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What Breathes Fire into the Equations?

A Response to Critics

It is difficult for the metaphysician to not be fascinated by Stephen Hawking's question, 'What is it that breathes fire into the equations and makes a universe for them to govern?' (Hawking, 1988, p. 174). Like a Tuscan countryside in the eyes of a painter, this statement inspires quite the stream of consciousness, at least in my idiosyncratic mind. For one thing, Hawking's wording sounds as if abstract entities provide push and pull to the universe. Why would the equations govern anything, rather than merely describing how events tend to unfold? Objections aside though, I like Hawking's question because it makes me wonder, given the mathematical nature of fundamental physical theories, what, in the realm of concreta, the lofty equations are describing. And, in another blip of consciousness, I am reminded of my Russellian monist friends, who would perhaps see, in Hawking's question, the related question: how do we know what is ontologically fundamental, if science just details the nomological-causal structure of the world, and remains silent about its underlying categorical properties? Not quite like the rich hues of Tuscany at sunset, but alas, the mathematical nature of physics intrigues me.

Many of the commentators take these issues seriously too, and, although we do not collectively agree on an answer to Hawking's question, their pieces venture thought provoking responses to my paper. Several commentators attempt to make Platonistic physicalism palatable, seeing nominalism as less inviting after my discussion. Others believe I have sold fictionalism short, or that I've said too little

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about my own positive view (i.e. protomentalism), which is my suggestion for a metaphysically fundamental entity that ‘breathes fire into the equations’. I am very grateful for all their insights and efforts. I will begin with Vision’s paper as some of these issues inform the rest of the discussion. I will then turn to Platonism (Barbara Montero, Carlos Montemayor, Gene Witmer), and, finally, nominalism (Mark Balaguer, Philip Goff). I close with Goff’s commentary, because it brings us full circle back to my defence of protomentalism, as we’ll see.

1. Panpsychism versus Protomentalism: Vision’s Critique

Vision presses me for more detail on my panprotopsychist view. *Inter alia*, he raises many worries for its close cousin, panpsychism — worries that he is concerned extend to my position.

I’ll need to put my cards on the table. Protomentalism posits a sole ontological ingredient to reality: quasi-mentalistic tropes. These tropes have their causal powers essentially, and, when in the right configurations, they feel a certain way to subjects of experience. And they serve as the truthmakers for theories in fundamental physics — they are what physics is *about*. Protomentalism is my version of what has been called ‘panprotopsychism’. To Hawking’s question, I hereby offer my fire breathing dragon.

Protomentalism vehemently rejects panpsychism. First, I agree with Vision that it is implausible that fundamental particles (strings, branes, etc.) have experiential properties. There is no evidence for this. Here, the panpsychist would respond that microexperience is a minimal kind of experience — it is the ‘what it’s like to be a microphysical entity’, and it is so minimal that we shouldn’t expect it to be detected. But why is experience still a form of experience when it is so watered down that it can inhere in a particle? The protomentalist says that there is, instead, protoexperience (Schneider, 2017). At the fundamental level, there are ingredients that give rise to conscious experience in certain macroscopic systems but which are not themselves forms of experience.

Second, in addition, the panpsychist holds that the bearers of the low-level experiential properties are mini-subjects. Perhaps they defend this because it seems reasonable to say that the entity that has experience must be some kind of a subject, or at least a mind, self, or person. Particles are nothing like subjects, minds, selves, or persons,

however. Of course, particles lack psychological continuity, brains, narratives, unified conscious experience, and so on. So they are missing the key ingredients that we associate with subjectivity (*ibid.*). I prefer to avoid these category mistakes and not use the expressions ‘experience’ and ‘subject’ in the context of microproperties and microsubstances (e.g. particles). Instead, all the protomentalist says is that we have the low-level ingredients that, under certain circumstances, give rise to macroexperiences and minds (selves, subjects, or persons).

