

The Ground between the Gaps

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[E]veryone must admit that *perception*, and everything that depends on it, is *inexplicable by mechanical principles*, by shapes and motions, that is. Imagine there were a machine which by its structure produced thought, feeling, and perception; we can imagine it as being enlarged while maintaining the same relative proportions, to the point where we could go inside it, as we would go into a mill. But if that were so, when we went in we would find nothing but pieces which push one against another, and never anything to account for a perception. (Leibniz 1998: 270)

[N]o matter what functional account of cognition one gives, it seems logically possible that the account could be instantiated without any accompanying consciousness. It may be naturally impossible—consciousness may in fact *arise* from that functional organization in the actual world—but the important thing is that the notion is logically coherent... [T]here is an *explanatory gap* between such accounts and consciousness itself. (Chalmers 1996: 47)

According to a line of thought tracing from Descartes, Leibniz, and Locke through to Kripke, Levine, and Chalmers, there is a *special explanatory gap* arising between the physical and the phenomenal. The core idea is that there is a contrast between (i) “standard connections” from the more to the less fundamental, such as between the H, H, and O atoms and the H₂O molecule they compose, in which there is a transparent rationale for why the H, H, and O should form an H₂O molecule; and (ii) the connection from the physical to the phenomenal, in which there is no transparent rationale for why any given physical state should ground any particular phenomenal feel (as opposed to some other feel, or no feel at all). This supposed contrast is then taken to indicate a distinctive sort of epistemic limit we face concerning the underlying nature of the phenomenal, or even to reveal that the phenomenal is a metaphysically fundamental ingredient in nature. This contrast now stands as what Levine (2001: 76) labels “the main obstacle to acceptance of materialism.”

I claim that there is no such contrast. Instead, *explanatory gaps are everywhere*. There is no transparent rationale in any of the standard connections, even from the H, H, and O atoms to the H₂O molecule, since it is not transparent that the H, H, and O atoms compose anything, much less something with the nature of an H₂O molecule. Correlatively, I claim that nothing of moment follows from such gaps, so long as they are bridged by principles of metaphysical grounding. The connections in question are bridged by substantive mereological principles concerning the existence and nature of wholes, which mediate metaphysical explanations just as laws of nature mediate causal explanations. In a slogan: *grounding bridges gaps*.

The core insight of the explanatory gap arguments is that the connection from the physical to the chemical is in some ways dissimilar to the connection from the physical to the phenomenal. The former looks like a kind of *mechanical explanation from the workings of the parts to the working of the whole*, and—as the opening passage from Leibniz so clearly reveals—consciousness cannot receive such a mechanical explanation. But I think that this is not a difference in transparency, but merely a difference in the substantive metaphysical principles needed to bridge the gaps.

There has been a great deal of discussion about explanatory gaps in the literature, so it may be useful to flag two distinctive aspects of my position. First, the main discussion in the literature has swirled around the relation between conceivability and possibility, and has centered on whether Kripkean a posteriori necessities like ‘water is H₂O’ show that explanatory gaps are not special to the transition from the physical to the phenomenal but arise even between the physical facts and the water facts. One can think of the explanatory link from the more basic physical facts to the water facts as involving two steps: a *mereological step* from the H, H, and O atoms (or deeper constituents) up to the H₂O molecule, and then a *conceptual step* from H₂O across to water. I am not concerned with the widely discussed conceptual step from H₂O across to

water, but with the prior mereological step from H, H, and O up to H₂O. I am saying that *there is a mereological gap between the H, H, and O atoms and the H₂O molecule.*

Secondly, the existing discussion has mainly been couched in terms of *supervenience* and related non-explanatory notions. Metaphysicians—led by Fine—have only recently (re-)turned to a notion of *grounding* with the structural features appropriate for backing the explanation of the less fundamental from the more fundamental, thus (re-)gaining the ideology needed to discuss metaphysical explanation, and to articulate explanatory versions of views such as physicalism. I am saying that *the ideology of grounding can shed light.*

Overview: In §1 I review and clarify the idea there is a special explanatory gap arising between the physical and the phenomenal. In §2 I examine the usual “transparent” connections such as between the H, H, and O atoms and the H₂O molecule they compose, and argue that such transitions require substantive metaphysical principles (in this case mereological principles about both the existence and the nature of wholes). In §3 I offer a more theoretical route to the more general conclusion that substantive metaphysical principles are needed in all concrete cases, by presenting a formalism for grounding relations generally (based on structural equation models) which requires the specification of dependence functions. Finally in §4 I articulate a form of physicalism—“ground physicalism”—on which the physical is the ultimate ground for the chemical, the biological, and the psychological, and show how it resolves explanatory gap worries.

1. Explanatory Gaps

There is said to be a *special explanatory gap* arising between the physical and the phenomenal. This idea is rooted in Descartes’s (1984: 54) contention that it is conceivable that the mind could exist without the body, surfaces in Leibniz’s (1989: 215; opening quote) insight that perception lacks a mechanical explanation, and re-arises in Locke’s (1996: 236) claim that we cannot know which material beings have the power to think and perceive.¹ The contemporary discussion was revived by Kripke’s (1980: 155) argument against materialism, articulated most explicitly by Levine (1983), and advanced most powerfully by Chalmers (1996, 2012).

Potted history aside, the core idea is that there is a contrast between the “standard connections” from the more to the less fundamental, such as from the H, H, and O atoms to the H₂O molecule they compose, and between the physical-phenomenal connection. The contrast is said to be that in the standard cases there is a transparent rationale for why the more fundamental is linked in this way with the less fundamental, while there is no such transparent rationale to the physical-phenomenal connection. This absence of transparency constitutes an explanatory gap.

In order to make this idea more precise, it will help to introduce some terminology. Explanation has a *tripartite structure* of *source*, *link*, and *result*. With causal explanation, there is the structure of *cause* (such as the rock striking the window), *law* (laws of nature), and *effect* (such as the shattering of the window). Metaphysical explanation has a parallel structure, involving *ground* (the more fundamental source), *principle* (metaphysical principles of grounding), and *grounded* (the less fundamental result). One finds a similar structure with logical explanation, involving *premise*, *inference rule*, and *conclusion*.

I say that it is no accident that causal, metaphysical, and logical explanation have the same tripartite structure, for they are one and all explanations. Explanation is a unified affair, with a unified conceptual role (including revealing patterns and providing a basis for understanding), invoked via univocal vocabulary (such as “why,” “because,” and “explains”). To explain is to trace patterns of dependence (Kim 1994: 67–9), and dependence comes in various flavors, including causal, metaphysical, and logical dependence. But for present

¹ Thus Locke (1996: 235) says that it is: “impossible for us, by the contemplation of our own *ideas*, without revelation, to discover, whether omnipotency has not given to some systems of matter fitly disposed, a power to perceive and think, or else joined and fixed to matter so disposed, a thinking immaterial substance: it being, in respect to our notions, not much more remote from our comprehension to conceive, that God can, if he pleases, superadd to matter a faculty of thinking, than that he should superadd to it another substance, with a faculty of thinking; since we know not wherein thinking consists, nor to what sort of substances the almighty has been pleased to give that power, ...”

purposes I mainly care about the tripartite ground, principle, and grounded distinction in explanations backed by metaphysical dependence.

With the tripartite structure of explanation to hand, one can then formulate the idea of an explanatory gap as arising when the link between the more fundamental ground state and the less fundamental grounded state is opaque (/non-transparent):

Explanatory Gap: There is an explanatory gap between ground and grounded if and only if it is opaque why the obtaining of this particular ground state is linked to the obtaining of that particular grounded state (as opposed to some other grounded state, or no grounded state at all).

As applied to the case of the physical and the phenomenal, the idea is that it is opaque why this particular physical state is linked to that particular phenomenal feel (rather than some other feel, or no feel at all). There is a *residual open question* as to why this particular physical state generates that particular phenomenal feel.²

Explanatory Gap involves the notion of a link being *opaque*. The core idea is that there is thought to be what Sturgeon (1994: 226) calls a “a hard-to-specify clarity” in the standard cases, such as the connection from the H, H, and O atoms to the H₂O molecule, where there is said to be no residual open question. A link goes opaque when this clarity is lost. This loss of clarity then gets unpacked in at least three not-obviously-equivalent ways, involving *conceivability*, *logical possibility*, and *epistemic a priori*:

Opacity: It is opaque as to why the obtaining of the ground state is linked to the obtaining of the grounded state if and only if the proposition that the ground state obtains without the grounded state obtaining is [conceivable / logically possible / a priori open].

These three not-obviously-equivalent ways of clarifying opacity may be thought of as conceptions of what it would take to leave no residual open question.³

For present purposes I need not choose between the three bracketed notions in *Opacity*, or engage with the vexed issue of whether or not they are equivalent. Since my claim is that there is no relevant contrast between the physical-chemical and physical-phenomenal connections, it will suffice for me to argue that the connection from the H, H, and O atoms to the H₂O molecule is opaque in every relevant sense: the proposition that the H, H, and O to H₂O connection fails to obtain is conceivable, logically possible, and a priori open. For in this way I can show that, for every relevant respect in which the physical-phenomenal connection has been deemed opaque, the physical-chemical connection is opaque as well.

2. Mechanical Explanations

² In this vein Levine (1983: 357) says: “[W]hat is left unexplained by the discovery of C-fiber firing is *why pain should feel the way it does!*” Likewise Chalmers (1996: 47) writes: “Even if the appropriate functional organization always gives rise to consciousness in practice, the question of *why* it gives rise to consciousness remains unanswered.” The contrast is with what Chalmers (2012: 305) speaks of “transparent bottom-up explanation” on which “there is no residual mystery about what the high-level facts are or about how the low-level facts give rise to them.”

