

Grounding the Unreal

[Forthcoming in *Philosophy and Phenomenological Research*]

Louis deRosset

February 2, 2017

Abstract

The scientific successes of the last 400 years strongly suggest a picture on which our scientific theories exhibit a layered structure of dependence and determination. Economics is dependent on and determined by psychology; psychology in its turn is, plausibly, dependent on and determined by biology; and so it goes. It is tempting to explain this layered structure of dependence and determination among our theories by appeal to a corresponding layered structure of dependence and determination among the entities putatively treated by those theories. In this paper, I argue that we can resist this temptation: we can explain the sense in which, *e.g.*, the biological truths are dependent on and determined by chemical truths without appealing to properly biological or chemical entities. This opens the door to a view on which, though there are more truths than just the purely physical truths, there are no entities, states, or properties other than the purely physical entities, states, and properties. I argue that some familiar strategies to explicate the idea of a layered structure of theories by appeal to reduction, ground, and truthmaking encounter difficulties. I then show how these difficulties point the way to a more satisfactory treatment which appeals to something very close to the notion of ground. Finally, I show how this treatment provides a theoretical setting in which we might fruitfully frame debates about which entities there really are.

The scientific successes of the last 400 years strongly suggest a picture on which our scientific theories exhibit a layered structure of dependence and determination. Economics is dependent on and determined by psychology; psychology in its turn is, plausibly, dependent on and determined by biology; and so it goes. This chain of dependence and determination may terminate in the microphysical. It may terminate instead in a theory of the entirety of the concrete cosmos.

Or, it may not terminate at all. The details of the story concerning whether and where things bottom out does not affect the plausibility of the claim that we find layered structure higher up.

A notion of relative fundamentality corresponds to this idea of a layered structure of dependence and determination. Biology, plausibly, depends on and is determined by chemistry. In just that sense, biology is less fundamental than chemistry. Relative fundamentality of this sort is transitive. If biology depends on and is determined by chemistry, and chemistry depends on and is determined by physics, then biology depends on and is determined by physics. The fundamentality ordering is asymmetric. If biology is more fundamental than psychology, then psychology is not also more fundamental than biology. So, relative fundamentality of this sort is an ordering relation.

It is possible to take the metaphor of layers too far. A layer of an ordinary cake is always either above or below any other layer.¹ The metaphor thereby suggests a picture according to which relative fundamentality is a strict linear order on theories, so that any two (distinct) theories are comparable with respect to which is more fundamental. This implication is implausible in some cases. Is geology more or less fundamental than molecular biology? It's hard to see how there could be an answer to this question, assuming that our conception of the final shapes of these theories is more or less on track. But it's also hard to see why the plausibility of the underlying idea of layered structure requires that there be an answer. We seem to have, at most, a partial ordering on theories. Perhaps we should talk about the branches of a bush, then, rather than the layers of a cake. The history of the discussion, however, centers on the metaphor of layers. I am content to continue this tradition, so long as we hold the limitations of the metaphor firmly in mind.

The plausibility of the idea of a layered structure of theories does not rest on any particular verdict concerning the relations of dependence and determination among particular theories. For instance, the question of whether psychology is determined by and dependent on biology is highly controversial. This question recognizably implicates the mind-body problem. To my mind, the verdict has not yet come in. So, the question of whether biology or, more pointedly, physics is more fundamental than psychology is very much unsettled. We shouldn't

¹There are more exotic cakes where the layers are not linearly ordered. An upshot of an argument below is that the structure of these exotic cakes is a better model for the structure of relative fundamentality among theories.

conclude on that basis, however, that the very idea of a fundamentality order on theories is misguided. The claim, for instance, that biology depends on and is determined by chemistry is plausible even if some form of Cartesian dualism turns out to be correct.

Let's take for granted, then, the claim that our theories exhibit layered structure. To simplify our discussion, let's also assume that the layered structure of theories bottoms out in final physics,² that final chemistry is less fundamental than final physics, and that final biology is less fundamental than final chemistry. This structure involves, in the first instance, relations among our theories. When we get down to the details concerning how our theories depend on and determine one another, however, it is tempting to explain these relations by appeal to a similar structure on the domains of entities that correspond to our theories. For instance, when we attempt to describe in detail how psychology is supposed to depend on and be determined by biology, it is tempting to say something like the following:

- each psychological property is realized by some biological property [Shoemaker, 2007];
- each psychological property is a determinable, of which some biological property is a determinate [Yablo, 1992], [Wilson, 2009];
- each token psychological state is constituted by some biological state [Pereboom, 2011]; or
- each psychological state is grounded in some biological state. [Rosen, 2010]

On such explications, there is apparently a layered structure in reality – in this case a layered structure of psychological and biological properties or states – corresponding to the layered structure of psychological and biological theories.

The question that will occupy me here is whether and how we might offer a less committal account of the layered structure of theories. Is it possible to deny that there is a layered structure in reality corresponding to the layered

²This assumption is in principle dispensable: the theory of layered structure I will be exploring is entirely neutral on what the content of the layers might be. It is consistent with finding physics at the fundamental layer, but also with finding there both physics and psychology, psychology alone, theology, or something as-yet undreamt of. It is even consistent with there being no fundamental layer. Also, I won't be worrying about a famous problem that attends this assumption, that there seems to be no satisfactory way of delineating physical theories so that we can be confident that final physics, which presumably deploys different primitives than does actually existing physics, counts as physical; see [Smart, 1978].

structure of our theories? To focus our discussion, I will assume that the *facts* that might be reported by the sentences of a theory are the aspects of reality that exhibit any layered structure we may find. On this assumption, we are wondering whether accommodating the layered structure of theories commits us to a corresponding layered structure of facts. Two points are worth noting. First, it is important to keep in mind that the focus on facts is a mere expository expedient. The discussion could be carried out *mutatis mutandis* with the assumption that we are out to deny that there are any properly biological individuals (*e.g.*, genes, phyla, clades, viruses, and epidemics) while affirming that there are biological truths that appear to refer to them. So, even those who would eschew appeal to facts altogether still face analogues of the questions treated here. Second, the notion of “fact” with which I will work is metaphysically thick: every fact in this sense is a part of reality.³ So, our question will be whether we can have a layered structure of theories without a corresponding layered structure of facts. For instance, is there any way of making sense of the idea that the truth of our best biological theory is dependent on and determined by the truth of our best chemical theory, without also claiming that there are properly biological facts that are dependent on and determined by the properly chemical facts?⁴ I will argue that there is a way, though it appeals to some unfamiliar resources.

Before diving in, however, a word about what I seek to show is in order. You will look in vain in this paper for arguments in favor of the idea that, *e.g.*, the truth of our biological theories is dependent on and determined by

³Here I deploy the notion of “Reality as it is in itself” defended in [Fine, 2001, p. 25]. I also follow [Fine, 2012a, p. 7] in thinking of facts in my sense as being part of or “constitutive of” that reality. Thus the sentences that correspond to “facts” in the sense I intend here will be those that express propositions that are “true in reality” in the favored terminology of [Fine, 2001]. There is, as Fine notes [2001, p. 2], a metaphysically thin use of ‘fact’ in ordinary English on which *P* entails ‘It is a fact that *P*.’ The notion of “fact” I am deploying in the paper is not expressed by this metaphysically thin use. Thanks to Martin Glazier and Jon Erling Litland for independently stressing the need for this clarification.

⁴We have assumed that biology is dependent on and determined, ultimately, by physics. Given this assumption, a fact is *properly* biological (chemical, *etc.*) just in case it is expressed by some biological (chemical, *etc.*) truth, but is not expressed by any physical truth. Thus, the view I aim to describe is consistent with there being some facts that are dependent on and determined by other facts, so long as they are all physical facts. So, for instance, facts expressed by a purely physical conjunction might be dependent on and determined by facts expressed by its conjuncts. The view I describe below relies on the idea that purely physical reality has some hierarchical structure; see §4 below. It is natural to think that this is a structure of dependence and determination. So, the view I describe below may not accommodate the idea that there is no structure of dependence and determination whatsoever among constituents of reality.

the truth of chemical theories even though there are no properly biological or chemical facts. I come, not to praise such a conciliatory irrealist view, but to describe it. The development of such a view is of interest, of course, to both defenders [Cameron, 2010] [Sider, 2011] [Williams, 2012] and critics. But the results should also have independent interest. My principal aim here is methodological: I hope to develop a conciliatory irrealist view in enough detail that we can discern some of its characteristic commitments. I argue in the last section that this facilitates the assessment of claims that there are truths of a given sort but no corresponding entities. Thus, the proposal should interest not only theorists who are attracted or opposed to the sort of view I will develop, but also those bemused fence-sitters who don't see how it could be resolved.

I will work up to my proposal by reviewing some problems that afflict the more familiar strategies. In addition to motivating the search for an alternative strategy, these considerations will help us focus our inquiry by more clearly specifying the sort of view I aim to describe.

1 Reduction

Our question is whether we can make sense of the idea of a layered structure of theories without appealing to a corresponding layered structure of facts. As an historical matter, the idea that there is a layered structure of theories was introduced by reductionists [Oppenheim and Putnam, 1958], and it is not surprising that reductionism about the theories in question paves the way to an affirmative answer. The explication of the notion of *reduction* is hotly contested. For present purposes, I will skirt the controversy by resorting to stipulation. Reduction of the sort I have in mind involves the identification of facts. For instance, if our best biological theory is reducible to our best chemical theory, then every truth in the language of the biological theory states a fact also stated by some truth in the language of the chemical theory. So, reducibility implies that, for every biological truth B there is a chemical truth C such that the fact that B = the fact that C .⁵ We can express the idea more naturally and succinctly by

⁵Readers may notice some use-mention confusion in this formulation. Generally, I will indulge in use-mention sloppiness except where there is danger of confusion. In the present case, I intend the claim schematically: for every true biological sentence ϕ there is a true chemical sentence ψ such that the relevant instance of the schema 'the fact that ϕ = the fact that ψ ' is true.

quantifying over facts: every biological fact is identical to some chemical fact. Call this sort of reduction *identity reduction*.

Identity reduction allows us to make sense of the idea of a layered structure of theories without appealing to a corresponding layered structure of facts. Suppose that the best biological theory is reducible to the best chemical theory, which is in turn reducible to the best physical theory. Then all of the biological claims state facts, but the facts they state are just plain old physical facts. A specification of the truths of final physics in a purely physical language is, on this view, a specification of all of the facts. On the view in question, there simply are no further facts dependent on and determined by these.⁶ The *world* is flat, even though our *theories* of it are layered.