I believe Vision and I are more or less in agreement about these drawbacks with panpsychism then. And it would seem that we are also both hesitant to say much about the underlying ‘inscrutables’ (to use Montero’s expression), if such exist. And he takes the panpsychist to task for saying too much about them. I do not believe in inscrutables, however. Many current panpsychists (often calling themselves ‘Russellian monists’) hold that at ontological rock bottom there is a mosaic of categorical properties. Dispositions supervene on these. This leads to the worry that physics just studies the dispositions, not the underlying categorical nature of the properties themselves, as the inscrutables do not have their causal powers or dispositions essentially. So the nature of reality is, in principle, inaccessible to fundamental physics. In this sense, the inscrutables call to mind Kant’s thing-in-itself. But here, the Russellian monist steps in with a positive suggestion: the inscrutables are phenomenal, or, for the pan-protopsychists, protophenomenal. In this way, something positive is said about the inscrutables, but the properties are still inscrutable in the sense that physics doesn’t explain them.

We should reject an ontology of inscrutables. A pure categoricalist view of properties is controversial and, I believe, mistaken. Some fundamental particles in physics, such as elementary bosons, are inherently force-bearing particles. It makes little sense to think that the fundamental properties these particles instantiate have non-causal natures, *contra* physics. They are what they do. Indeed, on a categoricalist view, properties can have entirely different causal powers in different possible worlds, yet retain their original identities.

On the view I favour, properties have causal natures. More specifically, properties are both dispositional and categorical (or ‘qualitative’). As John Heil explains: ‘A property’s dispositionality and qualitativeness are not aspects or properties of the property, they are rather the property itself, differently considered’ (Heil, 2012). This has

been called the ‘powerful qualities’ view of properties (see Heil, 2012; Heil and Robb, 2003). Heil and Robb elaborate:

Consider an ordinary quality: *being square*. This quality might appear to be a clear example of a categorical property. But note: in virtue of being square, an object is disposed to pass smoothly through holes of certain shapes (and not through others), disposed to reflect light in a particular way, disposed to make an indentation of a particular kind in a lump of clay. Being square, then, appears through and through dispositional. (Heil and Robb, 2003)

Given a powerful qualities view, the underlying properties aren’t inscrutable. They are dispositions detailed by science, and, when the properties are in certain configurations, they are felt by subjects ‘from the inside’. But what about this felt quality? Isn’t that inscrutable? Scientific work that aims to unite first-person investigations and the third-person study of consciousness is thriving (see many of the papers in Schneider and Velmans, 2017, for instance). So I am not at all persuaded that the inner feel of a quale is beyond scientific investigation, especially since the inner feel is fully dispositional, on this view. I am suggesting that causal powers and the felt quality of protomental properties are inextricably bound together; we could think of categoricity and dispositionality as being different modes of presentation (MOPs) of the very same property, which is itself protomental.

What about the explanatory gap? If there really are protomental properties at the heart of reality, the gap would be epistemological only; the gap does not indicate a distinction between mental and physical properties, or between categorical bases and their dispositions. Experiential properties feel a certain way to subjects of experience, because the subjects are the creatures having them, and others do not share this unique access to the inner feel. Further, there are not zombie worlds: your molecule-for-molecule duplicate cannot lack qualia (Heil and Robb, 2003). If someone much like you lacked qualia, there is no possible world in which it would be a creature having all and only the same protomental properties as you do. That creature would not be a true duplicate of you.

But then, what about Vision’s larger point, that emergence is unscathed by the Problem of the Base? This depends on what entities consciousness is said to emerge from. If the emergentist’s base is physical, my Problem of the Base applies: how can the base be cashed out in a physically kosher way? If nominalism is appealed to, do the nominalist’s resources truly support physicalism? If, on the other

hand, Platonism is in force, what about the problems I raised in the target paper having to do with naturalism, causation, etc.? Of course, as Vision says, one must take care to specify what is more or less economical (theories, entities within a category, ontological schemes, etc.), and relatedly, what claims about individuation are supposed to be doing.