³ Chalmers (1996: 107) focuses primarily on logical possibility (which he takes conceivability to reveal): “The very fact that it is logically possible that the physical facts could be the same while the facts about consciousness are different shows us that... there is an *explanatory gap* between the physical level and conscious experience.” Chalmers & Jackson (2001: 351) focus more on epistemic a priori: “[I]n showing how any instance of the phenomenon is itself implied by microphysical phenomena, we show that there is a sort of transparent epistemic connection between the microphysical and macroscopic phenomena... [W]here this sort of transparent entailment is present, the epistemic contingency in the macroscopic phenomena is reduced to the epistemic contingency in the microphysical phenomena: there is no further epistemic contingency in the connection.”

With a working understanding of explanatory gaps to hand, I am in position to argue that gaps arise even in the “standard cases” of connections between the more and the less fundamental, such as between the H, H, and O atoms and the H₂O molecule they compose. I am not specifically interested in water, or in the details of chemical bonding. Rather I am interested in the H, H, O to H₂O connection insofar as it is considered to be a representative example of *mechanical explanation from the workings of the parts to the working of the whole*, and insofar as this mechanical part-whole connection is in turn considered to be a representative example of *transitions from a more to a less fundamental level of nature*.⁴

I am skeptical that the H, H, O to H₂O connection is nearly as simple and mechanical as usually imagined, or as depicted in the sort of “ball and stick” models of high school chemistry (cf. Weisberg 2008). But since I am trying to show that even the most paradigmatically “transparent” connections in nature are not in fact transparent, I only help my case by simplifying the example in the simple and mechanical direction.

I am also skeptical that mechanical part-whole explanation is representative of transitions between levels, and even of the idea that fundamental structure in nature comes neatly stratified into “levels.” (One moral of this discussion is that there may be many different transitional principles and not just one.) The classic view is that nature is stratified into mereological levels.⁵ But some say that there are exceptions. One purported exception arises in the case of quantum mechanics, which some regard as inverting the expected explanatory order, in that the intrinsic state of whole quantum systems grounds the quantum states of their components (cf. Ismael & Schaffer *forthcoming*). Interestingly, one leading way of understanding quantum mechanics—namely Albert’s (1996) *wave function realism*—has been challenged precisely on grounds that it opens up an explanatory gap between the quantum mechanical and the manifest.⁶

A second and more directly relevant purported exception to the generality of mechanical explanation—noted by Kim (2002)—is that of the transition from the biological to the psychological. For it is not as if the brain (or whole organism) is a proper part of the mind, in the way that an H atom is a proper part of an H₂O molecule or an individual is a proper part of a society. So whatever the connection between the biological state and the psychological state may be, it cannot be a mechanical connection from the workings of the parts to the working of the whole.

But since I am trying to show that even the most paradigmatically “transparent” connections are not in fact transparent, I only help my case by supposing that all of nature is so neatly mereologically stratified. So

⁴ Thus Levine (1983: 358) offers the mechanical understanding of heat as mean molecular motion as his paradigm of transparency, and Chalmers (1996: 73-76) offers a variety of part-whole cases as his paradigms of transparency, including that of particles and the biological organisms they compose: “What kind of world could be identical to ours in every last microphysical fact but be biologically distinct? Say a wombat has two children in our world. The physical facts about our world will include facts about the distribution of every particle in the spatiotemporal hunk corresponding to the wombat, and its children, and their environments, and their evolutionary histories. If a world shared those physical facts with ours, but was not a world in which the wombat had two children, what could that difference consist in? Such a world seems quite inconceivable.”

⁵ In this vein Oppenheim & Putnam (1958: 9) associate levels of nature generally with mereological structure, as does Kim (1998: 15): “The ordering relation that generates the hierarchical structure is the mereological (part-whole) relation: entities belonging to a given level, except those at the very bottom, have an exhaustive decomposition, without remainder, into entities belonging to lower levels.”

⁶ For this complaint see Allori *et al* (2008) and Maudlin (2010). Thus Hawthorne (2010: 149) writes that, given a fundamental ontology of a world particle in Hilbert space, “you should be able to see that there’s an explanatory gap and that there will be no real hope of closing it.” I am saying (by way of *tu quoque*) that alternatives invoking Bohmian particles or other bits of “primitive ontology” in manifest three-dimensional space also face explanatory gaps, with respect to building up larger composite macroscopic states, such as the positions of pointers. (See also footnote 25 for a sketch of how the wave function realist can bridge the gap.)

I take the H, H, and O to H₂O transition as “fair game” for dispute. I trust that I beg no questions against Levine, Chalmers, or others who take there to be a special explanatory gap arising between the physical and the phenomenal, to argue that the same sort of gap arises even in the simplified mechanical image of the physical-chemical transition from H, H, and O to H₂O.

2.1 *The mereological existence gap*

My first reason for claiming that there is a mereological gap stems from the question of whether the H, H, and O atoms compose anything whatsoever. There is an ongoing debate in metaphysics—spurred by van Inwagen (1990)—as to when mereological composition occurs. *Universalists* say that every plurality of individuals has a fusion. *Nihilists* say that no (non-degenerate) plurality has a fusion. Various intermediate views say that various restricted pluralities—which may or may not include the H, H, and O atoms under discussion—have fusions.⁷

The key observation from the metaphysics debate is that it seems unlikely that any *contradiction* follows from either universalism or nihilism (likewise for many of the intermediate views, but it will suffice to consider just universalism and nihilism). Both universalism and nihilism are fairly simple, well-understood, and logically consistent theories, and both in fact share a common model (namely, the one atom model), which shows that the advocates for either view are committed to regarding the other view as consistent. Indeed the usual attitude of those in the metaphysics debate is that answering the question of when mereological composition occurs is a subtle matter of weighing the costs and benefits of consistent theories, and drawing an overall inference to the best explanation. The debate is not over logic or about the meaning of the term ‘part’ or anything like that, but rather over whether there exists anything that has proper parts. It is a substantive dispute about which concrete things exist. Given that there are the H, H, and O atoms, it is a substantive matter as to whether or not there also exists some further thing that is their fusion.⁸

This observation lends credence to the claim that it is not transparent that the H, H, and O atoms compose anything whatsoever. Recall (§1) that *Transparency* may be understood in terms of conceivability, logical possibility, and epistemic a priority, and that my strategy is to show that an explanatory gap arises on every understanding of *Transparency*. So I begin with conceivability. Since nihilism seems so clearly consistent, it follows immediately that nihilism is conceivable, at least in the sense of what Chalmers (2002) labels *secunda facie negative primary conceivability*: ‘primary’ in that one can conceive of nihilism as actually (and not merely counterfactually) holding, ‘negative’ in that the mode of conceivability is that the theory engenders no contradiction, and ‘secunda facie’ in that the appearance of negative primary conceivability survives detailed reflection (which is far more telling than an initial ‘prima facie’ appearance, with respect to the always distant target of ‘ultima facie’ or ‘ideal’ conceivability).

Indeed, nihilism even seems conceivable in the strongest sense, which Chalmers labels *ideal positive primary conceivability*: ‘positive’ in the sense Chalmers (2002: 150–1) explicates as requiring that “one can imagine a situation that verifies [statement] S,” where such imagination may be perceptual or may simply consist in conceptualizing “a configuration of objects and properties within a world.” So one need only conceptualize a configuration of three atoms and no composites. The nihilist is offering a clear and direct hypothesis about the configuration of objects, which is just what positive conceivability requires.

⁷ Indeed Van Inwagen’s (1990: 82) view is that (non-degenerate) fusions are found only when the activities of the individuals constitute *a life*, so he would deny that the H, H, and O atoms compose anything.

⁸ I agree with Rosen (2006: 19; cf. Rosen & Dorr 2002: 155) who labels composition principles “substantive” and says: “[Universal Mereological Composition] is not a conceptual truth. Given anodyne input it delivers an entity composed of my head and your body, Cleopatra’s arms and Nixon’s legs. And whatever one thinks of such scattered monstrosities, it is not a sign of logicolinguistic confusion to reject them.” In this vein Cameron (2007: 102) writes: “[T]here is nothing in the concept of certain things meeting certain conditions that there is a fusion of those objects. As a result there is no incoherence in the thought that things meet those conditions but fail to compose anything.”

The logical possibility of nihilism can be argued for either directly by its logical consistency, or indirectly through its conceivability, given that *secunda facie* negative primary conceivability is at least a good indicator of logical possibility, and that ideal positive conceivability is an even better indicator (Chalmers 2002: 160–1). Note that I am not saying that nihilism is *metaphysically possible*, in the specific sense of logical possibility restricted by the grounding principles, but merely that it is logically possible in the sense relevant for *Transparency*. (I accord zombie scenarios the same status of being logically possible but metaphysically impossible: §4.2.)

It remains to argue that the falsity of nihilism is not a priori knowable. How could it be? Since nihilism is a conceivable and consistent theory, on what basis—by what evidence—could an ideal mind, just by reflection, know that it is false? Note that I am not saying that the falsity of nihilism is instead a posteriori knowable, but merely that it is not a priori knowable. (My own view is that the falsity of nihilism is not knowable at all, either a priori or a posteriori. The most we can get is some slight overall rationale for preferring one compositional principle over another, but we can never get enough evidence to *rule out* nihilism or various other coherent options.⁹)

So I conclude that, on every relevant way of understanding the idea of a transparent rationale, the H, H, and O to H₂O connection it is not transparent. The claim that mereological composition occurs in this case is a substantive claim, which turns on the substantive matter of the true metaphysical principles of parthood. Thus my first rationale for the existence of an explanatory gap is:

Mereological Existence Gap: It is conceivable, logically possible, and a priori open that the H, H, and O atoms compose nothing whatsoever.

Thus it cannot be transparent that the H, H, and O atoms compose an H₂O molecule.

2.2 *The mereological nature gap*

My second reason for claiming a mereological gap between the H, H, and O atoms and the H₂O molecule they compose is that, even if the H, H, and O atoms compose something, it remains opaque *what they compose*, and in particular whether their fusion has the right sort of nature to count as an H₂O molecule. Even given mereological universalism, the most that follows is that there is a fusion of the H, H, and O atoms. But for all classical mereology is concerned, that fusion could be a cabbage.