There are, however, some well-known objections to proposed identity reductions, on the grounds of *multiple realizability*. The idea is that two sentences express the same fact only if they are co-intensional, and that there are good reasons to deny that, for instance, ‘Something is alive’ is co-intensional with any chemical truth. In particular, there is reason to believe that *being alive* could have been realized in chemically alien ways. For instance, it seems possible that recognizable macroscopic biological processes of nutrition and growth, metabolism, respiration, excretion, *etc.*, could have been realized in a chemistry of homeomerous elemental substances – earth, air, fire, and water, perhaps. I will be assuming for the remainder of the paper that these multiple realizability arguments are sound, and that the biological truths are not co-intensional with any truth of final physics. I propose, then, to set identity reduction to the side for the rest of the paper. Those who reject anti-reductive arguments may take the remainder of the paper to constitute a development of the views of their opposition.

Our discussion of identity reduction strongly suggests a model for the relation between final physics and the less fundamental theories that depend on and are determined by it. The consideration of alien realizers of *being alive* suggests that we identify the truth ‘something is alive’ with the disjunction of sentences stating all of its possible realizers. At the very least, we might think that the biological truth depends on and is determined by the purely physical truth that expresses its actual realizer in something like the way a typical disjunctive truth

⁶On this reductive view there are still relations of dependence and determination among the purely physical facts. See the discussion of this feature of identity reduction in §4.5 below.

depends on and is determined by its true disjuncts.⁷

Consider, then, the relation between the disjunctive truth ‘either Judy Thomson is a philosopher or Michelle Obama is’ and its true disjunct ‘Judy Thomson is a philosopher.’ (I am assuming that Michelle Obama is not a philosopher.) It is plausible to think that the disjunctive truth depends on and is determined by its true disjunct. But, assuming the disjunctive truth expresses a fact, the fact it expresses cannot plausibly be identified with the fact expressed by its true disjunct. The truth of the disjunction could have been “realized” by another fact, if Obama rather than Thomson had chosen philosophy as a vocation. In general, no identity reduction of disjunctions to their true disjuncts is plausible. Applied to this model, then, our question is whether we can explicate the idea that disjunctive truths depend on and are determined by their true disjuncts without appealing to disjunctive facts.

Reflection on this model for our problem yields an important upshot for the remainder of our discussion. The key premise in our example of a multiple realizability argument is that no physical truth is co-intensional with ‘something is alive’. If this premise is true, it also rules out any explication of the sense in which final biology depends on and is determined by final physics that requires a biconditional necessitation relation. If the truth ‘something is alive’ bears a relation of dependence and determination to some truth P of final physics, that relation does not consist even in part in the truth of a modally necessary biconditional of the form

- (1) Something is alive iff P .

The physical truth P nevertheless determines that something is alive, strongly suggesting instead that the conditional

- (2) Something is alive if P

is necessarily true. Similarly, it would be wildly implausible to take the relation of dependence and determination between the truth ‘Either Judy Thomson is a philosopher or Michelle Obama is’ and its true disjunct to consist even in part in the necessity of:

- (3) Either Judy Thomson is a philosopher or Michelle Obama is iff Thomson is a philosopher.

⁷Thanks to an anonymous referee for suggesting this way of making the analogy between properly biological truths and disjunctions explicit.

Instead, the determination takes a *merely conditional* form:

- (4) Either Judy Thomson is a philosopher or Michelle Obama is if Thomson is a philosopher.⁸

2 Ground

So, we have set identity reduction to the side. We need to make sense of the idea that, *e.g.*, final biology depends on and is determined by final physics, but that all of the *facts* are physical facts. A first step is to get clear on the nature of the relation of dependence and determination. Recent enthusiasm for the notion of *ground* is motivated by the potential of this notion for making sense of this sort of dependence and determination. There are many different relations of dependence and determination. Causal relations, for instance, are relations between, say, an event and some entities on which it causally depends and by which it is causally determined. Similarly, supervenience relations are relations between the supervenient and some entities on which it modally depends and by which it is modally determined.

But, it has been argued,⁹ there is another relation of dependence and determination, which corresponds to a certain sort of explanation marked by the locution “in virtue of.” Philosophers are fond of asking for explanations of this sort. Ethicists wonder what it is in virtue of which Oswald’s assassination of Kennedy was morally wrong. Epistemologists wonder what it is in virtue of which I am justified in believing that I have hands. Some metaphysicians ask what it is in virtue of which a statue cannot survive being squashed into a ball.

⁸I borrow the distinction between biconditional and merely conditional forms of determination from [Sider, 2011]. Sider’s account of the relations of dependence and determination among final biology, final chemistry, and final physics requires the possibility of a *metaphysical semantics*. A metaphysical semantics for ‘Something is alive’ might take the form of a biconditional truth condition like (1). Insofar as the proposed truth condition accurately captures the use of ‘Something is alive’ to characterize non-actual possibilities, a metaphysical semantics will require a modally necessary biconditional relation of determination. Multiple realizability arguments thus pose a challenge to a Sider-style account; a version of this objection to Sider is pressed by [Schaffer, 2013]. Sider acknowledges the force of the challenge and briefly sketches a response in [Sider, 2013, pp. 768-9]. His response there is to deny that the biconditional determination relation corresponding to (1) requires modal equivalence, and thereby reject one of the premises of the sort of multiple realizability argument in play. So, in assuming the soundness of multiple realizability arguments of this sort, I in effect assume that proposals appealing to biconditional determination relations, including Sider’s proposal, are off the table.

⁹See [Audi, 2012], [Correia, 2010], [deRosset, 2010, 2011, 2013], [Fine, 2001], [Rosen, 2010], [Schaffer, 2009], and [Trogon, 2009].

Explanations of this sort are not confined, however, to philosophy. They also appear in the natural sciences. According to chemists, alcohol is miscible in water partly in virtue of containing a hydroxide group. Physicists even now are wondering what it is in virtue of which gravity is so weak by comparison to the electromagnetic, weak, and strong nuclear interactions.

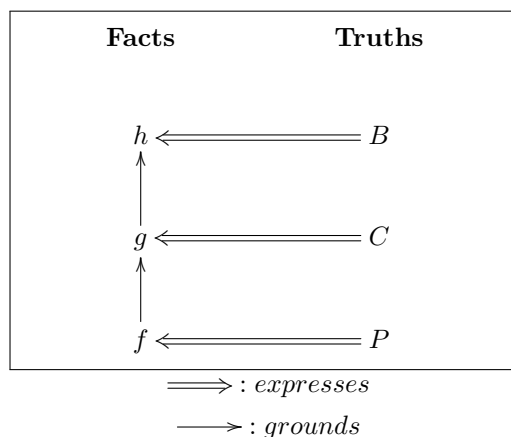
Determining what grounds what is often difficult. The philosophical and scientific questions that ask after ground are among the hardest questions we face. But there are also easy cases. For instance, it is highly plausible to think that either Thomson is a philosopher or Obama is in virtue of the fact that Thomson is a philosopher. Similarly, it is highly plausible to think that both Thomson and Obama are successful in virtue of two facts: that Thomson is successful, and that Obama is successful. (This last case illustrates the idea that the ‘in virtue of’ operator that we use to express ground may take more than one sentence in its *explanans* place.)¹⁰ What’s more, some cases of ground appear easy to recognize even when we’re not dealing with cases of explanatory logical relations. For instance, in what, perhaps, is historically the first attempt to discern a relation of ground from other relations of dependence and determination, Aristotle argues (*Categories*, 14b9-22) that the claim expressed by ‘There is a human being’ is true in virtue of the fact that there is a human being, and not *vice versa*, despite the fact that, as a matter of necessity, the claim is true iff there is a human being.¹¹

One might hope, then, to characterize the relation of dependence and determination that yields a layered structure of theories in terms of ground. On this view, final biology is grounded in final chemistry, which is grounded, in turn, in final physics. The problem with this proposal should be obvious. It is most natural to think of ground, like causation, as in the first instance a relation of dependence and determination among non-representational entities. What *causally explains*, say, the occurrence of an explosion are some facts involving fuses, blasting caps, TNT, oxidation, and the like. Similarly, what *grounds* the occurrence of that explosion will presumably be some facts involving a sudden release of heat, air compression, the disintegration of some rock into dust, and the like. The truth of sentences or theories just isn’t relevant. To a first approximation, then, *facts* are grounded in congeries of other *facts*. And, as

¹⁰See, for instance, [Fine, 2012b], [Rosen, 2010], and [Correia, 2010].

¹¹See [Corkum, 2008], [Sirkel, Manuscript]. Thanks to Riin Sirkel for pointing me to this passage.

Aristotle argued, it is most natural to think of the truth of claims in typical cases as grounded in the facts concerning extra-linguistic matters. To get a relation of dependence and determination among theories, one would need to say something along these lines: that final biology depends on and is determined by final physics in the sense that the facts expressed by the truths of the former theory are each grounded in some facts expressed by the truths of the latter. This yields something like the following picture, in which B , C , and P are the relevant biological, chemical, and physical truths, and f , g and h are the facts expressed by those truths.



As the picture illustrates, this view manifestly fails to explicate the layered structure of theories without appealing to a corresponding layered structure of facts.

Many theorists of ground have eschewed appeal to an ontology of facts, contending that we should formalize our theory of ground by appeal to sentential operators which do not pick out any relation, and whose arguments, semantically speaking, do not pick out entities [Correia, 2010], [Fine, 2001, p. 16]. One might hope that this view escapes the difficulty, since these theorists do not accept that facts are grounded in congeries of facts. Recall, however, that our choice to couch matters in terms of facts was a mere expository convenience. As a result, even those who would use a non-relational operator to regiment their theory of ground still face essentially the same problem. Grounding claims stated using operators still impute relations between entities which aren't facts: for instance, if $\{\text{Socrates}\}$ exists in virtue of Socrates' existing, then the relation x *exists in virtue of* y 's *existing* obtains between $\{\text{Socrates}\}$ and its member. Similarly,

using grounding to capture the dependence and determination of the biological truth ‘the terminator gene renders seeds sterile’ on circumstances involving certain molecules appears to require the existence of properly biological entities, including that gene. Similar remarks apply to those who claim that grounding relates entities other than facts [Schaffer, 2009].