So now that more of my cards are on the table, and it is clear I've appealed to a powerful qualities view of properties, one of Vision's objections would seem to apply:

And if that were enough to interject those states into the nature of consciousness, *consistency demands including in anything's nature all of its dispositions. That lands us in a cheap version of wholesale holism.* It may be taken on board by some, but it incurs a serious debt to be discharged just for the sake of panpsychism. (Vision, this issue, p. 63, italics mine)

While there is no question of *meaning* holism, a related worry is that dispositionalists face a problem in isolating certain dispositions as part of the nature of the property, while saying others do not. In this sense, as my work on mental symbols and concepts indicates, I opt for holism, including all the dispositions in the nature of a property (Schneider, 2011). I've argued, in the context of mental state individuation, that scientific taxonomies should be finely grained so as to capture types that are sorted by sameness and difference of causal powers (at the relevant explanatory level). Otherwise, the laws will have counter-examples or the theory (i.e. body of laws) will be incomplete. And I am prepared to live with the consequence of this 'holism', including saying that a given property could not have had a different causal power. But a slightly different property could have.

Vision also raises the ominous 'combination problem'. In the context of panprotopsychism, this is the problem of whether non-experiences (i.e. protoexperiences) can constitute experiences. Are protoexperiences the right sort of ingredients? But if one thinks about panprotopsychism for even a moment, one can quickly see that the problem is not serious. For it is important to consider this commonly accepted definition of panprotopsychism:

Panprotopsychism: the fundamental entities identified by physics have properties ('P properties') that are precursors to consciousness and can collectively constitute consciousness in certain sophisticated computational systems, such as brains. (See, for example, Chalmers, 2016)

Notice that, by definition, P properties, *if they exist*, ‘collectively constitute consciousness’. Because the P properties are just the sort of things that constitute consciousness in complex systems, if they truly exist, it doesn’t make sense to ask *if* they combine to form single conscious states. So it isn’t really fair to ask whether the panproto-psychist’s properties are the sort of things that can do this. The answer is a simple ‘yes, by their very definition’.

This may have the feel of a ‘wise guy’ move, but seeing this simple point moves the discussion forward. First, it is reasonable to ask *how* the properties combine to form macroconscious states in different types of conscious systems. But here, on the assumption that P properties exist, given that they *do* form macroconscious states in the right circumstances, by their nature, it is reasonable to simply say that the job of cognitive science is to detail the dispositions of the P properties. We then look to work in cognitive science to explain the dispositions, i.e. the brain processes behind the unity of consciousness, object binding, etc. Philosophical work on subjectivity and the unity of consciousness is also central to this enterprise, and these issues are deeply challenging in their own right.

But here I imagine Vision and others saying that the protomentalist is flirting with the devil. For my view sounds like physicalism, claiming that we can get from the non-experiential to the experiential. Why isn’t protomentalism just another brand of physicalism then? The Problem of the Base provides the needed answer to this question. I suggested that Platonistic physicalism may be the only option for the physicalist, yet it has serious problems. I’ve urged that certain monisms (i.e. panpsychism, idealism, and panprotopsychism) stand to be more economical than physicalism, and that they fare better with respect to both mental and physical causation. My view is that the macro-level mental entities do supervene on a base of sparse properties, *but the sparse properties are protomental ones*. This is not physicalism then, at least if physicalism is understood as being a view that rejects basic mentality. So the physicalist’s microproperties are the wrong sort of ingredients to solve the Problem of the Base; something mentalistic needs to be fundamental. No physical without the mental!

These are only a few considerations for protomentalism, and this brief discussion is only a quick pass at Vision’s astute concerns. A more involved argument strategy for protomentalism could follow that of David Lewis in *On the Plurality of Worlds* (1986): show that we are justified in quantifying over a certain ontological category because

doing so allows one to account for different philosophically important areas of concern in a parsimonious manner.