Thus further metaphysical principles of *property inheritance* are needed, in order to determine the nature of the fusion of the H, H, and O atoms. One can distinguish inheritance principles for *old properties* such as mass which are found at both the level of the atoms and the molecule, and inheritance principles for *new properties* such as miscibility (the capacity of liquids to mix in all proportions) which are only found at the level of the molecule. One can also distinguish inheritance principles that input *specific aspects* of the parts, from those that input *the total natures and arrangement* of the parts. With respect to mass, the relevant inheritance principle may be thought to only need to take in the specific masses of the two Hs and the O, and thereby output a mass for the fusion.¹⁰ With respect to miscibility, the relevant inheritance principle may well need to take in the total natures and arrangement of the H, H, and O, and only then output a miscibility for

⁹ As to the epistemic status of the composition principles, I agree with Miller (2010: 212) who observes: “[A]t least *prima facie*, whether some particulars with a certain arrangement compose something... doesn’t look like the sort of matter that can be determined *a priori*.” Bennett (2009: 71) goes farther and recommends full agnosticism: “There do not appear to be any real grounds for choosing between the competing positions about either composition or constitution. We are not justified in believing either side. These are basically cases of *underdetermination of theory by evidence*.” I still think that there are subtle overall advantages that lend universalism some rational preference, but I agree with the spirit of Bennett’s view that this is a case of underdetermination in which neither side can be eliminated.

¹⁰ In fact, mass is additive in Newtonian mechanics but not in special relativity. In special relativity, the mass of a composite is only determined through the energies and momenta (product of mass and velocity) of the particles.

the fusion. Generally speaking, in a mechanical explanation of the workings of the whole from the workings of the parts, one needs principles to specify how these “workings” are correlated.¹¹

My argument is that these metaphysical principles of property inheritance are substantive. I focus on the case of mass inheritance—usually thought to work by a simple additive function—since this case seems so simple and is sometimes even given as a paradigm of transparency.¹² And I introduce a rival hypothesis about mass and indeed about all the properties of derivative objects—which I label *zeroism*—on which all derivative fusions are epiphenomenal and *ipso facto* have zero mass and zero of every other causally relevant property. For the zeroist, derivative objects have no mass, no acceleration, and indeed no location whatsoever. (Why the zeroist bothers to posit her inert fusions as opposed to going in for nihilism I cannot guess. My point is not that her position is compelling but only that it is coherent and conceivable.)

I say that zeroism is (*secunda facie* and primarily) negatively conceivable because even on reflection no contradiction looms. I presume that the notion of a particular epiphenomenal object is coherent. And if one object can have this status, I see no contradiction in supposing that many objects jointly, and indeed that all derivative objects jointly, have this status. (Indeed, for what it is worth, zeroism is even consistent with mechanical principles such as Newton’s $F = ma$. First of all, all of the derivative fusions will satisfy $F = ma$ vacuously. Since they have no locations, distance relations involving them will be undefined and so no component forces will touch them, meaning that $F = 0$. And since they have neither masses nor accelerations, it is equally the case that $ma = 0$. Secondly, all of the fundamental atoms will continue to satisfy $F = ma$. If the derivative objects have no masses or charges etc. then they will not contribute any component forces, and so the mechanical behavior of the fundamental atoms will be untouched by their ghostly presence.)¹³

I also say that zeroism is (ideally and primarily) positively conceivable, insofar as it represents a clear and direct hypothesis about the configuration, natures, and causal powers of objects. One can imagine that zeroism holds, and so enjoy “an intuition of (or as of) a *world* in which S...” (Chalmers 2002: 151), where the world imagined provides the object of imagination.

The logical possibility of zeroism, and the lack of a priori knowledge of its falsity, then stems from its consistency and conceivability (§2.1). Or at least: if zeroism is logically impossible and/or such that it can be known a priori to be false, I should like to know why and how.

So I conclude that, on every relevant way of understanding the idea of a transparent rationale, it is not transparent that the H, H, and O atoms—even supposing that they compose something—compose a

¹¹ Newton himself is fully clear and explicit on the need to specify inheritance principles as additional physical content. Thus he (1999: 409) explicitly defines the connection between the motion of a whole and the motions of its parts: “The motion of a whole is the same as the sum of the motions of the parts; that is, the change in position of a whole from its place is the same as the sum of the changes in position of its parts from their places, and thus the place of a whole is the same as the sum of the places of the parts and therefore is internal and in the whole body.”

¹² For instance, Sturgeon (1994: 223) gives mass inheritance as a paradigm case of transparency: “[S]uppose we learn that an object weighs 15 stone... [I]f the weight is sufficiently startling, another question will be motivated, namely, what is it about the object which accounts for its weight? Here we are looking for a generative story: when we find the object is built from a trio of 5-stone parts, one of which is perhaps initially hidden, we shall no longer wonder about the weight of the composed object.” And Diaz-Leon (2011: 106) suggests that mass inheritance may even be a priori: “[M]aybe if we know, for instance, the individual masses of microphysical entities $x_1, x_2 \dots x_n$, which compose the macroscopic entity r , then we can infer a priori the mass of r . This seems plausible because we are using the same predicate both at the microphysical and the macrophysical level, namely, ‘mass’.”

¹³ As McQueen (2015) discusses, it is sometimes thought that mass additivity is deducible in Newtonian mechanics, but all these deductions—including McQueen’s refined version—involve substantive assumptions about property inheritance for composites that the zeroist rejects.

thing with the right sort of nature to count as an H₂O molecule. It is rather a substantive claim that property inheritance works in the right way in this case, which turns on the substantive matter of the true metaphysical principles of parthood. Thus my second rationale for the existence of an explanatory gap is:

Mereological Nature Gap: It is conceivable, logically possible, and not a priori knowable otherwise that the H, H, and O atoms compose something with the wrong nature to be an H₂O molecule.

Thus it cannot be transparent that, even if the H, H, and O atoms compose something, that something is an H₂O molecule.

2.3 *Why neither conceptual analysis nor a cosmoscope can help*

I have argued that it is not transparent that the H, H, and O atoms compose an H₂O molecule, due to *Mereological Existence Gap* and *Mereological Nature Gap*. It is worth pausing to explain how conceptual analysis cannot possibly bridge either of these gaps, and how Chalmers's image of a cosmoscope cannot help either (save to help explain why mechanical explanation may *seem* transparent).

Starting with conceptual analysis, an analysis of a given concept says what it takes to fall under it. The concept of being an H₂O molecule is the concept of an individual (an 'it' towards which we can make singular reference and can count as one, not just a plurality of atoms or a mere 'them').¹⁴ An analysis of the concept of an individual tells us what it would take for an individual to fall under the concept, via the schema:

Analysis Schema for Concepts of Individuals: Individual x falls under concept C if and only if x has features $F1, F2, \dots$

To illustrate, a filling-out of this schema for the concept of being an H₂O molecule might say that a given individual falls under the concept of being an H₂O molecule if and only if it has the features of being composed of an H, an H, and an O, bonded in the right pattern, and with the right mass and charge. Details aside, the analysis sets up a checklist for when a given individual falls under the concept.

Given a checklist for when a given individual falls under the concept, one still must "open the ontological books" to see what individuals the world gives out and what natures they have, to see if the world in fact gives out anything which checks off the entries in the checklist. With the H₂O molecule, one still needs to check whether the world gives out any individual with the needed features, e.g. composed of an H, an H, and an O, bonded in the right pattern, and with the right mass and charge. Being told that there are the plurality of H, H, and O atoms bonded in the right pattern is not sufficient information. One still needs to know if there is any individual composed of them, and what that individual is like.

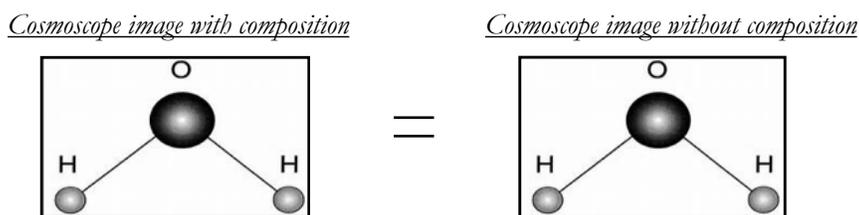
The mereological gap—as given by *Mereological Existence Gap* and *Mereological Nature Gap*—concerns what individuals are out there in the world, and what natures they have. Fix what it takes to fit a given concept. There remains the metaphysical question of whether the world hosts anything fitting.

Turning to Chalmers's (2012: 114–20; cf. 1996: 76) image of a *cosmoscope*—understood as a device for delivering "a sort of supermovie of the world" through which an ideal mind could see everything unfold—such a device effectively allows one to visualize a world with a certain base description. So it might be thought

¹⁴ This point is perhaps even clearer in the biological case, where our concept of an organism is the concept of an individual not a plurality (an 'it' not just a 'them').

that an ideal mind could use a cosmoscope, with the base description that there are the H, H, and O atoms arranged and bonded as such, to discern the presence of the H₂O molecule.¹⁵

Not so fast! The nihilist agrees that there are the H, H, and O atoms, arranged and bonded as depicted, but only denies that the atoms compose a whole. But there is no special blue light, golden glow, or other visual signature that that composition occurs.¹⁶ So the nihilist predicts exactly the same visual appearance the believer in composition:



(The zeroist predicts the very same image as well.) What emerges is a limitation of cosmoscopes. They can only provide information *up to visual discernibility*. But most competing metaphysical hypotheses are visually indiscernible. Not every bit of information about the world is visualizable.

This limitation of cosmoscopes may help explain why mechanical explanation can *seem* transparent, since the image of the parts alone is the same as the image of the parts plus the whole. So it can be easy for us to blur the cases with and without the mereological result. But it is much harder for us to blur the difference between cases with and without the phenomenal result (perhaps due to our specially intimate epistemic relation with the phenomenal). A second reason why mechanical explanation may seem transparent is that the mereological principles it presupposes are so familiar that they are easily overlooked. We leap from parts to whole without noticing the leap. But in any case—psychological speculation aside—I am saying that an ideal mind, given the empirical information that there are H, H, and O atoms in a given arrangement, and given the conceptual information that an H₂O molecule is an individual composed in a given way and with a given nature, still needs more information to determine whether an H₂O molecule is present. She needs to know if those H, H, and O atoms compose anything, and the nature of what they compose. She needs substantive metaphysical information about the principles of composition.