So, the traditional notion of ground will not serve our purposes. Metaphysical explanations marked by the ‘in virtue of’ locution appear to presuppose the existence of facts or other entities corresponding to the *explanandum*. Ground, traditionally conceived, is a relation of dependence and determination *among entities*.¹²

The apparent unsuitability of ground for the task of explicating the idea of a layered structure of theories without a layered structure of entities is discomfiting. It seems as if something that is in many respects like the notion of ground is needed to explicate the idea of a layered structure of theories. We need a notion that explicates the idea that one truth is “less fundamental” than another. Because this relation is transitive, we need a transitive notion. It is plausible to think that the operator for ground is transitive: if ϕ obtains in virtue of ψ and ψ obtains in virtue of χ , then ϕ obtains in virtue of χ . Similarly, we need a relation that is asymmetric in the relevant cases to vindicate the idea that the layers represent an ordering, from more fundamental to less fundamental. Again, ground fits the bill, since, if ϕ obtains in virtue of ψ , then ψ does not return the favor.¹³ So, the notion of ground has the *formal* features we need.¹⁴ It also has some of the *material* features we need. What we aim to characterize is a relation of dependence and determination: intuitively, we are looking for a specification of where in final physics the truths of biology “come from”, and what in final physics makes them true. A specification of the grounds of a given fact is a specification of that in virtue of which that fact obtains. This would

¹²Fine [2001] proposes a framework on which propositions that aren’t true in reality are grounded in propositions that are. In the terminology I am deploying here (see n. 3), this amounts to the claim that propositions that do not express facts are grounded in propositions that do. Thus, the prima facie puzzle about how this could be applies to Fine’s view. The proposal I sketch in §4.3 below thus amounts to an elaboration of Fine’s view which solves this puzzle.

¹³There are dissenters from both of these plausible views on the nature of ground. Schaffer [2012] contends that partial ground is not transitive. Della Rocca [2010] contends that ground is not asymmetric, and Jenkins [2011] develops a sophisticated view that is consistent with there being symmetric relations of ground among facts.

¹⁴It is not completely trivial to characterize the transitivity and asymmetry of ground, given that it is a many-one operator. See [deRosset, 2014] for an axiomatization that builds on Fine’s [2012a].

appear to provide us with exactly the the sort of explanation we need. What's more, as the example concerning the ground of

- (5) Either Judy Thomson is a philosopher or Michelle Obama is

illustrates, the determination relation indicated by true grounding claims takes a merely conditional form. So, the traditional notion of ground is poised to deliver an ordering on the layers that provides the right sort of explanation, and does not run afoul of multiple realizability arguments. Too bad it's unsuitable. Another idea is needed.

3 Truthmaking

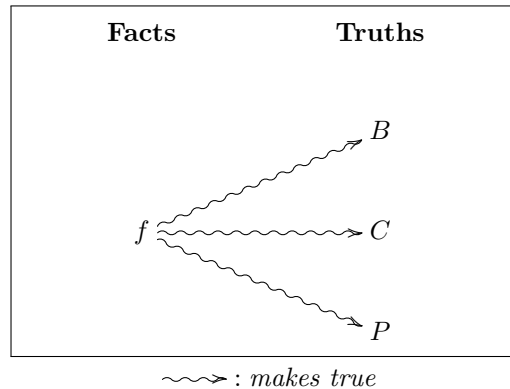
The notion of ground has the right formal and material features to underwrite the layered structure of theories. But understanding that layered structure in terms of ground appears to commit us to a corresponding layered structure of facts. What we want is some relation of dependence and determination on which a flat realm of facts can give rise to a rich, layered structure of truths. The notion of *truthmaking* appears well-suited to this task.¹⁵ The truthmakers for a given truth are the facts on which it depends and by which it is determined.¹⁶ There is a great deal of dispute about exactly how to understand the notion of truthmaking. I will make no attempt to resolve this dispute here. I will simply assume that truthmaking is a relation of dependence and determination.¹⁷

¹⁵See [Armstrong, 1997] for a classic exposition of the notion of truthmaking. See [Beebe and Dodd, 2005] for contemporary discussion, and [Cameron, 2010] for an explicit attempt to reconcile a sparse ontology, containing, perhaps, only physical facts, with the rich panoply of physical, chemical, biological, *etc.*, truths.

¹⁶Here I assume that the truthmakers are facts. Some truthmaker theorists contend that truthmakers are some other sort of thing; see [Mulligan et al., 1984] for a classic example. The discussion in this section could easily be amended to accommodate alternative views concerning the nature of truthmakers. Also, as we shall see, truthmaker theorists allow that many facts may (collectively) make a given claim true. For this reason, I assume below that congeries of facts serve in the first instance as truthmakers.

¹⁷Some truthmaker theorists explain truthmaking in terms of grounding. See [Liggins, 2012] for an exposition of the idea. Liggins, however, appears to have a narrower conception of truthmaking than is needed for present purposes. On Liggins's conception, an electron *e*'s being negatively charged may fail to be a truthmaker for '*e* is negatively charged' even if the latter is true in virtue of the former; see [Liggins, 2012, pp. 266, 267]. On the present conception of truthmaking, by contrast, something is a truthmaker for a given claim iff it is an entity which is part of reality and the truth of the claim depends on and is determined by it or by its existence, obtaining, occurrence, *etc.* So, nothing in this conception requires that in such a case *e*'s being negatively charged does not count as a truthmaker for '*e* is negatively charged.'

Truthmaking has the right features to explain the rich panoply of truths while keeping the ontology of facts sparse and flat. We have assumed that the truths of final physics express facts, and that those facts make the physical truths true. But the physical facts will also serve as truthmakers for the truths of final chemistry, biology, *etc.* We don't appear to need to appeal to biological facts, for instance, to specify those facts in virtue of which 'something is alive' is true. Some specification, we might imagine, of the arrangement and behavior of certain elementary particles offers a complete description of the facts which make 'you move, metabolize, sleep, digest, *etc.*' true; thus, in your case the arrangement and behavior of those particles makes 'something is alive' true. The proposal yields something like the following picture, in which B , C , and P are the relevant biological, chemical, and physical truths, and f is the relevant physical fact.



As the picture illustrates, the truthmaker theorist seems not to need any non-physical facts to serve as truthmakers for the non-physical truths.

What's more, the truthmaker theorist may hold that truthmaking is a relation of dependence and determination that takes a merely conditional form. Consider again the truth

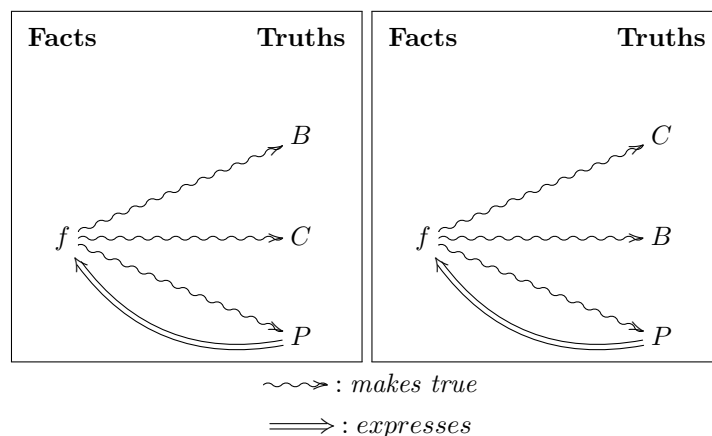
- (5) Either Judy Thomson is a philosopher or Michelle Obama is.

The facts that make this true, according to truthmaker theorists, are just those facts that make its true disjunct true. We don't need to specify necessary and sufficient conditions for the truth of a disjunction in order to say what makes it true. Similarly, we don't need to specify necessary and sufficient conditions for the truth of a biological claim in physical terms in order to say which physical

facts make it true. So, appealing to truthmaking need not run afoul of multiple realizability arguments.

Despite these considerable virtues, appeal to truthmaking seems not to suit our purposes. Truthmaking is admirably adapted to allowing that there is no layered structure of facts. The problem is that truthmaking appears to have the wrong features for underwriting the idea of a layered structure of theories. Truthmaking relates facts, thought of as elements of extra-representational reality, to sentences, claims, propositions, or other truth-apt representational entities. So, there is no truthmaking relation between, say, the truths of final physics and the truths of final biology. In this case, the truthmaker theorist may hope to appeal to the facts reported by the relevant truths of final physics. There is, we are supposing, this relation between certain truths P_0, P_1, P_2, \dots of final physics and the biological truth ‘something is alive’: there are facts expressed by P_0, P_1, P_2, \dots , and those facts are (collectively) truthmakers for ‘something is alive’. Thus, we can compose the relation between a truth and a fact it expresses with the truthmaking relation to specify a relation *among* truths.

But this expedient is available only in the special case in which the truths in the lower layer also express facts. We want to capture, not just the relation of dependence and determination between final chemistry and final physics, final biology and final physics, *etc.*, but also between final biology and final chemistry. Part and parcel of the idea of a layered structure of theories is that there are relations of dependence and determination among the non-fundamental theories. Biology is not fundamental; in this respect it is like chemistry. Biology is also *less fundamental* than chemistry; in this respect it is unlike chemistry. The proposal in question will not help us capture relations of relative fundamentality among truths that fail to express facts. To illustrate, consider these two pictures.



The only difference between them is that B and C have switched positions. The proposal on offer is consistent with both; if we hoped to represent the relation of relative fundamentality between B and C by their stacking order, then we will have to appeal to more resources than the truthmaker theorist has so far provided. As the pictures illustrate, no asymmetric relation of dependence and determination between the biological truth B and the chemical truth C is in evidence.

The fundamental challenge for the truthmaker theorist posed by these considerations is to somehow capture the compelling impression that final chemistry *explains* final biology. The truthmaker-based view depicted above offers no asymmetric relation of dependence and determination among the truths of final biology and final chemistry that might underwrite this impression.¹⁸

So, both the truthmaker-based and the ground-based proposals face difficulties. These difficulties motivate a search for another idea. What I hope to show now is that we don't have far to search. We already have the makings of a workable alternative on the table.

4 Grounding the Unreal

Here's where we are. The notion of ground has the right formal and material features to capture the layered structure of theories. But it does so by positing a corresponding layered structure of facts. Truthmaking is well-suited to a sparse and flat ontology of facts, but lacks the right formal and material features to capture the rich layered structure of theories. We would like some way to stitch

¹⁸Thanks to an anonymous referee for suggesting this formulation of the challenge.

together ground and truthmaking so that the result has the formal and material features of ground, but relies only on a sparse and flat ontology of facts. Can we do it?

Yes we can. The key is showing how the formal and material features of the ground-based approach can be simulated by appeal to resources countenanced by the truthmaking approach. Showing that this simulation is possible requires that we get a little clearer about the metaphysics of ground and the notions ingredient in the truthmaker-based approach. That's where I will start. The next step is using these resources to specify the elements of the simulation. This is where we stitch together ground and truthmaking. The third step will be arguing that the simulation is successful, so that the resulting view can accommodate a layered structure of theories without a corresponding layered structure of facts.