Some primitives are hard to swallow (as with Lewis's, I'm afraid), even if they promise to explain important philosophical phenomena in an economical fashion. I believe that an ontological commitment to protomentalism is palatable, however. To sum up some advantages of protomentalism:

- Like panpsychism, mental properties are at the ground level, so they are causal.
- It fares better than Platonistic physicalism with respect to both mental and physical causation.
- Protomentalism is among the most economical approaches (with idealism and panpsychism).
- Like panpsychism, protomentalism provides a single answer to two important philosophical problems: what is the place of phenomenal properties in nature? And what are the intrinsic properties that underlie physics? The answer is that protom mentality is fundamental, and underlies physics (see Chalmers, 1996).
- Protomentalism is compatible with the full range of nominalisms in philosophy of mathematics.
- Protomentalism avoids inscrutables. Given a philosophical commitment to P properties, it seems that science studies the nature of the P properties, and it even explains why the felt quality of experience is perspectival.
- The combination problem is not as serious for protomentalism, given the way P properties are defined, although there are significant related issues in metaphysics about the nature of a subject, and in cognitive science and philosophy involving the unity of consciousness, etc.

Now let me turn to various criticisms of the Problem of the Base. Barbara Montero, Carlos Montemayor, and Gene Witmer seem to share my concern with nominalism, seeking to make Platonism more palatable for physicalism.

2. Living with Platonism

Montero on Defining the Physical

Barbera Montero begins by observing that certain physicalists, such as Quine, Witmer, and Melnyk, claim that physicalism is compatible

with Platonism. Of course, I agree. But, as she knows, even if certain physicalists claim that abstracta are compatible with physicalism, this isn't the same as taking the further ontological leap of admitting that the physical base is abstract. The additional leap involves saying there are (what she calls) 'base-abstracta': basic entities that are all or partly abstract. This doesn't merely involve the claim that there is an independent realm outside of space and time, as Platonists contend, it also holds that the entities in the domain of physics are partly or entirely abstract. A mere claim that Platonism is true does lead a physicalist to dualism, and this can, *ceteris paribus*, result in lost ontological economy. But it is this latter claim — that there are base-abstracta — which presents the physicalist with all sorts of additional problems as well, problems that I identified in the paper.

But, setting aside the issue of base-abstracta for the moment, is the existence of abstract entities really compatible with physicalism, as she suspects? The devil is in the details of how 'abstract' and 'physical' are defined. For instance, it isn't uncommon to include in one's definition of 'abstract' the expression 'non-physical', although Montero indicates that she would not use this definition of 'abstract'. One could, as she says, understand 'abstract' as Jerome Katz does, so as to allow abstract entities to have a spatial or temporal location, so it would not reasonably follow that they are non-physical. But I am under the strong impression that this is a non-standard understanding of 'abstract' in philosophy of mathematics, and if physicalism requires redefining a key concept in philosophy of mathematics, one that radically alters our conception of Platonism, this should be argued for on independent grounds, not just out of a need to formulate Platonistic physicalism.

I suspect that a better move is for the Platonistic physicalist to retain the heart of the notion of an abstract entity, i.e. that abstracta are non-spatial, non-temporal, acausal, and immutable, and press on, trying to make abstracta physically kosher. But for what it's worth, I don't think it is all that easy to formulate a physicalism compatible with abstract entities. Bearing in mind the dualism at the heart of the Platonistic physicalist's reality, perhaps the physicalist could simply restrict the quantifier in the claim 'everything is physical' to the realm of spatio-temporal entities only. In this way, Platonism and physicalism each make claims about the entirely distinct realms. (I suspect this move is behind some of the claims that abstracta are compatible with physicalism.) But over the last few years new discussions in physics (in theories of quantum gravity, in particular) suggest that space-time

is emergent. If this is right, then fundamental physical reality, like Plato's heaven, is not spatio-temporal. Indeed, the puzzling thing is that the base looks *prima facie* highly mathematical and abstract. Restricting the quantifier to space-time inhabitants would exclude fundamental entities!