Clarification: I am not saying that there are no differences between the physical-chemical and the physical-phenomenological connections. I think the cases differ in many ways. My point is just that neither connection is transparent in any sense relevant to explanatory gap arguments.

3. Metaphysical Grounding

I have argued that even paradigm examples of the “standard cases” thought to be transparent—such as the connection between the H, H, and O atoms and the H₂O molecule they compose—turn out to harbor

¹⁵ The idea that a cosmoscope (combined with conceptual analysis) can be used to transparently visually discern the workings of the whole is the main consideration advanced by Chalmers (1996: 73 and 76; 2012: 291). This style of “visualization” argument seems to have wide appeal. For instance, Maudlin (2010: 123)—pressing an explanatory gap against wave function realism—uses a visualization argument to maintain that his preferred Bohmian ontology of particles can yield a transparent explanation of the macroscopic facts.

¹⁶ In this vein Rosen & Dorr (2002: 155) note that the dispute over when composition occurs cannot “be resolved by straightforward empirical means,” adding: “Can you tell just by looking? This is hard to believe. Those who disagree with you—the nihilist and the mereologist, let us say—have eyes in their heads that work every bit as well as yours. On the basis of observation, they arrive at divergent answers.” They continue: “Wheel out your stethoscope, your electron microscope, your MRI, your Geiger counter. Dip the particles in acid; freeze them in liquid helium. Who knows what will happen? Our [mereological] description of the case does not say.”

explanatory gaps, due to the need for substantive mereological principles (§2). I now offer a more theoretical argument to a more general conclusion, namely that substantive metaphysical principles are needed in all concrete transitions from more to less fundamental (mereological or otherwise). The argument proceeds by presenting a formalism for grounding relations generally (based on structural equation models, drawn from Schaffer [2016]) which requires the specification of dependence functions, and then arguing that these functions are substantive in all concrete transitions.

In the background of this part of the discussion lies the hope that moving from the non-explanatory notion of supervenience to grounding can shed light on metaphysical explanation. With supervenience one simply has two families of properties, and one can only ask whether or not they modally co-vary.¹⁷ With grounding one has a relation of directed dependency, with a more articulated structure. In particular—on the framework I recommend—one has the more and the less fundamental, as well as *dependence functions* that say how each less fundamental aspect of reality is, on the basis of its more fundamental grounds. (These dependence functions play the exact same role in grounding and metaphysical explanation as nomologically supported counterfactual dependence patterns do in causation and causal explanation.)

I claim that, in all concrete transitions from more to less fundamental, the dependence functions involved provide substantive information. An ideal mind, informed only of the more fundamental aspects of concrete reality, could not yet infer anything at all about the less fundamental aspects of concrete reality, without the added information as to *how the less fundamental is determined by the more fundamental*. (I restrict my claim to “concrete reality” in order to exempt cases involving mathematical and logical dependence, where one does seem to enter the realm of the a priori.)

3.1 Structural equation models for grounding

I begin with a brief sketch of the structural equation model treatment of grounding. Grounding—as I use the notion—is a relation of directed dependency among entities, answering to the idea that there is not just a distinction between the more and the less fundamental, but moreover a *connection* from the more to the less fundamental. Grounding names that connection. I offer no reductive analysis of the notion (reductive analyses generally fail) but instead aim to articulate a formal model and trace conceptual interconnections.

The model I prefer is borrowed from the structural equation model treatment of causation developed primarily by Pearl (2000) and Spirtes, Glymour & Scheines (2000). The rationales for using analogous formal models for grounding and causation include (i) the many deep structural parallels between grounding and causation as relations of directed dependency, (ii) the general aptness of structural equation models for modeling relations of directed dependency (and not just causation), and (iii) the special common feature of both grounding and causation as relations that back explanation. In a nutshell: *explanations are backed by dependence, grounding and causation are forms of dependence, and structural equation models aptly model dependence*.

Structural equation models themselves can be understood via three layers of structure (cf. Halpern 2000). To begin with one needs to represent *the system under study* by selecting variables to represent the features of reality that are of interest. With structural equation models, these variables are born divided into exogenous variables representing independent conditions, and endogenous variables representing dependent conditions. These variables also come born situated in a space of incompatible values representing contrasts. Thus one introduces *the signature*, understood as a triple $S = \langle U, V, R \rangle$. U is a set of exogenous variables, V is a set of endogenous variables, and R is a function mapping every variable $X \in U \cup V$ to an at-least-two-membered set of allotted contrasts.

For instance, if one is modeling the mass-inheritance of the H₂O molecule from the H, H, and O atoms, a natural way to represent the system under study would be to have the three exogenous variables $H1$,

¹⁷ As Kim (1993: 167) aptly notes: “Supervenience itself is not an explanatory relation. It is not a ‘deep’ metaphysical relation; rather, it is a ‘surface’ relation that reports a pattern of property covariation, suggesting the presence of an interesting dependency relation that might explain it.”

$H1$, and O representing the masses of the first H atom, the second H atom, and the O atom respectively, one endogenous variable $H2O$ representing the mass of the H2O molecule, and a range function that maps every variable to the set of real numbers:

$$\mathbf{S1} = \langle \mathbf{U1} = \{H1, H2, O\}, \mathbf{V1} = \{H2O\}, \mathbf{R1} = \{\langle H1, \{\mathbf{Reals}\}\rangle, \langle H2, \{\mathbf{Reals}\}\rangle, \langle O, \{\mathbf{Reals}\}\rangle, \langle H2O, \{\mathbf{Reals}\}\rangle \rangle$$

In this way one represents a system involving three independent and one dependent feature of reality, each allotted any real-numbered option.

Next—and most crucially for what follows—one needs to add in *the dynamics* by codifying dependence functions to say how each endogenous variable is to be evaluated, on the basis of the values of other variables.¹⁸ Thus one introduces *the linkage*, which is a pair $\mathbf{L} = \langle \mathbf{S}, \mathbf{E} \rangle$ where \mathbf{S} is a signature as just characterized, and \mathbf{E} is a set of structural equations. For every endogenous variable $V \in \mathbf{V}$, \mathbf{E} must include an equation $E \in \mathbf{E}$ such that E outputs a value v to V on the basis of values allotted to certain other variables, which thereby count as V 's parents. \mathbf{E} is also subject to a global acyclicity (“no loops”) constraint: no variable can stand in the ancestral of the parenthood relation to itself. In the case under discussion of modeling mass-inheritance, assuming—as is apt for Newtonian systems—that mass is additive, the appropriate linkage is:

$$\mathbf{L1} = \langle \mathbf{S1}, \mathbf{E1} = \{H2O = H1 + H2 + O\} \rangle$$

In this way one adds information about the pattern of dependence of the mass of the H2O molecule on the masses of the H, H, and O atoms, in this case that the pattern is given by the addition function.

Finally one still needs to say *what actually happened*. One seeds the “initial conditions” by setting a function stating a value for each exogenous variable. Thus one adds in *the assignment*, which is a pair $\mathbf{M} = \langle \mathbf{L}, \mathbf{A} \rangle$ where \mathbf{L} is a linkage as just characterized, and \mathbf{A} maps every exogenous variable $U \in \mathbf{U}$ to exactly one value (and does nothing else). Continuing the mass-inheritance model, and rounding off atomic weights in Daltons, the appropriate assignment is:

$$\mathbf{M1} = \langle \mathbf{L1}, \mathbf{A1} = \{\langle H1, 1 \rangle, \langle H2, 1 \rangle, \langle O, 16 \rangle\} \rangle$$

Now one is in a position to derive $H2O = 18$, and thereby solve for the mass of the H2O molecule.

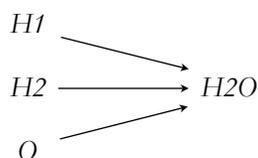
The key point is that in order to derive $H2O = 18$, one needs to use the structural equation $H2O = H1 + H2 + O$. Without the information that this is an apt equation for modeling the inheritance of mass—that is, without the information that mass is additive rather than multiplicative or combined by some other function—no such derivation is possible. Whatever the ultimate viability of structural equation models of grounding might be, I say that they are pointing in the right direction on this matter, in revealing a need to include information about the particular dependence function at work in a given grounding connection:

Grounding Principles: The background structure against which grounding claims are to be modeled includes information about the particular dependence function at work.¹⁹

¹⁸ This is only apt for the deterministic case. For indeterministic causation one needs functions that output a probability distribution over values of the endogenous values (one also needs to assign values at the third stage, not just to the initial conditions, but to all the conditions subject to consistency with the probability distributions). In the main text I restrict attention to the deterministic case because I do not think that indeterministic grounding is possible. At any rate the grounding cases at issue are deterministic.

¹⁹ See Schaffer (2016 and *forthcoming*) for further discussion of the importance of *Grounding Principles*, and how it represents something captured by structural equation models that goes missing in other grounding formalisms, such as those of Fine (2001, 2012) and Rosen (2010).

The role of the dependence functions may easily be missed, and goes missing even in grounding formalisms that only offer partial ordering structure. Structural equation models permit a useful graph theoretic visualization: draw each variable as a vertex, and for every case of parenthood draw a directed edge from parent to child. The graph for the mass-inheritance model is thus (as one might expect):



These directed acyclic graphs correspond to partial orderings. But they are incomplete representations because they do not represent the form of the function by which the value of $H2O$ is determined from the values of $H1$, $H2$, and O (they also leave out the contrasts allotted to the variables, and the values assigned to the exogenous variables). Structural equation models are richer, and map many-one to such graphs. One must look at the models themselves and not the graph-theoretic visualizations to find the gaps.