4.1 The Elements of the Metaphysics of Ground

I am going to show in detail how to simulate the ground-based approach without committing ourselves to properly chemical or biological facts. This is most easily achieved by boiling down the metaphysics of ground sketched in §2 to a few, very simple ingredients. That discussion suggests a picture of how ground structures the facts.¹⁹ Consider a fact f that has a ground. We can trace the relation of dependence and determination between f and any congeries of facts which are its immediate grounds. Because relations of ground are transitive, we can chain those relations together. So, each of f 's immediate grounds may be linked to further grounds for f , and so on. The structure we have just described is a tree, with f at the top, unmediated grounds for f a level below, their unmediated grounds a level further below, and so on. Call a tree of this sort a *grounding tree*. On this picture, the facts are structured by relations of ground into a *forest* – a bunch of grounding trees. The facts at the bottom of any grounding tree for f are (collectively) grounds for f , with the intervening links tracing mediators for that relation of ground.

This picture draws on two metaphysical ideas. First, it presupposes that there are facts. Our discussion has shared this presupposition from the very beginning. Second, it presupposes that there is a relation of *direct* 'in virtue of' explanation, which corresponds to the direct links between facts in a grounding

¹⁹This picture is adapted from [Rosen, 2010] and [Schaffer, 2009].

tree. Directly below f in any of its grounding trees are facts which, together, are an *unmediated ground* of f . A *mediated ground* for f is a congeries of facts that explains f (in the relevant way) because it explains some other facts that explain f . Unmediated grounds for f need take no such explanatory detour. To illustrate, it is plausible to think that

(6) Michelle Obama is successful

and

(7) Judy Thomson is successful

are, together, an unmediated ground for

(8) Both Obama and Thomson are successful.

On the other hand, if the fact expressed by

(9) My jacket has a mass greater than one gram

obtains in virtue of the antics of quarks and leptons, then those microphysical facts provide only a mediated ground for the fact involving the mass of my jacket. The facts concerning the arrangement of quarks and leptons are those in virtue of which my jacket has a mass greater than one gram because they ground, say, the existence and features of the molecules that make my jacket up.

With the domain of facts and the relation of unmediated ground in hand, we can explicitly delineate the domain of grounding trees.²⁰ It is this structure – the facts arrayed into a forest of grounding trees corresponding to explanatory relations among truths – that I will be simulating. The simulation will proceed by specifying simulacra for both elements of the metaphysics of ground: (i) the *facts* that, according to the ground-based approach, are expressed by, say, properly chemical and biological truths; and (ii) the relations of *unmediated ground* that, according to the ground-based approach, link those facts.

4.2 The Elements of the Metaphysics of Truthmaking

Consider again the biological truth

²⁰See [deRosset, 2014] for a formal statement of the principles in play here, together with a semantics for claims of ground.

(10) Something is alive.

On our assumptions, the sort of view suggested by the truthmaker-based approach sketched in §3 holds that there isn't really any fact corresponding to this biological truth. There are just the facts reported by certain purely physical claims, and those physical facts collectively make (10) true without grounding any further fact stated by (10). More generally, on the sort of view we are exploring, there are some facts; those facts might be expressed by appropriate claims; but there are truths that don't express new facts, but somehow are made true by congeries of the old facts. Biological truths like (10) are supposed to provide an example. The idea here is that every biological *truth* is made true by whatever makes its chemical and physical basis true, but the whole truth about biological *facts* is: there aren't any.

This view appeals to two metaphysical ideas. First, it appeals to a domain of facts. Second, it assumes that these facts can be grouped together into "congeries," and that a congeries of facts may do truthmaking work.²¹ The view also appeals to a semantic notion: truthmaking. Putting these ideas together, we get the claim that some congeries of facts makes (10) true, even though (10) expresses no fact.

So, here are our raw materials:

1. a domain of facts;
2. congeries of those facts;
3. a many-one, transitive, irreflexive relation of dependence and determination among facts: *ground*; and
4. a relation of dependence and determination between congeries and truths: *truthmaking*.

These are the materials we need to seamlessly capture the idea that there is a layered structure of theories but no corresponding layered structure of facts.

²¹The commitment to congeries is a central feature of the view I sketch. I will be representing congeries set-theoretically. For stylistic reasons, I also will sometimes drop mention of congeries, and say that certain facts themselves are doing truthmaking work. See §4.5 below for a discussion of what the commitment to congeries comes to on the approach I suggest.

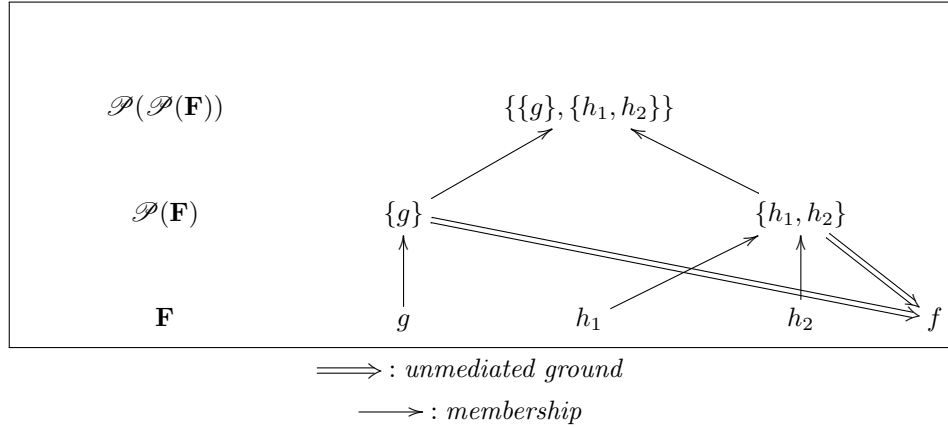
4.3 Ground (or near enough) without facts

How shall we put together our assembled raw materials to capture the idea of a layered structure of theories without a corresponding layered structure of entities? As in §§2 and 4.1, in what follows I will offer a somewhat informal exposition of a formally specifiable framework. It will turn out to be a framework in which we can specify simulacra for the forest of grounding trees which the grounding theorist uses to explicate the idea of a layered structure of theories. The formal framework enables us to prove results that form the basis of an argument for the adequacy of the resulting simulation. The difficulty of the details, then, is warranted in the end by the clarity of the framework and the firmness of the results. There are also additional payoffs explored in §5 below.

Suppose we are given a domain of facts F , and the relation R of unmediated ground on those facts. F just contains facts, not what above I called “congeries” of facts. To represent congeries of facts, we’ll need to extend our domain.

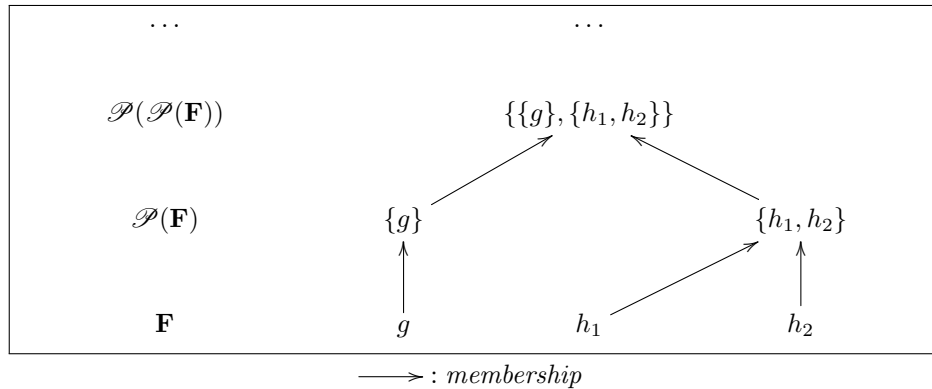
How should we extend the domain to incorporate congeries? Before directly addressing that question, I will make a technical remark central to my specification of the simulation. Notice that R is a many-one relation: it relates subsets of F to members of F . Suppose, for instance, that a fact g is one unmediated ground of f , the two facts h_1, h_2 are (collectively) another, and there is no third.²² Then R relates two subsets of $F - \{g\}$ and $\{h_1, h_2\}$ – to the fact f . So, R implicitly associates with f a set of subsets of F : $\{\{g\}, \{h_1, h_2\}\}$. The same goes for every other fact in our domain of facts F . This picture represents the situation.

²²If Fine’s [2012a] principle of amalgamation is true, then there will be a third ground: the three facts g, h_1 , and h_2 taken together. For concreteness, we might imagine for now that f is a fact stated by ‘ $(G \vee (H_1 \wedge H_2))$ ’, where each of the sentence letters states the fact represented in the main text by the corresponding lower-case letter. See §5 below for some complications.



The technical remark is, then, this: for any fact f that has a ground, the relation R of unmediated ground determines a higher-level correlate of f . For instance, in the situation depicted above, $\{\{g\}, \{h_1, h_2\}\}$ is the correlate of f .

The presence of a higher-level correlate for each fact in our original domain of facts enables the specification of simulacra of facts for, *e.g.*, properly chemical truths. Suppose that we didn't want to admit a properly chemical fact f into our domain of facts, but simply wanted to say that a certain chemical *truth* ϕ was made true by certain congeries of members of F , including g and (collectively) h_1 and h_2 . It is now easy to see how we might get what we want. We can just remove f from our old picture to yield a new one:



Now, the congeries of all congeries of facts that make ϕ true goes proxy for the missing fact f . As the dots at the top of the diagram indicate, the idea obviously generalizes to yield congeries of congeries, congeries of congeries of congeries, and so on. The extension of the domain to include congeries can thus be given

recursively. Call the result of extending our domain to include congeries the *constructive extension* of the domain.²³

With the specification of a constructive extension of a domain of facts in hand, we can now treat truths as having two different kinds of semantic value in our framework. Some truths, perhaps, express facts. Semantic values for those truths will just be the facts they express. Other truths do not express facts, but are made true by one or more congeries of facts. Semantic values for those truths will comprise all of the congeries of facts that make them true.

We complete the sketch by extending R to take account of unmediated relations of dependence and determination among congeries of facts. Consider a situation in which we need to add to our domain of facts a new fact f whose unmediated grounds are $\{g\}$ and the pair $\{h_1, h_2\}$. Let's imagine for the moment that f is the fact expressed by

(10) Something is alive.

By our assumption that (10) expresses f , it's clear how to extend R to a relation R^+ which relates each of $\{g\}$ and $\{h_1, h_2\}$ to f . But now suppose instead that (10) is true but expresses no further fact. It might seem that there is no way to extend R , since there is nothing to which an extension R^+ might relate each of the erstwhile grounds $\{g\}$ and $\{h_1, h_2\}$. But there is something, if only we look in the right place. We have, in our constructive extension of the domain of facts, the congeries of facts represented by $\{\{g\}, \{h_1, h_2\}\}$: this congeries comprises each of the truthmakers for (10) and is our simulacrum for the missing biological fact f . Thus, R^+ may relate each of the erstwhile grounds $\{g\}$ and $\{h_1, h_2\}$ to that member of our constructive extension. Formally, the extension of R to R^+ is represented in the simplest way possible: by set-membership.