Montero offers further thoughts on how to make abstracta physically kosher:

For example, one could argue that if the fundamental physical is defined, as it sometimes is, in terms of that which is given to us by physics, then, unless one thinks that physics is constrained to the spatio-temporal, being physical does not entail being spatio-temporal. Or one might argue that since the fundamental physical is simply the fundamental non-mental... then, assuming that there is nothing mental to such abstracta, they are part of the physical realm. However... what would happen to the debate over physicalism if physicists discovered something that gives rise to space-time, yet is not itself spatio-temporal? Would that necessarily falsify physicalism? If, as it seems, most philosophers on either side of the debate over physicalism would still see physicalism as an open question, it seems that the mere lack of spatio-temporal properties does not suffice to make something non-physical. And thus, if abstracta are not physical, or if they are in tension with physicalism, or contrary to physicalistic ideals, it must be for some other reason than (or at least in addition to) their lack of spatial and temporal properties. But what could this be? Could it be that abstracta are contrary to physicalism because they leave us with a dualistic ontology? (Montero, this issue, pp. 44–5)

There is a lot to mull over here. For one thing, as I've noted, the physicalist must reckon with the fact that the leading theories of quantum gravity take space-time to be emergent. (Unfortunately, one can't dismiss emergent space-time by complaining about string theory, as emergent space-time is found in loop quantum gravity, although I suspect a kind of prototime is found at the rock bottom level in both. See *infra*, p. last page.) And when emergent space-time is taken seriously, it becomes clear that the physicalist should not say that being spatio-temporal is necessary for being physical.¹ As Montero knows, this makes defining physicalism tricky for those physicalists who had looked to space-time as a distinctive mark of the physical.

¹ Is it sufficient? I do not believe so, as mental or protomental phenomena could be spatio-temporal.

But suppose these issues can be dealt with. Would a physicalist dualism be attractive, to begin with? I urged that there are tremendous problems. Further, if the physicalist is dualist (and, as I noted, this need not even involve base-abstracta), physicalism loses ontological economy, relative to competing approaches. To be sure, as Montero notes, the metaphysician *should* multiply entities when necessary. But is doing so really necessary in this case? Must we be Platonists? Nominalists in philosophy of mathematics would obviously disagree. If they are right, physicalism can't avoid erroneously adopting abstracta. And non-physicalists, but not physicalists, can brandish the razor.

To warm us up to the basic idea of a dualistic physicalism, Montero provides an example of a form of dualism that is compatible with physicalism:

For example, from what I gather of physics... dark matter is thought to either be made up of ordinary matter particles, in the form of massive compact halo objects, 'MACHOs', or of something entirely different from ordinary matter particles, such as weakly interacting massive particles, 'WIMPs'. (Why is it that physicists get to have all the fun while we feel compelled to traffic in 'abstracta', 'concreta', and other terminological soberties?) Would it threaten physicalism if dark matter turns out to comprise something utterly different from ordinary matter? And then there is dark energy. (Montero, this issue, p. 46)

By my lights, her intriguing example is a case of different kinds of particulars within a singular realm, not a true case of ontological pluralism. The difference between her case and an abstract/concrete dualism, or the more standard case of Cartesian souls, is that MACHOs and WIMPs are explainable by physics (i.e. a future, completed physics), whereas the study of abstract entities and Cartesian souls will not be explainable by anything like physics as we know it, but by metaphysics, philosophy of mathematics, and/or theology. Abstracta and Cartesian souls, should they exist, would inhabit realms distinct from the physical.

I am grateful to Montero for all these thought provoking ideas. In a similar vein, Carlos Montemayor also outlines ways to improve Platonistic physicalism.

Montemayor on Information Theory

In his intriguing commentary, Carlos Montemayor raises the important issue of whether there are information theoretic resources available to the physicalist. He explains:

In a broad sense, ‘information’ can be defined in terms of the reduction of uncertainty. According to this general definition, the more information you have, the less uncertain you are about a subject matter or the completion of a goal, and vice versa. Information, thus, can be understood as an epistemic term, related to evidence and explanation. Construed this way, appealing to information theory suggests that one can indeed circumvent the problem of Platonism, which is an ontologically committed view about the existence of mathematical objects. (Montemayor, this issue, p. 93)