3.2 The opacity of concrete dependence functions

So far I have sketched a formal model for grounding on which information about particular dependence functions must be included, as per *Grounding Principles*. I say that *in the relevant cases of concrete transitions from more to less fundamental, the dependence functions are substantive*. (I do not say that all dependence functions are substantive. Indeed—insofar as it is appropriate to think of the relation between the truth of the disjunct p and the truth of the disjunction $p \vee q$ as a grounding connection—I would happily say that such dependence functions are a priori knowable. In the abstract cases involving math and logic one is in the realm of the a priori knowable. I am only saying that the concrete connections in nature are substantive.²⁰)

On the widely held assumption that all concrete connections are inter-level mereological connections (§2), my claim that these connections are all substantive follows from the arguments for *Mereological Existence Gap* and *Mereological Nature Gap* (§§2.1–2.2). But there are two reasons why I do not wish to settle for this assumption. First of all, I think it is mistaken to think that all concrete connections are mereological connections, and that this mistake haunts attempts to interpret quantum mechanics. The mechanical model of explaining the workings of the whole in terms of the workings of the parts has become so dominant that not only do we miss the substantive principles it involves, but we demand that other explanatory connections must conform to the mechanical model or else we deem them mysterious.²¹

Indeed, most going interpretations of quantum mechanics—whether they posit *primitive ontology in three-dimensional space* (e.g. Bohmian particles), as preferred by Maudlin (2010) and Allori (2013) on explanatory grounds, or do away with it entirely—still posit at least some holistic and non-mechanical explanatory connection as well (e.g. the Bohmian Guidance Equation, by which the wave function in configuration space connects to the particles in manifest three-dimensional space). So it seems to me that one of the lessons

²⁰ On virtually any standard view, a deep question looms as to why the concrete cases are not a priori knowable but the abstract cases are. What is it about the metaphysical concrete/abstract distinction that lines up with the epistemic a priori/a posteriori distinction? I do not have an answer on offer. It is also possible to deny that the abstract cases involving math and logic are a priori. Those who take this view of the abstract cases will no doubt agree with me that the concrete cases are not a priori knowable either.

²¹ Kitcher (1981: 515–22) develops the idea that explanatory unification consists in the stringency of accepted argument patterns. An explanatory connection that conforms to the mechanical model may be thought of as fitting a more stringent collection of argument patterns overall. But this does not make other sorts of argument patterns non-explanatory. It merely shows—I think rightly—that accepting other sorts of patterns makes our overall explanatory scheme for the world somewhat less unified. The world may not support a maximally unified explanatory scheme.

coming from both quantum mechanics and the metaphysics of mind is going to be that not all natural explanation is mechanical explanation.²²

But the second reason why I do not wish to settle for the assumption that all concrete connections are mereological—a reason which is more interesting for current purposes—is that the arguments given for *Mereological Existence Gap* and *Mereological Nature Gap* in the mereological case generalize in interesting ways to all concrete connections.

As far as generalizing *Mereological Existence Gap*, in the mereological case the relevant alternative hypothesis that could not be a priori ruled out was mereological nihilism (§2.1). The natural generalization to all concrete inter-level connections is what Bennett (2011: 28) calls *flatworldism*, which is the view that, in the concrete realm, only fundamental entities exist. For all of the same reasons that nihilism is a coherent view whose status is a substantive matter, flatworldism is equally a coherent view whose status is a substantive matter. So it is not transparent from the fundamental entities that any non-fundamental concreta exist, and so no connection from any fundamental entities to any putative non-fundamental concreta could be transparent, regardless of whether the connection runs through mereological principles or other sorts of principles.

As far as generalizing *Mereological Nature Gap*, in the mereological case the relevant alternative hypothesis that could not be a priori ruled out was zeroism (§2.2). The natural generalization to all concrete connections regardless of their form is what I label *ghostworldism*, which is the view that non-fundamental entities exist but are epiphenomenal. (Why the ghostworlder bothers to posit derivative entities as opposed to going in for flatworldism I cannot guess. My point is not that her position is compelling but only that it is coherent and conceivable.) For all of the same reasons that zeroism is a coherent view whose status is a substantive matter, ghostworldism is equally a coherent view whose status is a substantive matter. So it is not transparent from the fundamental entities that any non-fundamental entities have the natures needed to count as H₂O molecules, wombats, or societies, regardless of whether the concrete connection runs through mereological principles or other sorts of principles.

Putting this together:

General Existence and Nature Gaps: It is conceivable, logically possible, and not a priori knowable otherwise that there are no derivative entities (flatworldism), and conceivable, logically possible, and not a priori knowable otherwise that there are derivative entities but they are all epiphenomenal (ghostworldism).

Given *General Existence and Nature Gaps*, explanatory gaps are everywhere in nature, lurking in every concrete transition from more to less fundamental, to be bridged only by the addition of substantive grounding principles. Grounding principles are needed to determine whether there are derivative concrete entities at all, and to determine what they are like.

Those who would demand a priori grounding principles strike me as akin to those in the early days of the sciences who demanded a priori causal principles (“rational mechanics”). We have come to recognize the need for substantive dependence functions in concrete causal cases. I am trying to extend this insight to concrete metaphysical cases.

²² In some ways I consider the situation analogous to that of the situation in which Newton posited gravitational force. At the time it was thought that the only “satisfying” sort of explanation was through billiard-ball style contact. Newton (1999: 943) himself regarded gravitational force as obscure and declined to offer a deeper hypothesis for its presence: “I have not as of yet been able to discover the reason for these properties of gravity from the phenomena, and I do not feign hypotheses.” Later physicists simply came to accept (gravitational and electrical) forces as part of the basic explanatory package. (This has nothing to do with transparency but just with familiarity.) It seems to me that we may likewise need to accept new explanatory models—and perhaps a plurality of such models—to understand nature.

There is a deep question looming as to what constraints should be imposed on the grounding principles. I am not denying that constraints are needed. Perhaps—just as with causal principles—the primary constraint is the holistic constraint of finding the simplest and strongest overall system. I am just saying that *rational transparency is a bad constraint on grounding principles*, just as it is with causal principles.

4. Ground Physicalism

I close by articulating a form of physicalism which has it that the physical is the ultimate ground for the phenomenal, and defending such a physicalism from explanatory gap concerns (including warding off zombies). I am not trying to argue for this form of physicalism. I regard the view as antecedently plausible, fitting an elegant and otherwise empirically well-confirmed conception of the structure of nature, and am here only concerned with articulating a form of physicalism that can surmount those explanatory gap arguments that Levine (2001: 76) labels “the main obstacle to acceptance of materialism.”

4.1 *Ground physicalism defined*

The form of physicalism I have in mind says that the physical is the ultimate ground for the phenomenal and all other aspects of the psychological, and takes the starting point formulation of:

Ground Physicalism: The physical is the ultimate ground for the chemical, the biological, and the psychological.

Ground Physicalism is intended to mesh with the classical picture of levels of nature (Oppenheim & Putnam 1958), with the physical on the bottom level and the chemical, biological, and psychological on higher levels, and with the bottom level serving as the ungrounded ground of all the higher level aspects of nature.²³

Six clarifications: First, *Ground Physicalism* only concerns the chemical, the biological, and the psychological since I do not think that the physicalist must take a stand on the mathematical or other abstract matters, and so some restriction seems apt. From the perspective of explanatory gap concerns, it would be an advance enough for the physicalist to defend such a restricted claim. (One can of course extend the template of *Ground Physicalism* to further domains such as the moral and the meaningful as one wishes.)

As a second clarification, I make no attempt to define ‘physical’ (or ‘chemical’ or ‘phenomenal,’ etc.) I take these notions to have sufficient intuitive content to work with. There is a vexed question as to what exactly makes something physical, and in particular whether a connection should be made to the content of current physics (which will no doubt be superseded), to the content of ideal physics (which is currently unknown), or perhaps to something less theoretical and more directly observational (cf. Stoljar 2010: chs. 3–5). I do not have anything on offer to contribute to this issue.

Thirdly, I assume for the sake of simplicity that there is a bottom level of nature, which forms the ultimate ground for all higher level phenomena. Difficult issues lurk as to how (if at all) one may formulate physicalism if there is no bottom to nature (cf. Schaffer 2003, Montero 2006), and I do not want to get bogged down here. It would be an advance enough for the physicalist if she could show how to ward off zombies given that there is a basic physical level of nature.

Fourthly, *Ground Physicalism* is not intended to provide a general statement of physicalism, or to correspond to any “litmus test” thesis which all “physicalists” must accept. I am skeptical that there is any such litmus test. *Ground Physicalism* is simply intended to correspond to a recognizably physicalist doctrine, untroubled by explanatory gap worries.

²³ Some precursors: Schaffer (2009a) claims that physicalism is best understood as a grounding thesis. Dasgupta (2014: 557–9) also recommends viewing physicalism as a grounding thesis, based on the connection between grounding and metaphysical explanation, together with the guiding idea that “physicalism is ultimately an *explanatory* thesis.”

$$L2 = \langle S2, E2 = \{M = P1 + P2 + P3\} \rangle$$

This represents how exactly the intensity of the pain is determined. And finally one needs to say what firing intensities the C-fibers actually display. Let us assign:

$$M2 = \langle L2, A2 = \{ \langle P1, 1 \rangle, \langle P2, 1 \rangle, \langle P3, 5 \rangle \} \rangle$$

Now one is in a position to derive $M = 7$, and thereby solve for the feel of the experience as being a moderate pain, namely one that is 7 out of 15 on the pain scale.

So just as one can solve for the mass of the H₂O molecule given the masses of the parts and apt dependence functions, one can solve for the feel of the phenomenal experience given the physical conditions of the organism and apt dependence functions. Neither of the connections is transparent, but neither is the worse for it.²⁵

4.2 “But what about zombies?”