So, adding congeries and truthmaking to our picture allows us to accommodate the idea that there are truths which state no further facts. It remains only to show how the proposal on offer captures the relations of dependence and determination among theories in virtue of which they are structured into layers. Our treatment of ground shows the way. We are given an extension of R to R^+ that delineates the relations of unmediated dependence and determination among elements of the constructive extension of our domain of facts. R^+ is an extension of the relation of unmediated ground; call it the *unmediated*

²³See [deRosset, 2015] for a formal specification of the constructive extension of a domain of facts.

grounding⁺ relation.²⁴ This relation gives us a corresponding domain of trees: the nodes of the trees are filled by facts or congeries, and the connections among those nodes are given by R^+ . We can call this the domain of *grounding*⁺ trees, to differentiate it from the domain of grounding trees. On this picture, the facts and congeries are structured by relations of ground^+ into a *forest* – a bunch of *grounding*⁺ trees. The facts at the bottom of any *grounding*⁺ tree for a fact or congeries f are grounds^+ for f , with the intervening links tracing mediators for that relation of ground^+ . A sentence of the form

$$(11) \quad \phi_0, \phi_1, \dots \text{grounds}^+ \psi$$

is true, on this setup, iff there is a *grounding*⁺ tree for the semantic value of ψ which bottoms out in the semantic values of the ϕ 's.²⁵

These truth conditions for *grounding*⁺ claims in effect yield three very different ways in which a sentence of the form

$$(12) \quad \phi \text{ grounds}^+ \psi$$

can be true. If ϕ and ψ each express facts, then (12) is true iff the fact expressed by ϕ grounds the fact expressed by ψ . Simplifying a bit, if ϕ expresses a fact but ψ does not, then (12) is true iff the fact expressed by ϕ is a truthmaker for ψ . And, if neither ϕ nor ψ expresses a fact, then (12) is true iff the congeries of

²⁴The most natural way to specify the *grounding*⁺ relation is to let it be the relation among facts and congeries that we get by chaining instances of the unmediated *grounding*⁺ relation. Officially, that's the specification I will be assuming. However, as I indicated in n. 5, I will indulge some sloppiness with respect to distinguishing use and mention. In particular, I will often talk indifferently of *grounding*⁺ relations among truths, or between facts or congeries of facts and truths. In the latter case, I have in mind the relation between a fact or congeries f and a truth ϕ when f *grounds*⁺ the semantic value of ϕ . And, I have in mind the obvious parallel specification of a *grounding*⁺ relation among truths.

²⁵See [deRosset, 2015] for a formal specification of a semantics and logic for the *grounding*⁺ operator. The sort of semantic theory envisioned there aims only to represent the relations between truths, facts, and congeries of facts in such a way that we can formally treat relations of dependence and determination among truths. The logic it generates involves relations of consequence only among *grounding*⁺ claims. No relations of consequence among other claims are modeled. A more familiar semantic theory would instead assign semantic values to sentences irrespective of their truth or falsity, and aim to represent logical relations among those sentences. The unfamiliarity of the present approach is, perhaps, mitigated by the fact that the assignment of one kind of semantic value to a sentence in some language by the semantic theory on offer does not prevent the assignment of a different kind of semantic value to that very sentence by another, more traditional semantic theory. The assignments of semantic values do not compete so long as the semantic theories in question have different aims. Thanks to Eliot Michaelson for emphasizing the need for this clarification. See [Sider, 2011, §7.3.2] for a similar attempt to distinguish the aims of Sider's *metaphysical semantics* from those of more familiar semantic theories, which he calls *linguistic semantics*. The present approach, unlike Sider's, requires only a conditional form of determination between a truth and its semantic correlate; see n. 8.

truthmakers for ϕ is a truthmaker for ψ .²⁶ This is how the notion of ground^+ seamlessly stitches together the notion of ground and the notion of truthmaking to give us a notion of dependence and determination with the right formal and material features to accommodate the idea of a layered structure of theories without a corresponding layered structure of facts.

4.4 Simulation Achieved

As I noted above, the framework in which facts are replaced by congeries of truthmakers, and grounding relations replaced by grounding^+ relations can be formally specified. We can then show that the resulting framework precisely simulates the ground-theoretic proposal sketched in §2 above. Suppose we are working in a language with a many-one sentential operator ‘ $<$ ’; intuitively, we may think of a sentence of the form ‘ $\phi_0, \phi_1, \dots < \psi$ ’ as expressing the claim that ψ obtains in virtue of the ϕ_i . Call claims which can be regimented using ‘ $<$ ’ *grounding claims*. The formal results show that the logic of ground and the logic of ground^+ exactly coincide, so we may interpret ‘ $<$ ’ as indicating either ground or ground^+ . The arguments for these results use a lemma which says that, given a constructive extension of a domain of facts F and the correlative extension R^+ of the relation R of unmediated ground , we can specify a domain of facts F^+ and a relation of unmediated ground on that domain which together verify *exactly the same grounding claims*. Call this lemma the *simulation lemma*.²⁷ Given a view on which certain swaths of discourse do not express facts but do exhibit grounding^+ relations, the simulation lemma guarantees us a corresponding view on which all sentences express facts, and the grounding^+ relations are just ordinary grounding relations among those facts. Intuitively, this construction takes us from any model containing both facts and congeries to one containing only facts.

²⁶The principal simplification is that we are considering the special case in which the semantic value of ϕ is an unmediated ground^+ of the semantic value of ψ . For the general case, (12) is true iff the semantic values of ϕ and ψ bear the ancestral of this relation. Similar remarks apply to the case in which ϕ expresses a fact and ψ does not.

²⁷See [deRosset, 2014, Lemma D.1, p. 251] for a precise statement of the simulation lemma. The construction verifying the simulation lemma is formally trivial: we just add to F some new facts to serve in place of mere congeries of old facts. This gives us a new domain of facts F^+ . We need to add to R the relations between subsets of F^+ and members of F^+ needed to preserve exactly the links encoded in R^+ . For instance, if the constructive extension contains the congeries $\{\{g\}, \{h_1, h_2\}\}$, but no corresponding fact, then F^+ will need to contain a new fact f , and R will need to be extended to relate each of $\{g\}$ and $\{h_1, h_2\}$ to f .

The two models represent two views of the metaphysics of the situation. These views disagree on what the facts are. The *sparse* view holds that some sentences don't express facts; its *full* counterpart view holds that every sentence expresses a fact. But they agree on the relations of dependence and determination among truths. They differ, though, on what those relations consist in. The full view explains a truth ϕ 's dependence on and determination by a truth ψ by appeal to grounding relations among the facts those truths express; the sparse view simulates this account, explaining the same phenomenon by appeal to grounding⁺ relations among the semantic values of those sentences. Since, on the sparse view, those semantic values are all either physical facts, or congeries that ultimately bottom out in physical facts, no non-physical aspects of reality are required for the simulation.

From the point of view of the sparse theorist, the full theorist is mistaking relations of (mere) ground⁺ for relations of ordinary ground. From the point of view of the full theorist, the sparse theorist is mistaking relations of ground for relations of (mere) ground⁺. These are easy mistakes to make. Recall that our object language contains some sentences and a many-one operator '<' for an asymmetric, transitive relation of dependence and determination among truths. Then, the simulation lemma entails that whether we interpret '<' as ground or ground⁺, exactly the same '<' sentences will come out true on the two views. Thus, the use of grounding claims to specify what grounds what will not distinguish the sparse view from its corresponding full view. In this sense, the theory of grounding cannot, by itself, settle the question of what facts there really are. From inside a language suited only to express grounding claims, we can't tell the difference between a sparse world and a corresponding full one. We would need a richer object language to specify which facts there really are.

It may be useful at this point to say explicitly how the view on offer meets the challenges we found for the grounding and truthmaker theorists. The challenge for grounding theorists, recall, was that their view appears to require properly chemical and biological facts to serve as relata in the grounding relation. On the present view, however, the role played in the grounding theorist's account by properly biological and chemical facts may be played instead by congeries constructed out of the physical facts. Moreover, the simulation lemma shows that the congeries play this role perfectly.

Recall that the challenge for the truthmaker theorist's approach was that

truthmaking appeared to have the wrong formal and material features for capturing the layered structure of theories. Truthmaking is a relation between facts and truths, and so seems unsuited by itself for explicating a relation of dependence and determination among truths. The particular case in which, I argued, the trouble for the truthmaker theorist was most easily discerned was the case of a chemical truth C , to which a biological truth B bore a relation of dependence and determination. In the present framework, this intermediate position for C is captured by the truth of the claim that C grounds⁺ B . In the simplest case, this occurs when the congeries of truthmakers for C is itself a truthmaker for B . More generally, the proposal sketched here allows us to prove that *grounds*⁺ has the right formal features: it is a many-one, transitive, irreflexive relation.

The material feature we need from *grounds*⁺ is that it is a relation of dependence and determination well-suited to underwrite our impression that C explains B . Call a relation *explanatory* iff its obtaining between C and B entails that C explains B . In the simplest case, C is an unmediated ground⁺ of B , and so its semantic value is both a constituent of the semantic value of B and a truthmaker for B . In more complicated cases, C is a mediated ground⁺ of B . This strikes me as an explanatory relation, but suppose that I am wrong about that: the relation is not explanatory. I assume that the relation that obtains between truths ϕ and ψ iff ϕ expresses a fact that is grounded in the fact expressed by ψ is explanatory. On this assumption the simulation lemma shows that, even if *grounds*⁺ is not itself an explanatory relation, it behaves exactly like one. Thus, the proponent of the sparse view can simulate whatever a proponent of the full view says about first-order chemical and biological matters that leads her to conclude that C grounds B . *Grounds*⁺ is a perfect simulacrum of *grounds* for our purposes. So, *grounds*⁺ meets the challenge the truthmaker theorist faces: it either is or perfectly simulates an explanatory relation, and so underwrites our impression that there is an explanatory relation linking C and B .

4.5 Objections

The view I have sketched requires that reality contain not just physical facts, but also all of the elements of the constructive extension of the physical facts. Is this cheating? Does the view I have sketched deny, for instance, that biological truths like

(10) Something is alive.

state facts, while surreptitiously supplying facts (via our interpretation, which maps truths to congeries of their truthmakers) for them to state? No. It would be a mistake to identify the congeries comprising the truthmakers for a sentence with the fact expressed by it.