I am not convinced that an appeal to information theory helps the physicalist. For one thing, when information is explained in this broad sense, it seems mind-dependent, as it involves the reduction of uncertainty, which is being described in terms of goals and subjects. But the devil is surely in the details, and Montemayor quickly follows up with a brief elaboration on various approaches:

For instance, Shannon’s notion of information measures it in terms of the physical notion of entropy, applying it to uncertainty reduction; quantum information has more complexity and capacity than classical information in a way that can be precisely measured. These accounts of information emphasize measurement, quantitative approaches, and manipulability. Qualitative accounts of information contrast information with specific epistemic achievements, such as justified belief or knowledge, or they specify differences in information from a semantic perspective (*ibid.*). Common to all these definitions, however, is the commitment that information is constrained (formally or causally), stored, and manipulable. (*ibid.*)

Montemayor doesn’t explain whether or how any of the qualitative approaches truly avoid pulling in intentional or mentalistic entities, such as meanings, goals, and perspectives. Further, it isn’t clear how the quantitative accounts avoid abstracta. Further, if entropy is not a fundamental feature of the universe, but emerges from a non-spatio-temporal structure of some sort, information, if spelled out in terms of entropy, will not be a basic feature of the universe. If that is the case, it would be circular to deploy information to individuate fundamental entities in the physical base.

This is not to rule out information theoretic approaches, but to raise issues for further reflection. I believe this is very much in the spirit of

Montemayor's paper. For instance, he suggests the physicalist respond to the following excellent question:

Call this the *Informational Problem of the Base*. The goal would be to explain the nature of information as part of our understanding of physics and its relation to, among other things, consciousness within a monistic framework... The Informational Problem of the Base transcends physicalism. For example, some non-physicalists use information to motivate their views (see Chalmers, 1996) and prominent pan-psychist views are explicitly informational (see Oizumi, Albantakis and Tononi, 2014). How can the physicalist defend her account of the base if information is used to motivate non-physicalist views? (*ibid.*, p. 95)

Montemayor then turns to a different issue, pondering whether the physicalist even needs to take Platonism seriously, as it doesn't guide enquiry in physics itself:

But surely philosophers of science and practising physicists would consider mere mathematical abstracta to be too uninformative and general to understand physics. For instance, contemporary physics relies on vast areas of mathematics that were developed independently of experimental or empirical considerations. But the relevance of these areas in physics is always dependent on how they can become manipulable through experiment. Platonism, a view about the reality of numbers, cannot guide physicists in performing this task. Couldn't physicalists say that the philosophy of mathematics is orthogonal to philosophy of science and irrelevant to our understanding of how quantum mechanics and gravity operate? (*ibid.*, p. 98)

I am not saying the Problem of the Base is, or should be, a problem for physics, as a discipline, although I'm aware of the related, but distinct, concerns about whether string theory can be tested, and I'm truly perplexed about claims about emergent space-time. These latter two concerns bother those in physics proper, whereas the Problem of the Base does not. But this doesn't mean that the Problem of the Base is not a serious philosophical problem. In addition, Platonists would counter that mathematics is at the very ontological heart of physics. One of the best arguments for being a Platonist is the famous Quine-Putnam indispensability argument, which holds that the indispensability of mathematics to empirical science provides good reason to believe that mathematical entities exist (Quine, 1976; Putnam, 1979).

Montemayor's final point is that the physicalist should provide a better account of the abstract/concrete distinction, to help solve the Problem of the Base. As he knows, this distinction is difficult to draw, so he suggests that physicalists maintain that the distinction isn't sharp, that they understand it in terms of a distinction between the

possible and the actual, and that the physicalist take modality as primitive. I look forward to physicalist developments of the abstract/concrete distinction. I'm afraid I'm not clear on the positive proposal here; the idea seems to be to appeal to actual properties as paradigm cases of concreta, and further, to appeal to the most natural properties, i.e. the sparse properties identified by a completed physics. But the sparse physical properties are precisely the kind of properties which the Problem of the Base arises for, as they seem, *prima facie*, to be heavily mathematical. But perhaps the key here is to locate precisely what Montemayor is looking for, a theory of information that silences concerns about abstracta.