I turn to one of the most prominent explanatory-gap-based anti-physicalist arguments, with an eye to showing how *Ground Physicalism* can ward off trouble. Associated with the explanatory gap between the physical and the phenomenal is the conceivability of a scenario that is a perfect microphysical duplicate of actuality but with different phenomenal experiences, including a scenario—which Chalmers (1996: 94) calls a *zombie world*—that is completely devoid of any experiences. Zombie worlds are said to be conceivable, while—in contrast—no analogous scenario is said to be conceivable for chemistry or biology.²⁶

I claim that there is no such contrast. Let a *dead world* be a scenario that is a perfect microphysical duplicate of actuality but devoid of any biological life. I say that not only is a dead world conceivable, but that I have already provided a way to conceive of one. For consider a scenario that is a perfect microphysical duplicate of actuality and in which flatworldism holds. Since it is conceivable that flatworldism holds at actuality, this scenario is conceivable. Since flatworldism holds at this scenario, the world being imagined hosts only microphysical particles and no derivative fusions or derivative entities of any other sort, and *a fortiori* hosts no biological organisms. It is devoid of life. In place of you and I, the world being imagined hosts only particles arranged in your shape and in mine. (Ghostworldism would work as well to help us imagine a dead world, provided that being a biological organism requires having certain causal powers and effectual liabilities.) Indeed this conceivable scenario is not merely a dead world but also a *dissolute world* devoid of any

²⁵ Likewise the wave function realist can solve for the positions of classical particles in manifest space, given her fundamental ontology and apt dependence functions. Indeed Albert (2013: 54–56) describes just such a function for the Bohmian wave function realist, saying that the wave function “*formally enacts...* a system of $D/3$ classical three-dimensional particles—the i th of which is the projection of the world particle onto the $(3i-2, 3i-1, 3i)_C$ subspace of the D -dimensional space in which the world particle floats.” I am adding that the wave function realist need not follow Albert further in demoting classical particles to mere “appearances,” or in giving an (overly permissive) functional analysis of “what it is to be a table or a chair or a building or a person” out of a felt need to render the connection transparent. Instead I say that she should simply posit such a connection as additional content of her theory, and argue that alternatives invoking Bohmian particles or other bits of “primitive ontology” in manifest space equally need to posit substantive connections such as from particles to pointers (as per the *tu quoque* argument in note 6; see also note 15).

²⁶ Along these lines Chalmers (1996: 71) says: “Conscious experience is almost unique in its failure to supervene logically.” He goes on (1996: 73) to argue: “The logical supervenience of most high-level facts is most easily seen by using conceivability as a test for logical possibility. What kind of world could be identical to ours in every last microphysical fact but be biologically distinct? ... [B]iological facts are not the sort of thing that can float free of their physical underpinnings even as a conceptual possibility.” And: “The same goes for architectural facts, astronomical facts, behavioral facts, chemical facts, economic facts, meteorological facts, sociological facts, and so on. A world physically identical to ours, but in which these sort of facts differ, is inconceivable.”

chemical compounds, a *stormless world* devoid of any meteorological occurrences, and a *starless world* devoid of any astronomical bodies. It would truly be nothing more than atoms in the void.

The conceivability of zombies is used to argue against physicalism as follows:

1. A zombie world is conceivable.
2. If a zombie world is conceivable, then a zombie world is possible.
3. A zombie world is possible.
4. If physicalism is true, then a zombie world is not possible.
5. Physicalism is false.

But given—as just argued—that a dead world is equally conceivable, the following argument has equal force:

6. A dead world is conceivable.
7. If a dead world is conceivable, then a dead world is possible.
8. A dead world is possible.
9. If physicalism is true, then a dead world is not possible.
10. Physicalism is false.

But, at least since the exit of vitalism, few think that biology imperils physicalism. What has gone wrong?

My view is that the arguments equivocate on the interpretation of the context-sensitive term ‘possible’ between 2 and 4, and between the analogue claims of 7 and 9. If what is meant is mere logical-*cum*-conceptual possibility, then I accept 2 and 7 but deny that there is any conflict with physicalism in 4 and 9, at least when understood as *Ground Physicalism*. *Ground Physicalism* makes a claim about grounding, namely that certain relevant phenomena (e.g. the chemical, the mental) are ultimately grounded in the physical. So *Ground Physicalism* only requires the claims that a zombie world and a dead world are metaphysically impossible, where metaphysical possibility is understood as conceptual possibility further restricted by the grounding principles.

Whereas if what is meant by ‘possible’ is metaphysical possibility, then I accept 4 and 9 but deny 2 and 7. All that 1 and 6 says is that a zombie world and a dead world are conceivable, not that they are also consistent with the actual grounding principles, as metaphysical possibility further requires.

Putting this together, I think that *Ground Physicalism* gives one a principled way to uphold:

Mere Conceptual Possibility: A zombie world and a dead world are each merely conceptually possible but not metaphysically possible.

Since *Ground Physicalism* is a claim with the modal strength of metaphysical necessity (§4.1), it is thereby consistent with *Mere Conceptual Possibility*.²⁷

I turn very briefly to Jackson’s (1986) related case of Mary, the brilliant physicist-*cum*-neurologist-*cum*-calculational-prodigy, who is imagined to know every physical and neural detail of the world, and to be able to draw all logical consequences, but to have never herself actually experienced red. And so it is said that Mary—despite knowing all the physical and neural information and being capable of drawing all logical consequences—still fails to know what it is like for others to see a rose or a sunset. And so it is concluded

²⁷ By upholding *Mere Conceptual Possibility* I uphold a version of what Chalmers (1996: 166) calls *type-B materialism*. Chalmers (1996: 167) regards the metaphysics behind type-B materialism as “either incoherent or obscure,” adding that it is also ad hoc insofar as “the main motivation is simply to avoid dualism at all costs.” I think that these aspersions are fairly cast against many other type-B materialisms, but not against the view I defend, which is rooted in a general view about grounding, metaphysical possibility, and the structure of metaphysical explanation generally. It is the introduction of grounding that allows for the formulation of a coherent and independently motivated form of type-B materialism.

that phenomenal information is something extra, in addition to the physical and neural information which Mary has, and any consequences of this information which she can so easily draw.

I agree that the phenomenal information is extra information. My point is that the same holds for all other higher-level information. For instance, Mary does not yet know anything about sociology, because for all she knows there are no higher-level phenomena than the neurobiological. For all she knows the world “flattens out” above the neural, and so hosts no societies at all.

I think that Mary suffers from a two-fold deprivation. First, she has been deprived of metaphysical information insofar as she has not learned the relevant bridge principles. Secondly, she has been deprived of conceptual information, insofar as—barring additions to the story—she does not have the full phenomenal concepts needed to know what it is like for others to experience a rose or a sunset. These deprivations interact. If “God” told Mary the bridge principles, she still would not understand them. What Mary needs is to acquire the relevant phenomenal concepts (which are usually acquired through having the experience oneself, but perhaps could be directly surgically implanted or otherwise instilled), and then to learn the needed bridge principles concerning them. Just give Mary some grasp on the phenomenal concept of red, and give her the function from rose and sunset situations to experiences of red, and then—calculational prodigy that she is—she will then know what it is like for others to see a rose or a sunset; namely, that their experiences fall under the phenomenal concept of red.

Associated with the zombie argument, as well as the knowledge argument starring Mary, is a certain idea of what must be included in an *a priori scrutability base* (Chalmers 2012: ch. 4; cf. Chalmers & Jackson 2001: 328–36). This is a packet of information that an ideal mind could use as a basis to know every truth whatsoever. Chalmers (2012: 290–9) suggests that an ideal mind who knows $P-QTI$ —where P are the microphysical truths, Q are the qualitative truths, T is the totality truth, and I are the indexical truths for her—is thereby in position to know every truth whatsoever. I may be understood as suggesting a two-step modification of this picture. First, I deny that $P-QTI$ is sufficient until the principles of metaphysical grounding are included. So I say that for an *a priori scrutability base* one needs $P-QTIG$, where G are the truths of grounding (compactly expressed via the root principles of what grounds what). But secondly, it follows from *Ground Physicalism* that once G has been added, Q may be safely deleted without loss of scrying power, since G includes the principles needed to scry Q . So in place of $P-QTI$ with its place for phenomenal truths, I put forward $P-TIG$ as a happy physicalist alternative.²⁸

4.3 “You’re no physicalist!”

I close by considering the objection that my *Ground Physicalism* is really a form of dualism or emergentism mislabeled, or at any rate not really physicalism, insofar as I freely invoke strong metaphysical bridge principles with one foot beyond the physical. One way to put this objection: in saying that one needs both the ultimate physical grounds *and* the metaphysical inter-level links too, aren’t I effectively admitting that “the physical is not enough”?²⁹ A different way to phrase this objection: on my view the fundamental facts include the grounding principles, which are *impure* insofar as they have non-physical constituents. But if every

²⁸ Insofar as $P-TIG$ allows one to scry Q , any apparent positive conceivability remaining for zombies from $P-TI$ would merely be due to ignorance of the content of G . So understood the position is a new and specific version of what Stoljar (2006) calls an “ignorance hypothesis.”

²⁹ In this vein, Horgan (1984: 24) holds that the bridge principles must be principles of meaning or else physicalism is doomed: “[I]f cosmic hermeneutics requires Moore’s sort of bridging principles, then in an intuitive sense it is just *false* that the microphysical facts determine all the facts; rather, evidently we must say that the determining is done by the microphysical facts *together with* these metaphysically rock-bottom, necessarily-true, facts about the relations between descriptive properties and normative properties.”

constituent of a fundamental fact is itself fundamental, aren't I thereby committed to the fundamentality of the non-physical (including the phenomenal)?³⁰

I postpone the objection momentarily, in order to first build a positive case as to why *Ground Physicalism* deserves to count as a form of physicalism. I doubt that there is a uniquely correct definition of 'physicalism,' but I can offer five core physicalist intuitions which *Ground Physicalism* upholds, which together show why *Ground Physicalism* is strongly deserving of its label.

One core physicalist intuition is just the direct intuition that the chemical, the biological, and the psychological—and perhaps more—are *ultimately grounded* in the physical. These domains are not merely nomologically correlated (as the dualist may admit) but are metaphysically connected. *Ground Physicalism* is just a direct inscription of this intuition, which Loewer (2001: 39) expresses as: “the fundamental properties and facts are physical and everything else obtains *in virtue of* them.”

