\exists x)(\exists y)(Fx \ \& \ Fy \ \& \ x \neq y)$$

where 'F' expresses the qualities of each sphere.

Instead, a better justification of the second premise is that in a Max
Black world there would be no way to ground individualistic facts con-
cerning the two spheres in qualitative facts, contrary to the qualitavist's
view. This is close what Adams had in mind when he wrote that

... the clearest way of proving the distinctness of two proper-
ties is usually to find a possible case in which one would be
exemplified without the other. In order to establish the dis-
tinctness of thisnesses [i.e. individualistic properties] from all
suchnesses [i.e. qualitative properties], therefore, one might try
to exhibit possible cases in which two things would possess all
the same suchnesses, but with different thisnesses.²⁵

Label one of the spheres A and the other B. Put in terms of properties,
Adams' observation is that A and B share their qualitative properties and
yet sphere A has the individualistic property of being identical to A while
B does not. This suffices to show that the individualistic property *is distinct
from* any of A's qualitative properties, which was Adams' aim. To argue
that the individualistic property *is not grounded in* any of A's qualitative
properties, we just add the plausible assumption that if a property P is
grounded in property Q, then necessarily anything with Q also has P.

²⁵Adams [1], p. 12

That is the argument put in terms of properties, but let us reconstruct it in terms of facts. Consider the fact that A exists and the fact that B exists. In what might each of these be grounded? Putting the possibility of plural grounds aside, there must be some fact about the distribution of qualitative properties that explains A's existence, and likewise for B. But, one would argue, the qualitative facts that explain A's existence must be different from those that explain B's, else there would be no account of their distinctness. Now, since both spheres have many qualitative properties, one could try saying that A's existence is explained by something's being iron and spherical, and that B's existence is explained by something's being black and hard. But this would be utterly implausible: since A and B share all their qualitative properties, it would be a mystery why being black and hard explains B's existence but not A's. Therefore, nothing qualitative can plausibly be said to ground A's existence and not B's. The argument is therefore slightly different than that which was run against the traditional Bundle Theory. In that case, the Bundle Theory *logically implied* that the spheres were identical, contrary to hypothesis. In this more general case there is no such implication; instead, the charge is now that there is no plausible explanation of their existence.

That is, I believe, the best defense of the second premise. How should qualitivists respond? Interestingly, they almost uniformly grant the second premise and instead deny the first. Thus, the literature is full of qualitivists bending over backwards to show that we may plausibly deny the possibility of a Max Black world. For example, Hacking argues that a Max Black world can be re-described as a world in which there is just one sphere situated in a non-Euclidean space so tightly curved that it is 2 miles from itself.²⁶ And Hawthorne argues that individuals can be multiply located in space, so that the Max Black world can be re-described as a Euclidean world in which a single individual A is located 2 miles from itself.²⁷ There appears to be an implicit assumption, then, that to block the argument the qualitivist must deny that Max Black worlds are possible.

But if plural grounding is possible, the assumption is false. Even if we concede the possibility of Max Black worlds, the above argument for the second premise at best shows that neither A's existence nor B's existence has a qualitative ground on its own. So if plural grounding is possible, it remains open that the individualistic facts in the Max Black world—including A's existence and B's existence—are plurally grounded in the world's qualitative nature in just the way that the structuralist describes. As a result, the qualitivist may concede the possibility of Max

²⁶See Hacking [10].

²⁷See his [15], originally published under the name 'O'Leary-Hawthorne'.

Black worlds and yet deny that they are problematic for her view. Qualitavists should welcome this result, for there are compelling arguments based on plausible assumptions that Max Black worlds are indeed possible (for example, Adams' argument from the possibility of two spheres that are *almost* qualitatively identical). A qualitavist who denies the possibility of Max Black worlds must therefore deny those plausible assumptions, but if plural grounding is possible there is no need for her to do so.

Of course, this is by no means a full defense of qualitavism since there are other arguments to contend with. Still, it is an example of a case in which recognizing the possibility of plural grounding has a significant, and perhaps surprising, impact on an issue in metaphysics. Whether other issues are similarly affected is a question I leave for another time.

6 Conclusion

The recent literature on ground has uniformly assumed what I call a singularist view, according to which any fact that admits of explanation can be explained on its own. The assumption is embodied in the standard logical form of claims about ground which prevent the opposing pluralist view from being formulated. But I have argued that if certain assumptions about the fundamental nature of the world are granted it is plausible that certain facts are grounded plurally, rather than singularly, in the world's underlying nature. I also argued that recognizing the possibility of plural grounds has a significant impact on debates in metaphysics. If this is right, the singularist assumptions pervading the recent literature on ground need to be reconsidered.²⁸

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