Gene Witmer on Platonism and Universals

In his rich and provocative discussion, Gene Witmer's main concern is that I implicitly hold that it is acceptable for physicalists to appeal to abstract entities in the physical base because I do not object to the physicalist's use of universals in the physical base. So it is bizarre that I maintain that abstracta pose a problem for physicalism.

I'll need to contrast immanent from transcendent universals, and explain how this distinction bears on nominalism in philosophy of mathematics. As Witmer mentions, I note the distinction between two different brands of nominalism (p. 14, footnote 6). Nominalism about properties in metaphysics is close kin to nominalism in philosophy of mathematics, so it is easy to suspect that, just as those who reject nominalism in philosophy of mathematics embrace abstracta, so too those who reject nominalism about universals accept them. But this isn't the case.

To be sure, if a physicalist appeals to Platonism about universals then she clearly appeals to abstract entities (where, again, I understand such in the standard way: as immutable, acausal, non-spatial, atemporal entities). And yes, I would object to her Platonism, urging that the base is abstract. But physicalists tend to reject transcendent universals for either tropes or Armstrongian (i.e. immanent) universals. According to D.M. Armstrong, there are no universals outside of space and time. Universals are wholly present in each instantiation (Armstrong, 1989a,b). (I'm not a fan of this latter claim: how could something be entirely present in each instantiation and multiply located, as universals are supposed to be? So I've abandoned Armstrongian universals for tropes.) In any case, the proponent of Armstrongian universals aims to reject abstract entities.

What about tropes? Are they abstract? Tropes are a strange beast. They are called ‘abstract particulars’, and this leads people to assume, as is natural, that they are abstract in the orthodox sense discussed in the paper. But this is not what is meant by ‘abstract particulars’. Tropes, e.g. *the televising of the Superbowl on Sunday, seeing the glass of Montepulciano in Florence on Wednesday*, are simply concrete property instances. They are paradigmatically spatial, temporal, and causal.

But this is just an aside, as Witmer raises tropes for another reason, and he knows that tropes are not abstract in the sense mathematical entities are. For he writes:

...it seems a live option to think of mathematical entities as themselves kinds of properties. If, however, properties can be understood as classes of tropes, the way is clear to think of mathematical entities as classes of tropes as well. In that case, however, the first premise of the main argument — that abstracta individuate some of the entities in the physical base — loses its motivation. (Witmer, this issue, p. 82)

Keith Campbell offers a similar strategy, which I responded to in the target paper (p. 23). This approach seems to presuppose the notions of number and addition (*ibid.*). Witmer responds that my reply to Campbell would equally apply to a protomentalist’s use of trope nominalism. But I take the truthmakers for concepts (like the concept of number) to be built out of configurations of fundamental protomental properties. Such truthmakers can be mentalistic, or protomentalistic, whereas the physicalist’s cannot be.

Witmer then turns to three of the problems that I raise for Platonistic physicalism. The first that he discusses is the problem of object natures, and here he worries that metaphysical constituency is conflated with the notion of a spatial part. Of course, metaphysical constituents are not the same as spatial parts, but the point is that it is odd to think of an abstract entity as a metaphysical constituent of a spatial object, at least according to each of the leading theories of substance, the bundle and substratum views. Both take an object’s nature to be determined by properties, and they claim the constituent properties are the properties that have instances that are within the spatio-temporal boundaries of the object (as blurry as those boundaries are, upon scrutiny).² Mathematical properties surely

² The substratum view appeals to substrata as well, saying substances are propertied substrata.

describe the object, but it is far from clear that they are constituents of the object.

Of course, Witmer is correct that the physicalist could reject these leading theories for a view in which substances are basic. But many physicalist theories posit a basic level of property instances and build up from there, so they aren't interested in basic substances. Further, I wonder if there is even room for basic substances in the world of quantum gravity, where matter itself is said to be emergent. Would something neither spatial nor temporal be a substance at all? And would it be a suitable substance for a physicalist who wants fundamental substances to be the ontological building blocks of macro-substances?