A second core physicalist intuition is the idea that the physical *explains* the chemical, the biological, and the psychological (Dasgupta 2014: 557–9). Given that grounding backs metaphysical explanation just as causation backs causal explanation, *Ground Physicalism* positions the physical in precisely the “cause-like” role needed to back explanations of the chemical, the biological, and the psychological.

A third core physicalist intuition is that there is *nothing special* about the psychological as opposed to the chemical or the biological, with respect to their metaphysical basis.³¹ It is inscribed directly into *Ground Physicalism* that the chemical, the biological, and the psychological are on equal footing, at least with respect to being ultimately grounded in the physical. And given that grounding backs metaphysical explanation, *Ground Physicalism* also entails that the chemical, the biological, and the psychological are explained from the physical in the same style.

A fourth core physicalist intuition is that the physical forms a *supervenience base* for the rest. At least within some relevant class of worlds, physical indiscernibility entails full indiscernibility.³² Grounding entails *metaphysical supervenience*. In the class of metaphysically possible worlds (those with the same grounding principles as ours), physical indiscernibility entails full indiscernibility. After all, if one fixes the grounds and the bridge principles together, the grounded result follows with logical necessity. This falls out of the structural equation model treatment (§3) insofar as physical indiscernibility means duplicating the values of

³⁰ In a related vein, Sider (2011: 106) recommends a principle of purity, on which the fundamental facts cannot invoke any non-fundamental constituent notions: “When God created the world, she was not required to think in terms of non-fundamental notions like city, smile, or candy.” (*Caveat*: Sider is concerned with primitive ideology whereas I am focused here on ontological basicness.) And Dasgupta (2014) sees in Sider’s argument a reason to reject “brute connectivism” (which I am upholding) in favor of a view on which the connections hold on the basis of *the essences* of the derivative entities, where essence claims are said to be “autonomous” in the sense of not being apt for grounding.

³¹ In this vein Montero (2013: 106) offers a *via negativa* conception of physicalism as only requiring that “mental properties are not uniquely non supervenient on (narrowly) physical properties,…” but are in the same boat as other higher-level properties.

³² Thus Lewis (1983: 364) defines physicalism (/materialism) as a restricted supervenience claim: “Among worlds where no natural properties alien to our world are instantiated, no two differ without differing physically; any two such worlds that are exactly alike physically are duplicates.” Relatedly Jackson (1998: 8) defines physicalism as follows: “Any world which is a *minimal* physical duplicate of our world is a duplicate *simpliciter* of our world.”

exogenous variables, and insofar as metaphysical possibility means duplicating the (deterministic) functions fixing the values of the endogenous variables.³³

A fifth core physicalist intuition is that “all God would need to do” would be to create the physical, and the rest would thereby come for free. Given *Ground Physicalism*, all “God would need to do” would be to create the physical grounds, and the chemical, biological, and psychological—and perhaps more—would then arise with metaphysical necessity. The ultimate grounds would be in place.

Of course the term ‘need’ is context-sensitive, and what exactly “God would need to do” depends on what is being held fixed. In a context in which deterministic laws of nature are being held fixed, there is a perfectly good sense in which “all God would need to do” would be to seed the initial conditions and let the rest unfold like clockwork. In a context in which no generational principles whatsoever are being held fixed at all, then “all God would need to do” would be to make everything without exception, since without generational principles of any sort—be they logical, metaphysical, or nomological—nothing could be generated at all. But insofar as physicalism is being offered as a thesis of grounding, the intended interpretation of ‘need’ should hold fixed the generational principles associated with grounding.

Having made a positive case as to why *Ground Physicalism* deserves to count as a form of physicalism, I return to the two objection that my invocation of strong metaphysical bridge principles renders the view non-physicalist. As to whether I am effectively admitting that the physical is not enough (as per the first way to put the objection), I ask in return: “Enough for what?” I say that the physical is enough for grounding the chemical, the biological, and the psychological (etc.), in a way parallel to the way that the causes are enough for the effect, and the premises are enough for the conclusion. In all cases there is mediation by generational principles (and without any generational principles nothing is enough for anything else). I say that the relevant sense of the context-sensitive term ‘enough’ is *enough to ground*, and in the relevant sense I say—as a physicalist should—that the physical is indeed enough, and that “all God would need to do” is to create the physical.

As to whether I am indirectly committed to the fundamentality of the non-physical by positing fundamental grounding principles with non-physical constituents (as per the second way to put the objection), I say first that—given the tripartite source/link/result structure of explanation (§1)—one needs to move beyond a bipartite fundamental/derivative distinction, to a tripartite ultimate grounds/root principles/derivatives distinction. That is, one must distinguish, within the “fundamental,” between that which plays the source role of ultimate grounds, and that which plays the linking role of root principles. When there are three roles involved, nothing but confusion can arise from insisting on only using two classificatory boxes. In the causal case, it would be a confusion to say that laws of nature are extra causes: the laws are not extra causes but separate factors that play the distinctive role of linking causes to effects. Likewise in the logical case, it would be a confusion to say that inference rules are extra premises: the inference rules are not extra premises but separate factors that play the distinctive role of linking premises to conclusions.³⁴ Likewise—say I—in the metaphysical case it would be a confusion to say that root principles are extra ultimate grounds. They are separate factors that play the distinctive role of linking grounds to grounded.

³³ Montero (2013: 102) uses a flatworld-style scenario to counterexample the claim that physicalism entails unrestricted supervenience, since a minimal physical duplicate of our world could be a flatworld. I agree and indeed take her counterexample to anticipate my argument for the conceptual possibility of a dead world (§4.2). But I would just add that the friend of *Ground Physicalism* can retain a restricted but still powerful supervenience thesis, holding through the sphere of worlds in which the grounding principles are held fixed.

³⁴ Indeed in the logical case one falls into Carroll’s (1895) paradox of Achilles and the Tortoise if one conflates the inference rules with the premises. As long as the Tortoise can keep convincing Achilles to re-label his inference rules as premises, the Tortoise can prevent Achilles from drawing any inference from his stock of premises, and require him to add any rule involved in drawing an inference as just one more premise, *ad infinitum*.

Now given the distinction between the ultimate grounds and the root principles, one can see that I do not posit any chemical, biological, or psychological elements among the ultimate grounds. The ultimate grounds remain “pure.” I do posit root principles, which mention non-fundamental conditions on the right. For instance, they may connect the physical state of the system on the left, with its chemical, biological, or psychological state on the right. So these are “impure” on the right. I just say that, given that the principles are posited to link the grounds on the left with the grounded on the right, this represents a stable and motivated perspective. In particular, it does not follow, from the fact that these non-fundamental conditions are mentioned on the right of root principles, that they are thereby ultimate grounds.³⁵

(A partially related matter: alongside the general grounding principles I posit, there are also the particular grounding facts that all grounding theorists posit, such as the fact that this particular physical state grounds that particular chemical state. Here the question arises (from Sider 2011: 107) as to *what grounds the grounding facts*. I endorse the “collapse” view (Bennett 2011, deRosset 2013) that the grounding facts are derivative, grounded in the very grounds they cite on their left. I add that *what explains the grounding facts* are the grounds they cite on their left, via the principles. See Schaffer *forthcoming* for further discussion.)

That said, I acknowledge that there is a stronger view in the vicinity of *Ground Physicalism*, which also strongly deserves to be considered a form of physicalism:

Ground+Principle Physicalism: The physical is the ultimate ground for the chemical, the biological, and the psychological, and the grounding connection operates via *purely physical principles*.

I just think that *Ground+Principle Physicalism* is false. To bridge the relevant existence and nature gaps (§§2-3), the links need to connect the physical source to the chemical, biological, and psychological results. Purely physical principles can only connect the physical to the physical. The upholder of *Ground+Principle Physicalism* not only fails to reach the psychological, but cannot even get to the chemical.

But I also say that *Ground Physicalism* is physicalism enough and defensible enough. Not every form of physicalism needs to be true. Correlatively, perhaps some who have opposed physicalism in other forms might find *Ground Physicalism* more plausible.³⁶

Epilogue: Metaphysics, Schmetaphysics?

I have claimed that one must posit substantive metaphysical principles in the standard mechanical connections such as from the H, H, and O atoms to the H₂O molecule they compose, on the understanding that it matters whether the H, H, and O atoms compose anything, and whether—if they do compose something—it has the right nature to be an H₂O molecule. But some will say that I have treated these metaphysical questions in an overly inflated way. Indeed Chalmers himself (2009) advocates a deflationary

³⁵ So must “the book of the world” (in Sider’s nice phrase) make reference to the biological? This returns us to the first concern about what would be enough. The book of ultimate grounds may remain pure, and make no reference to the biological. It is book enough for the world, so long as “enough” is understood as “enough to ground.”

³⁶ Thanks especially to Dave Chalmers, and also to David Albert, Karen Bennett, Zach Blaesi, Adam Bradley, Shamik Dasgupta, Tom Donaldson, Geoffrey Lee, Joe Levine, Antonella Mallozzi, Kris McDaniel, Trenton Merricks, Barbara Montero, Alex Moran, Adam Pautz, Howard Robinson, Ted Sider, Brad Skow, Daniel Stoljar, Scott Sturgeon, Amie Thomasson, two anonymous referees for *Philosophers’ Imprint*, and audiences at UC-Irvine, Miami, the Rutgers-Lund Graduate Conference, the UMass-Amherst Graduate Conference, Metaphysical Mayhem, Barcelona, Hamburg, Oxford, CUNY, the Rutgers Metaphysics Reading Group, North Carolina State, the Corridor Reading Group, University of Southern California, Pittsburgh, and the Ranch Metaphysics Workshop.

“anti-realist” view of metaphysics.³⁷ So could metaphysical deflationism “help” to re-open a special explanatory gap for the phenomenal?

Dialectically speaking, I doubt that a friend of explanatory gap arguments would want to premise her argument on metaphysical deflationism (nor have I ever seen these arguments flagged as “for deflationists only”). Doing so simply invites the physicalist to reject the deflationary premise (as many would anyway). By my lights, any argument from deflationism to the denial of physicalism is best “tollens”-ed.