Suppose, for illustration, that the physical basis for (10) expresses a fact f involving, say, the behavior of certain particles. Then, on the picture I have sketched, we may imagine that the sole truthmaker for (10) is f . Thus, the semantic value our picture associates with (10) is $\{\{f\}\}$. If, in contravention of the view we are exploring, (10) were to express a fact, it would be a fact which could obtain even if the particles involved in f did not exist, and even if f did not obtain. The congeries formally represented by $\{\{f\}\}$ could not exist if those particles did not exist, and would not obtain if f did not obtain. At least, that is a very plausible view to take, and there is no reason for the proponent of the view I am sketching not to take it. So, there's no reason to think that the elements introduced when we constructively extend the domain of facts are themselves further chemical or biological facts, and so no reason to think that an interpretation assigning those elements to chemical or biological sentences is secretly supplying facts for those sentences to state. Adding congeries of facts and truthmaking to our picture allows us to accommodate the idea that there are truths which state no further facts.

It might be thought, however, that this proposal's reliance on congeries of facts, congeries of congeries of facts, *etc.*, is fishy. Consider again the case of

(10) Something is alive

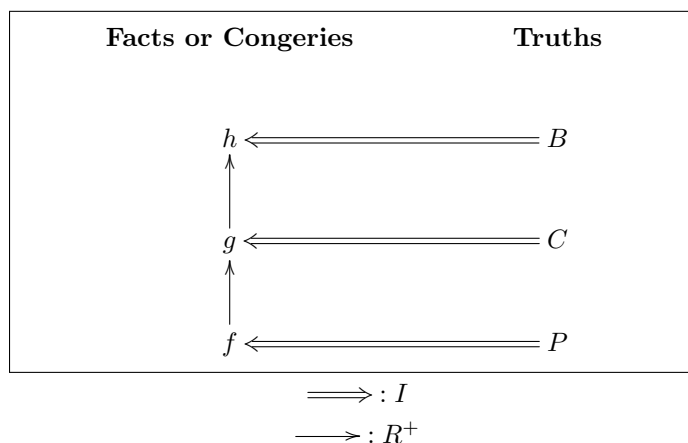
on the assumption that its physical basis expresses a fact f . Our interpretation maps (10) to a certain congeries of congeries of facts, whose sole member is a congeries of facts whose sole member is f . But this congeries of congeries of facts plays a role in the account of how the truth (10) is grounded⁺ that f does not play. In particular, because (10) is mapped by our interpretation to the congeries of congeries, it is grounded⁺ in f , while no sentence mapped to f is grounded⁺ in f . But, an objector might urge, it boggles the mind to think that there is a difference between this congeries of congeries of facts and its sole factual basis f .

It must be admitted that the reliance on congeries of congeries ... of facts involves a substantial commitment for the proposal on offer. ‘Congeries’ is just a covering term I have used (and which is conveniently spelled the same in both the singular and plural) for a bunch of things. I have not said anything about how the bunching is to be understood, but the proposal does impose constraints on any such understanding.²⁸ For instance, if, inspired by [Fine, 2012a], we identify a congeries of facts with the fusion of those facts, then the proposal will need to distinguish the fusion of the fusion of f from f itself. Though this distinction is unfamiliar, [Fine, 2010] describes a mereological framework that accommodates it. Similarly, if, inspired by [Boolos, 1984], we interpret talk of a congeries of facts as plural talk of those facts, then the proposal will have to distinguish the plurality of the plurality whose sole member is f from f itself.²⁹ Of course if, inspired by the formal semantic treatment, we interpret talk of congeries set-theoretically, then there is no problem distinguishing $\{\{f\}\}$ from f . This last alternative is perhaps the most important for present purposes. The familiarity and clarity of the set-theoretic explication of the notion of a congeries should go some way to assuaging the puzzlement that prompts the objection.

It might be objected instead that the view on offer relies after all on a layered structure of entities. The biological truth ‘something is alive’ is mapped by our interpretation to the congeries h of facts comprising its truthmakers. The chemical truth C is mapped to another congeries g , on which h depends and by which h is determined. Let I indicate the relation between a sentence and its semantic value and R^+ the relation of unmediated ground⁺. Then the picture looks just like the picture for the case of ground, with the columns and arrows relabeled:

²⁸I confine my remarks on congeries to a specification of the core commitments of the conciliatory irrealist view I am describing. Such a view will be consistent with a wide variety of more robust theories of the nature and features of congeries, so it would be misleading to stick the view with any particular such theory. Moreover, adequately distinguishing and defending any particular one of the theories mentioned above would require more space than is available here. For what it’s worth, in my view the most plausible theory holds that congeries are pluralities and accepts the existence of higher-order pluralities on the basis of the sort of combinatorial considerations advanced in [Linnebo, 2003, pp. 87-88]. I leave the defense of this claim to future work. Thanks to Dan Korman, Mark Moyer, and an anonymous referee for emphasizing the need for clarity on this point.

²⁹See [Linnebo, 2003, pp. 87-88] for considerations which suggest such a distinction.



True, the entities higher up in this layered structure are called “congeries” rather than “facts.” But it is not clear how this difference could amount to any substantive advance over the ground-based proposal discussed in §2.³⁰

A similar challenge afflicts identity reduction. The identity reductionist identifies the fact f expressed by ‘something is alive’ with that expressed by a purely physical truth, but f is not fundamental. Presumably f is expressed in a purely physical language by some complicated conjunction, disjunction, or generalization. Suppose, to illustrate, that f is expressed by a purely physical disjunction. Then, plausibly, f is dependent on and determined by facts expressed by any true disjunct. In general, then, f will be a non-fundamental physical fact, dependent on and determined by more fundamental physical facts. So, the identity reductionist, too, must appeal to a layered structure of entities.

The answer to this sort of objection on behalf of both identity reduction and the proposal sketched here is the same: in both cases, the facts or congeries to which they appeal are purely physical. A symptom of their physical nature is that they are expressible in a purely physical language that includes conjunction, disjunction, and other logical connectives. Boolean combinations of purely physical truths are still purely physical truths. But, *e.g.*, conjunctions correspond to the congeries of facts expressed by their conjuncts, and those congeries of purely physical entities are still purely physical entities. So, on both views, though there may be a layered structure of dependence and determination among the physical facts and congeries thereof, there are no properly chemical or biological facts. On both views, there are more truths than just the physical truths, but there are no more facts (or congeries of facts) than just

³⁰Thanks to Kathrin Koslicki and Martin Glazier for independently pressing this objection.

the physical facts (and congeries thereof). We were looking for a way to understand the relations of dependence and determination among biology, chemistry, and physics that does not appeal to properly biological or chemical facts. The proposal on offer delivers the goods.³¹

5 Diagnostics for Reality

Call someone who proposes to reconcile a sparse ontology with a rich structure of grounding relations among truths in the way I have suggested a *sparse grounder*. The simulation lemma shows that the sparse grounder can mimic the original grounding theorist’s explanation of the layered structure of theories without committing herself to the reality of facts expressed by those theories. Does *nothing* we may say, then, about what grounds what commit us to the reality of any fact? That would be too hasty a conclusion to draw. The simulation lemma requires that *if* we agree with the sparse grounder about what grounds what, then we can’t tell the difference between a sparse world and the corresponding full one. But nothing compels us to agree with the sparse grounder about what grounds what, and the sparse grounder’s proposed interpretation of ‘grounds’ as indicating ground⁺ relations seriously constrains which claims about what grounds what she can endorse if she is to maintain that a given truth expresses no fact.

We will need to enrich our object language to express these constraints on what is real. Let’s use ‘<’ to indicate ground and ‘<<’ to indicate unmediated ground. We will use ‘ \mathcal{R} ’ to distinguish truths that express facts: ‘ $\mathcal{R}\phi$ ’, for a truth ϕ , indicates that ϕ expresses a fact and, intuitively, can be read (with some abuse of grammar) as “ ϕ is real.” Negation and conjunction will have their usual interpretations, and the other truth-functional connectives are defined in terms of negation and conjunction in the standard way. Finally, we will permit ourselves to quantify over facts and congeries of facts. For instance,

$$(\exists f, G)(p, G < f \wedge \mathcal{R}f)$$

means, intuitively, that there is some congeries of facts that, together with p , grounds some fact. It is easy to specify the natural truth conditions of claims in our extended object language so that their truth values are fixed given

³¹From here on, I will use ‘ground’ and its cognates to indicate ground⁺.

the sparse grounder's specification of a semantics for grounding⁺ claims. For instance, ' $\mathcal{R}\phi$ ' is true iff ϕ expresses a fact, and ' $(\exists x)\phi < x$ ' is true just in case there is a member of the constructive extension to which the value of ϕ bears a grounding⁺ relation.

We can use this language to express the constraints on reality required by the sparse grounder's view. A number of constraints fall out immediately. The most interesting of these is:

DIFF Only the real can make a distinctive contribution to grounding further truths: if ϕ and ψ have exactly the same unmediated grounds but ϕ grounds something ψ does not, then one of ϕ or ψ is real.

$$[((\forall A)(A \ll \phi \Leftrightarrow A \ll \psi) \wedge \neg(\forall B, f)(B, \phi < f \Leftrightarrow B, \psi < f)) \Rightarrow (\mathcal{R}\phi \vee \mathcal{R}\psi)]$$

The idea here is that what an unreal truth makes the case is just a function of the way in which it is grounded: the unreal makes no *distinctive* contribution to what is the case.³² Only a fact-stating truth can make a difference over and above the difference made by its unmediated grounds. This is analogous to the claim, familiar from the philosophy of mind, that only real things can make a distinctive *causal* contribution to the course of events.³³ Moreover, **DIFF** is independently plausible for broadly similar reasons as its causal analogue. If a truth ϕ and a truth ψ do different explanatory work, then it seems as if that difference in explanatory potential must come from somewhere. If they are grounded in the same way, then it can't come from how they are grounded. The only plausible alternative seems to be that the extra contribution must come from some part of reality corresponding to at least one of them. It is a strength of the sparse grounder's framework, then, that it yields this plausible constraint.³⁴

DIFF imposes significant demands on the sparse grounder's view of what grounds what. Consider, for example, what **DIFF** requires the sparse grounder

³²*Argument:* suppose neither ϕ nor ψ is real. Then, the interpretation maps each to some element of the constructive extension of F . If they have exactly the same unmediated grounds, then the interpretation maps them to the *same* element. Thus, the semantic values of ϕ and ψ are one and the same, so occupy exactly the same positions in the forest of grounding⁺ trees, and so ground⁺ exactly the same things. QED.

³³See, for instance, [Kim, 1993a] for discussion.

³⁴Another, more familiar constraint that falls immediately out of the sparse grounders' framework is

BASIC Only the real is ungrounded. $[(\forall A)A \not< \phi \Rightarrow \mathcal{R}\phi]$

to say about disjunctive truths. Recall that

(5) Either Judy Thomson is a philosopher or Michelle Obama is

is immediately grounded in

(13) Judy Thomson is a philosopher.

A plausible claim, consilient with the motivations for the sparse grounder's view, is that neither (5) nor any other disjunction of the form

(14) Either Judy Thomson is a philosopher or ϕ

(where the sentence standing in for ϕ is false) states a fact. Let's make the plausible assumption that the truthmaker for any instance of (14) whose second disjunct is false is just the congeries of truthmakers for its true disjunct. Then each such instance of (14) is grounded in the very same way by (13). On these assumptions, the view at hand requires that (5) does not ground any contingent truth. Suppose that (5) grounds some truth R . By **DIFF**

(15) Either Judy Thomson is a philosopher or $\neg R$

also grounds R . If grounds necessitate, then (15) necessitates R . By standard propositional modal reasoning, it follows that $\neg R$ necessitates R , and so R is necessary.³⁵

This is a serious problem for the sparse grounder. She faces a choice among several ways of responding to it, but each of those responses comes at a theoretical cost. My aim for the remainder of the section is to explore some of the more obvious responses and tally the costs of each. This exploration provides a case study in the assessment of a claim that all truths of a given kind are unreal. I aim thereby to demonstrate the utility of the sparse grounder's framework for assessing claims of unreality.

³⁵This statement of the problem incorporates an improvement due to Kit Fine on a prior statement. An anonymous referee has also noted that the problem metastasizes. It generalizes from disjunctive truths to truths apparently attributing disjunctive properties. A similar problem may also afflict pairs of truths concerning the existence of the set $\{a, b, \dots\}$ and the corresponding mereological fusion of a, b, \dots , so long as it is plausible to think that such truths are both unreal and grounded in the very same way. Similar remarks may also apply to pairs of truths apparently attributing overlapping determinable properties to the very same thing, assuming that these truths are unreal but grounded in the very same way. In general, if one endorses a version of the sparse grounder's irrealism about disjunctive properties, sets, fusions, and determinables, then one will have to defend the substantive commitments required by the relevant applications of **DIFF**.

One response to the problem would be to admit that (5) and the relevant instances of (14) state facts. But that would be to abandon the idea that disjunctive truths are unreal. This claim is, as we saw at the end of §1, a plausible analogue of the claim that chemical and biological truths do not state facts, the *raison d'être*, we have assumed, of the sparse grounder's view. If we cannot sensibly maintain that there are no disjunctive facts, that casts doubt on our ability to sensibly maintain that there are no properly chemical or biological facts.

Alternatively, the sparse grounder might deny that grounding entails necessitation. However, the claim that grounding entails necessitation is plausible, though controversial.³⁶ It would be better for the sparse grounder to seek some way of accommodating it.

Another strategy is for the sparse grounder to accept that disjunctions in general don't ground contingent truths. This would be a radical step, though broadly consilient with work in metaphysics and the philosophy of mind suspicious of any determinative role for "disjunctive" entities.³⁷ It would, however, also threaten her explanation of how one unreal truth can ground another without stating a fact. Let's consider again the sparse grounder's claim that our chemical truth C grounds our biological truth B without there being any properly chemical fact stated by C . Suppose further that B is contingent. If the sparse grounder accepts that disjunctions don't ground contingent truths, then she must also accept that there is not and could not be a disjunctive truth whose second disjunct is false that is grounded in exactly the same way as C . Suppose $(P \vee Q)$ were such a disjunctive truth. Since both C and $(P \vee Q)$ are unreal, application of **DIFF** yields the conclusion that $(P \vee Q)$ grounds B . The strategy of accepting that disjunctive truths ground only necessary truths would then commit the sparse grounder to the claim that B is necessary, contradicting our assumption.

So, accepting that disjunctions do not ground contingent truths requires arguing that there is no disjunction with a false disjunct that is grounded in exactly the same way as C . It's unclear, initially, how this could be made plausible. Suppose for illustration that C 's sole truthmaker is the physical

³⁶See [deRosset, 2010] for an argument that grounding entails necessitation, though see n. 28 in that paper for an important qualification. See [Trogon, 2013] for a different argument for the same conclusion. See [Skiles, 2015] for arguments against that claim.

³⁷See, for instance, [Lewis, 1986, p. 61], [Fodor, 1974, pp. 109-110], and [Kim, 1993b].

fact f , and let P express f . Then, so long as disjunctions with false disjuncts are made true by whatever congeries of facts are truthmakers for their true disjuncts, the disjunction $(P \vee \neg B)$ will be grounded in just the same way as C . The sparse grounder must, then, revisit the assumption about truthmakers for disjunctions that got the view into trouble in the first place. That assumption holds that the truthmakers for a disjunction with a false disjunct are exactly the truthmakers for its true disjunct. The sparse grounder might dispute this assumption by contending that the disjunction has a truthmaker that its true disjunct lacks. This will solve the problem only if the extra truthmakers are different for disjunctions with different false disjuncts, so that the new ground is somehow contributed by the false disjunct.

There are a number of ways this might be done. I will briefly discuss two. First, one might “go possibilist”, by appealing not just to actual truthmakers, but also to possible truthmakers. Consider again a disjunction of the form

(14) Either Judy Thomson is a philosopher or ϕ

where ϕ is false. The proposal is that the truthmakers for (14) will include not just (actual) truthmakers for ‘Thomson is a philosopher’, but also (possible) truthmakers for ϕ . Thus, disjunctive truths with different (false) disjuncts will typically have different truthmakers.³⁸ The problem with this possibilist approach is that it does not really comport with the sparse grounder’s ambitions. We have assumed since §1 that certain truths are realizable in physically alien ways. Let’s consider an instance of (14) in which ϕ is a disjunct which is realizable *only* in a physically alien way. Consider, for instance,

(16) Either Judy Thomson is a philosopher or something is composed of some homeomerous elemental substance.

On our assumptions, the second disjunct of (16) is contingently false. Assuming actual physics is even approximately on track, there are no claims (true or false) expressible by final physics which might have expressed truthmakers for that falsehood. (Here I assume that any truthmaker for the second disjunct of (16) will involve a fact expressed by some instance of ‘ α is composed of substance τ ’, where the term τ refers to an alien homeomerous substance undreamt of in final

³⁸Thanks to Jon Litland and an anonymous referee for suggesting this solution. Disjunctions with necessarily false disjuncts are not handled by this proposal. I leave this problem for “going possibilist” to the side. See [Fine, 2014, §4] for a truthmaker semantics that appeals to impossible truthmakers, or, as he calls them, “contradictory states.”

physics.) So, the possible truthmakers for (16) will include more than just the (actual or possible) physical facts and elements of their constructive extension. But we have also assumed that the layered structure of theories bottoms out in final physics. The fundamental basis, then, on which all truths depend and by which they are determined is limited to facts (and congeries) expressed by truths of final physics. The sparse grounder's ambition is to defend a view on which the facts of final physics are the only facts there are. So, while the proposal to "go possibilist" may not introduce (possible) properly chemical or biological facts, it appears not to comport with the sparse grounder's ambition.

Another way to differentiate truthmakers for different instances of (14), pre-figured by theorists of ground, is to appeal to the notion of a *conditional truthmaker*.³⁹ A conditional truthmaker for a sentence makes the sentence true *given the presence of a truthmaker for some other claim*. Conditional truthmakers are to be contrasted with *unconditional truthmakers* which make a claim true independently of the presence of truthmakers for other claims. The kind of truthmaking to which the sparse grounder has appealed so far is unconditional. The suggestion is that her problem with disjunctions merits the introduction of a new idea.⁴⁰ Suppose, for instance, that a fact f makes the claim

(17) Bill Gates is rich

true. Then it is plausible to think that f also makes

(18) Bill Gates is rich if Carlos Slim is

true *given the presence of a truthmaker for 'Carlos Slim is rich.'*⁴¹ Suppose now that g is a truthmaker for 'Slim is rich.' Then we might indicate the conditional truthmaker f , *given g* by $g:f$. The conditional truthmaker $g:f$ is to be distinguished from the congeries $\{g, f\}$, which plausibly is an unconditional truthmaker for

(19) Bill Gates is rich and Carlos Slim is rich

³⁹Bader [Manuscript] develops the idea of a conditional ground, and distinguishes it from unconditional ground in a way parallel to the proposal to distinguish conditional and unconditional truthmakers. He defends the distinction as necessary, among other things, to appropriately characterize grounds for disjunctions. Poggiolesi [forthcoming] appeals to conditional grounds to give a logic for ground, and applies the idea to the grounding of disjunctions. The sparse grounder is thus continuing her policy of simulating the views of grounding theorists using truthmaking and a sparser ontology of facts.

⁴⁰Yablo [2014, ch. 6] appeals to a similar idea in another context.

⁴¹See [Yablo, 2014, ch. 6] for motivation and discussion of this claim.

but not a conditional truthmaker for anything, and hence not a conditional truthmaker for (18).

How might the sparse grounder apply this idea to the case of a disjunctive truth ($P \vee Q$) with a false disjunct Q ? The sparse grounder might suggest that the truthmakers for this disjunction include conditional truthmakers: the truthmaker for the disjunction is the congeries of the truthmakers for P *given the presence of a truthmaker for $\neg Q$* .⁴² This proposal would relieve the sparse grounder of the trouble stemming from disjunctions. The proposal requires that we have different truthmakers in general for $(\phi \vee \psi)$ and $(\phi \vee \chi)$, when ϕ is true, and ψ and χ are distinct but both false. So, the disjunctions are not all grounded in the same way, and will not get the same semantic value. Thus **DIFF** does not apply to yield the conclusion that $(\phi \vee \psi)$ plays just the same role in grounding as $(\phi \vee \chi)$. So, the argument that the relevant disjunctions do not ground any contingent truths does not get off the ground.

We latched onto the proposal to differentiate the ways in which instances of (14) are grounded because it appeared necessary to sensibly maintain a response to the sparse grounder's problem that accepts the result that disjunctions do not ground any contingent truths. But, it is now clear, once we adopt that proposal, we don't need to accept that result. That is, if the sparse grounder accepts that disjunctive truths with false disjuncts have conditional truthmakers, she can maintain the unreality of disjunctive facts without being forced by **DIFF** to accept that the relevant instances of (14) ground only necessary truths. Denying that disjunctive truths do any grounding of contingent truths ultimately requires distinguishing the grounds for instances of (14) with false disjuncts. But, once that is done, there is no longer any need to deny that disjunctive truths ground other contingent truths. So, the most elegant and plausible solution to the problem allows that disjunctive truths do grounding work, and instead denies the claim about truthmakers for disjunctions on which the problem depends.