But dialectics aside, I doubt that metaphysical deflationism could help to re-open a special explanatory gap for the phenomenal. The underlying reason is that deflationism for claims about the existence and nature of the chemical equally afflicts claims about the existence and nature of the phenomenal. So to the extent that deflationism can close the gaps I have pointed to in the chemical case, it can equally close the gaps others have pointed to in the phenomenal case. (It is hard to be a dualist, if all metaphysical claims are false or trivial.)

Chalmers (2012: 267–71) offers a threefold classification of metaphysical views, understood in terms of different attitudes one might take towards a given metaphysical sentence *S* at context *c*:

Antirealism. *S* is not true but merely defective at *c* (and perhaps in general “there are no ontological truths at all”).

Lightweightism. *S* is analytic and thus a priori at *c*.

Heavyweightism. *S* is either synthetic but still a priori at *c*, or else added principles must be included in the scrutability base to account for the truth of *S* at *c*.

He classifies *Antirealism* and *Lightweightism* as forms of deflationism, and *Lightweightism* and *Heavyweightism* as forms of realism. I myself am a friend of *Heavyweightism*, but for present purposes I am concerned to show that there is no special explanatory gap for the phenomenal on any of these views, for none of them separates the chemical from the phenomenal.

Three clarifications: First, what counts as a “metaphysical sentence” is a difficult matter, but not one at issue. I propose to just grant that there is a notion of a metaphysical sentence which covers all of the sentences at hand (so that it might help the friend of explanatory gap arguments), without extending to all sentences whatsoever (so that it might target a specially problematic class of “metaphysical” claims for deflation). I assume that this notion covers all sentences containing quantifiers (e.g. ‘there is an H₂O molecule’), but allow that it may cover further sentences involving grounding claims or claims about the natures of derivative entities that do not use quantifiers (e.g. ‘that is miscible’).³⁸ My claim is that *even granting such a notion*, there is still no special gap for the phenomenal to be found on any framework.

Secondly, I assume—with Chalmers—that a metaphysical framework should apply to all metaphysical sentences equally. *A fortiori* it should apply to claims about the existence and the nature of the chemical in just the same way that it applies to claims about the existence and the nature of the phenomenal. Anything else seems unprincipled.

³⁷ Indeed Chalmers anticipates the *Mereological Existence Gap* portion of my argument, saying (2012: 268) that if the base is stripped to the microphysical then “even macrophysical entities pose a challenge” since it might be thought that “the existence and distribution of atoms is a priori compatible with either the existence or nonexistence of molecules” on grounds that “from a statement that certain entities exist, it never follows a priori that any other entities exist.” His primary reply is to reject “the heavyweight view of ontology.”

³⁸ Most existing anti-realist frameworks (including that of Chalmers 2009) target all and only sentences containing quantifiers. I think that these frameworks need to be extended to cover grounding claims and claims about natures that do not use quantifiers. In the main text I am just granting that any needed extensions have been given.

Thirdly, I do not assume that a metaphysical framework must treat all contexts equally, so I allow that a framework might uphold a mixture of approaches across contexts. For instance, one might uphold *Antirealism* in contexts in which Donald Trump is the speaker, *Lightweightism* in contexts in which Mike Pence is the speaker, and *Heavyweightism* otherwise. Indeed Chalmers himself upholds *Antirealism* relative to “ontological contexts” but *Lightweightism* relative to “ordinary contexts.”³⁹

It will help to work from the deflationary options of *Antirealism* and *Lightweightism*, to contextualist mixtures, and then to inflationary *Heavyweightism*. So starting with *Antirealism*, this view conflicts with the truths of chemistry (e.g. ‘there is an H₂O molecule’) and with Moorean truisms (e.g. ‘here is a hand’), and it is inconsistent with classical quantified logic since it entails that tautologies containing quantifiers (e.g., ‘ $(\exists x)Fx \vee \sim(\exists x)Fx$ ’) cannot count as true but must count as defective. But leave such concerns aside. For present purpose what matters is that—given that *Antirealism* applies to all metaphysical sentences equally—it deflates the existence of the phenomenal just as much as it deflates the existence of the chemical. Given *Antirealism*, not only is there no truth as to whether there exists an H₂O molecule, but there is equally no truth as to whether there exists a phenomenal experience. There is also no truth as to whether there is a physical state, an explanatory gap between the physical and the phenomenal, or anything at all. (It is hard to be a dualist if no metaphysical claims are true!)

Turning to *Lightweightism*, I find the notion of analyticity involved hard to fathom. I think that the most that can be analytic are the conditions under which a concept is satisfied. It cannot be analytic which concrete individuals the world gives out, or whether a conceptual condition happens to be satisfied. So it cannot be analytic that, even if the world gives out an H, an H, and an O atom (arranged and bonded in the right ways), it also gives out a further individual—their fusion—satisfying further conditions enabling it to count as an H₂O molecule (§2.3). And in general it cannot be analytic that, if fundamental reality is so, then there are also just so many derivative entities as well, satisfying various further conditions.

But let the notion of “analyticity” stretch so far, so as to allow connections across individuals and between further conditions, and thereby to deflate the existence and nature gaps between H, H, and O atoms and H₂O molecules as being closed “just by meanings.” With analyticity stretched so far, the existence and nature gaps between the physical and the phenomenal seem equally deflatable. For if it can be “just by meanings” that the H, H, and O atoms compose something miscible, it can equally be “just by meanings” that these neurons and synapses compose someone miserable. Or at least, no relevant difference between the chemical and the phenomenal has been identified, that keeps the latter specially out of reach of this stretched-out notion of the analytic.⁴⁰ (It is hard to be a dualist if analytic connections are so easy!)

If there are remaining constraints on this stretched-out notion of analyticity which separate the chemical and the phenomenal cases, I should like to hear them. One idea is to appeal back to transparency, by banning this notion of the analytic from stretching across opaque connections, and then claiming that the

³⁹ In more detail: Chalmers (2009) posits a contextually variable *furnishing function* which map worlds to domains of quantification. He distinguishes *ontological contexts* in which the speaker intends to invoke an absolute domain, from *ordinary contexts* with no such intention. He doubts that there is any absolute domain. So on his preferred view, the furnishing function at ontological contexts crashes, rendering metaphysical sentences defective (*Antirealism* reigns in the ontology room); while the furnishing function at various ordinary contexts determines a contextually varying domain of quantification (a contextualist form of *Lightweightism* holds sway in the pub). Chalmers is also open to a view on which fundamental truths are singled out for special and perhaps even *Heavyweightism*-style treatment, especially because he (2009: 119) thinks that there is a fact of the matter as to whether for instance “a physicalist or a phenomenalist view of the fundamental level is correct,” adding that his “sympathy for anti-realism reaches its limits: I find it impossible to believe that *this* is something about which there could be no fact of the matter.”

⁴⁰ Thomasson (2007; cf. Schaffer 2009b) defends *Lightweightism*, arguing that these stretched-out analytic connections arise because terms must be associated with application conditions to fix determinate reference. Her account of the analytic applies to chemical and phenomenal terms equally, since both equally need application conditions.

physical-phenomenal connection is specially opaque. But obviously that would be circular, insofar as the point of bringing in *Lightweightism* at this stage was precisely to establish that the physical-phenomenal connection is specially opaque. (“Why is this connection specially opaque? Because there is no analytic connection. Why is there no analytic connection? Because the connection is specially opaque.”) Explanatory gap arguments run through this circle could not prove that the physical-phenomenal connection is specially opaque, but already presuppose it.

So neither *Antirealism* nor *Lightweightism* separates the chemical from the phenomenal, nor threatens to re-open any special gap for the phenomenal. Contextualist mixtures of *Antirealism* and *Lightweightism*—including Chalmers’s own mixture of *Antirealism* for ontological contexts and *Lightweightism* for ordinary contexts—can fare no better. Such mixtures not only inherit the problems of both *Antirealism* (including violations of classical quantified logic) and *Lightweightism* (hyperextended analyticities), but they simply mix the reasons why there is no special physical-phenomenal gap at various contexts. That is, in contexts in which *Antirealism* holds, explanatory gap arguments will fail because ‘phenomenal states exist’ will not be true; while in contexts in which *Lightweightism* holds, explanatory gap arguments will fail because the phenomenal will be just as much in the range of analytic entailments as the chemical. (It is hard to be a dualist if metaphysical claims just swing between being false and being so easily analytic!)

Contextualist mixtures that include *Heavyweightism* in with *Antirealism* and/or *Lightweightism* are logically possible as well, but add nothing new. They inherit the problems of *Antirealism* and/or *Lightweightism*, but add no solutions.

Turning finally to *Heavyweightism*, I consider this the most plausible option all along, and I have argued that the relevant existence and nature claims are not a priori knowable (§§2-3). Here is where Chalmers and I at last converge. We both agree that *if the heavyweight view is correct and the existence and nature claims are not a priori knowable, then substantive principles of grounding need to be added to get explanations.*⁴¹ (We only disagree on the prior plausibility of such a heavyweight view.) In effect my main argument is that, once grounding principles are admitted into the scrutability base, they bridge the explanatory gap between the physical and the phenomenal. Given the physical information plus the physical-phenomenal grounding principles, the phenomenal becomes scrutable.

So I conclude that the friend of explanatory gap arguments should not appeal to metaphysical deflationism, nor would it help. The deflationist approaches of *Antirealism* and *Lightweightism* equally deflate the phenomenal, and the inflationary approach of *Heavyweightism* equally inflates the chemical. I think that the problem is not that I have inflated the chemical, but rather that the friend of explanatory gap arguments has inflated the phenomenal without extending the same courtesy to the chemical.

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⁴¹ Thus Chalmers (2012: 269) says: “What if a heavyweight view is correct? In this case the scrutability base may need to be expanded slightly in order to cover positive truths about the existence of macrophysical or abstract objects. The most natural way for this to work is for certain general ontological principles to be added: perhaps principles saying that when certain microphysical conditions obtain, certain macroscopic entities exist.”

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