In my estimation the proposal to appeal to conditional truthmakers to differentiate truthmakers for different instances of (14) with false disjuncts is the best response to the problem we have been discussing. Still, it gives off at least a whiff of the ad hoc. In effect, countenancing the conditional truthmaker

⁴²As a technical matter, the definition of the constructive extension of a domain of facts will need to be amended to handle the case of conditional truthmakers. The amendments are straightforward: we let R^+ relate G and f if the members of f include either G or $f^* : G$, for some f^* .

$g : f$ and distinguishing it from the unconditional truthmaker $\{g, f\}$ introduces a novel way in which congeries can be combined to make up a new entity. This should be counted as a theoretical cost of the view. I won't here offer any assessment of whether this cost is worth the benefits. My ambition in this paper remains to describe the sparse grounder's view, rather than to argue for (or against) it. My aim in this section in particular has been to point out various strategies a sparse grounder might use to maintain that disjunctions are unreal, and to tally the theoretical price to be paid for each strategy. The point for present purposes is that some such price must be paid.

It should also be emphasized that **DIFF**, which is what causes the trouble, is plausible independently of the peculiarities of the sparse grounder's framework. So, this problem is no anomalous result of the sparse grounder's particular proposal for avoiding commitment to disjunctive facts. It's a problem for anyone who would hold both that disjunctive truths are dependent on and determined only by their true disjuncts, and that there are no disjunctive facts. If all of the alternatives are ultimately unacceptable, then the unreality of disjunctive facts cannot sensibly be maintained. So, the trouble arising from the alleged unreality of disjunctions cannot be reckoned a defect of the sparse grounder's way of accommodating the idea of a layered structure of truths without appealing to a corresponding layered structure of facts. On the contrary, that framework serves to clarify both the challenge and the various ways of meeting it.

The sparse grounder offers us a way of understanding relations of dependence and determination among theories. Unlike identity reduction, this proposal naturally accommodates our assumption that the truths of less fundamental theories are multiply realizable. Unlike a more familiar, ground-based account, this proposal does not require that the truths of the less fundamental theories express facts. Unlike another, more familiar, truthmaking-based account, this proposal naturally accommodates relations of relative fundamentality among non-fundamental theories. It thus appears to provide a satisfactory account of a layered structure of theories that does not rely on a corresponding layered structure of facts. The proposal naturally and immediately yields a plausible, substantive, and interesting constraint linking the structure of grounds among truths to claims about which of those truths are real. This constraint gives us a sufficient condition in ground-theoretic terms for at least one of any pair of truths to express a fact. The sufficient condition has bite: it forces difficult theoretical

commitments on those who would deny the reality of facts corresponding to a given body of truths.

In this sense, the sparse grounder's framework gives us *diagnostics for reality*: conditions which, given a specification of what grounds what, allow us in certain cases to determine what facts there really are. In doing so, the sparse grounder offers us a theoretical setting for disputes about the nature and structure of reality. Her view merits exploration.⁴³

References

- D.M. Armstrong. *A World of States of Affairs*. Cambridge University Press, 1997.
- Paul Audi. A Clarification and Defense of the Notion of Grounding. In Benjamin Schnieder and Fabrice Correia, editors, *Metaphysical Grounding: Understanding the Structure of Reality*, pages 101–21. Cambridge University Press, 2012.
- Ralf Bader. Conditional Grounding. Manuscript.
- Helen Beebe and Julian Dodd, editors. *Truthmakers: The Contemporary Debate*. Oxford University Press, 2005.
- George Boolos. To Be is to Be a Value of a Variable (or to Be Some Values of Some Variables). *Journal of Philosophy*, 81(8):430–49, August 1984.
- Ross P. Cameron. How to have Radically Minimal Ontology. *Philosophical Studies*, 151(2):249–64, November 2010.
- Phil Corkum. Aristotle on Ontological Dependence. *Phronesis*, 53(1):65–92, 2008.
- Fabrice Correia. Grounding and Truth-Functions. *Logique et Analyse*, 53(211): 251–79, 2010.

⁴³Versions of this paper have been presented at the Birmingham Fundamentality Workshop, the 2014 Inland Northwest Philosophy Conference entitled “Metaphysics on the Mountain,” the Centre for the Study of Mind and Nature at the University of Oslo, the University of Massachusetts, Amherst, a conference at the CUNY Graduate Center entitled “The Metaphysics and Epistemology of Grounding.” Thanks to those audiences and Louise Antony, Phillip Bricker, Billy Dunaway, Kit Fine, Martin Glazier, Mark Jago, Nic Jones, Dan Korman, Kathrin Koslicki, Jon Erling Litland, Mark Moyer, and Alastair Wilson for comments and discussion. Special thanks are owed to an uncommonly diligent, anonymous referee, whose astute comments greatly improved this paper.

- Michael Della Rocca. PSR. *Philosophers' Imprint*, 10(7):1–13, July 2010.
- Louis deRosset. Getting Priority Straight. *Philosophical Studies*, 149(1):73–97, May 2010.
- Louis deRosset. What is the Grounding Problem? *Philosophical Studies*, 156(2):173–197, May 2011.
- Louis deRosset. Grounding Explanations. *Philosopher's Imprint*, 13(7):1–26, April 2013.
- Louis deRosset. On Weak Ground. *Review of Symbolic Logic*, 7(4):713–44, December 2014.
- Louis deRosset. Better Semantics for the Pure Logic of Ground. *Analytic Philosophy*, 56(3):229–52, September 2015.
- Kit Fine. The Question of Realism. *Philosophers' Imprint*, 1(2):1–30, June 2001.
- Kit Fine. Towards a Theory of Part. *Journal of Philosophy*, CVII(11):559–589, November 2010.
- Kit Fine. The Pure Logic of Ground. *Review of Symbolic Logic*, 5(1):1–25, March 2012a.
- Kit Fine. Guide to Ground. In Benjamin Schnieder and Fabrice Correia, editors, *Metaphysical Grounding: Understanding the Structure of Reality*, pages 37–80. Cambridge University Press, 2012b.
- Kit Fine. Truthmaker Semantics for Intuitionistic Logic. *Journal of Philosophical Logic*, 43(2-3):549–77, June 2014.
- J.A. Fodor. Special Sciences (Or: The Disunity of the Sciences as a Working Hypothesis). *Synthese*, 28(2):97–115, October 1974.
- C.S.I. Jenkins. Is Metaphysical Dependence Irreflexive? *The Monist*, 94(2):267–76, April 2011.
- Jaegwon Kim. The Nonreductivist's Troubles with Mental Causation. In *Supervenience and Mind: Selected Philosophical Essays*, pages 336–57. Cambridge University Press, 1993a.

- Jaegwon Kim. Multiple Realization and the Metaphysics of Reduction. In *Supervenience and Mind: Selected Philosophical Essays*, pages 309–35. Cambridge University Press, 1993b.
- Joseph Levine and Kelly Trogdon. The Modal Status of Materialism. *Philosophical Studies*, 145(3):351–62, September 2009.
- David Lewis. *On the Plurality of Worlds*. Blackwell, Oxford, 1986.
- David Liggins. Truth-makers and Dependence. In Benjamin Schnieder and Fabrice Correia, editors, *Metaphysical Grounding: Understanding the Structure of Reality*, pages 254–271. Cambridge University Press, 2012.
- Øystein Linnebo. Plural Quantification Exposed. *Noûs*, 37(1):71–92, March 2003.
- Kevin Mulligan, Peter Simons, and Barry Smith. Truth-Makers. *Philosophy and Phenomenological Research*, 44(3):287–321, March 1984.
- Paul Oppenheim and Hilary Putnam. Unity of Science as a Working Hypothesis. In H. Feigl, M. Scriven, and G. Maxwell, editors, *Minnesota Studies in the Philosophy of Science*, volume II, pages 3–36. University of Minnesota Press, 1958.
- Derk Pereboom. *Consciousness and the Prospects of Physicalism*. Oxford University Press, 2011.
- Francesca Poggiolesi. On defining the notion of complete and immediate formal grounding. *Synthese*, forthcoming.
- Gideon Rosen. Metaphysical Dependence: Grounding and Reduction. In Bob Hale and Aviv Hoffmann, editors, *Modality: Metaphysics, Logic, and Epistemology*, pages 109–36. Oxford University Press, 2010.
- Jonathan Schaffer. On What Grounds What. In David Chalmers, David Manley, and Ryan Wasserman, editors, *Metametaphysics: New Essays on the Foundations of Ontology*, pages 347–83. Oxford University Press, 2009.
- Jonathan Schaffer. Grounding, Transitivity, and Contrastivity. In Benjamin Schnieder and Fabrice Correia, editors, *Metaphysical Grounding: Understanding the Structure of Reality*, pages 122–38. Cambridge University Press, 2012.

- Jonathan Schaffer. Metaphysical Semantics Meets Multiple Realizability. *Analysis*, 73(4):736–51, October 2013.
- Sydney Shoemaker. *Physical Realization*. Oxford University Press, 2007.
- Theodore Sider. *Writing the Book of the World*. Oxford University Press, 2011.
- Theodore Sider. Symposium on *Writing the Book of the World*. *Analysis*, 73(4):751–70, October 2013.
- Riin Sirkel. Essentialism and Ontological Interdependence in Aristotle’s *Categories*. Manuscript.
- Alex Skiles. Against Grounding Necessitarianism. *Erkenntnis*, 80(4):717–751, August 2015.
- J.J.C. Smart. The Content of Physicalism. *Philosophical Quarterly*, 28(113): 339–41, October 1978. Cited in [Levine and Trogdon, 2009].
- Kelly Trogdon. Monism and Intrinsicity. *Australasian Journal of Philosophy*, 87(1):127–48, March 2009.
- Kelly Trogdon. Grounding: Necessary or Contingent? *Pacific Philosophical Quarterly*, 94(4):465–85, December 2013.
- J.R.G. Williams. Requirements on Reality. In Benjamin Schnieder and Fabrice Correia, editors, *Metaphysical Grounding: Understanding the Structure of Reality*, pages 165–85. Cambridge University Press, 2012.
- Jessica Wilson. Determination, realization, and mental causation. *Philosophical Studies*, 145(1):149–169, July 2009.
- Stephen Yablo. Mental Causation. *Philosophical Review*, 101(2):245–80, April 1992.
- Stephen Yablo. *Aboutness*. Princeton University Press, 2014.