Witmer then turns to the issues I raise for the Platonistic physicalist that concern naturalism and causation. He aptly notes that committing to tropes alleviates these problems. I had suggested this as well (Schneider, this issue, pp. 29–30) so I obviously agree. But, as noted, doing so is less economical than competing non-physicalist positions that just appeal to a single theory of properties, rather than to both tropes and transcendent universals. So the physicalist would need to motivate the twofold appeal on independent grounds.

Another important option that Witmer supports is providing an account in which ‘*some* of the entities in the physical base are abstract, or at least partly abstract in nature’ (Witmer, this issue, p. 86). It would be interesting to see a Platonistic physicalism developed in either of these ways. Concerning the latter option, as he notes, ‘It’s not as if any reason has been given for thinking that every entity that counts as physical must be entirely abstract’ (*ibid.*). I agree, although the conclusion of the main argument of the paper still applies; it had specifically noted the possibility that base entities could be partly abstract (Schneider, this issue, p. 11). Further, I find the notion of partially abstract entities initially problematic: ‘It strikes me as incoherent for an entity to be a metaphysical composite of something abstract and concrete. How can something be both in and not in space-time, or be both changing and unchanging?’ (*ibid.*, p. 12).

Witmer then considers the problem of lost ontological economy. Here, he offers a general objection to versions of nominalism that explain abstracta in terms of mentality, ‘...if no minds had ever existed, no mathematical claims would have been true’ (Witmer, this issue, p. 89). He finds this unpalatable. Of course, his objection would apply to physicalist nominalists as well, but his point is to defend Platonistic physicalism, in particular, and he is concerned that the non-

physicalist's putative gain in ontological economy comes at too heavy a cost. But I'm not convinced that, on the assumption that there is good reason to reject Platonism, it is really so implausible to say that the truth of mathematical statements depends on mental entities of some sort.

Finally, in the context of his discussion of this matter, Witmer comments: 'It is a bit odd to be told that the Platonistic physicalist is positing ingredients that are "not part of physics itself" in the same paper in which we are told that the mathematical character of theories from physics itself is what threatens the physicalist with Platonism' (*ibid.*, p. 88). To clarify, these 'ingredients' are abstracta. The ontological commitment to Platonism stems not from physics itself, but from metaphysics and philosophy of mathematics, whereas the mathematical character of current physical theories, such as string theory, is within physics.

These commentaries have provided many important suggestions for the Platonistic physicalist to pursue, as a way to solve the Problem of the Base, and, relatedly, as a means to answer Hawking's fascinating question. Platonism cannot be easily dismissed; the Quine-Putnam indispensability argument is too serious. But the physicalist/nominalist has resources up his sleeve as well. So I'll now turn to Mark Balaguer's attempt to defend fictionalism.

3. Reviving Nominalism

In his thoughtful commentary, Balaguer rejects my claim that fictionalism is mind-dependent, although, as far as I can tell, his claim that I mischaracterize fictionalism is too strong. (In my target paper, I quoted scholars of fictionalism, including him, to support the position that orthodox fictionalism is mind-dependent. And he grants that Field's fictionalism is mind-dependent. So I'm a bit perplexed.) But in any case, he believes his own version of the view is not mind-dependent, and his version is crucial to consider. He explains:

...I've argued... that fictionalists should employ the following definitions instead: (a) the so-called *story of mathematics* is just the claim that Platonism is true (or more precisely, it's the claim that *plenitudo* Platonism is true — more on this in a bit); and (b) a sentence is *true in the story of mathematics* iff (roughly) it would have been true if Platonism had been true — or, more precisely, iff it would have been true if there had actually existed a (plenitudo) realm of abstract mathematical objects. (The reason the second formulation is a better characterization of what fictionalists believe (when they say that

sentences like ‘3 is prime’ are true in the story of mathematics) is that the first formulation involves a claim about *Platonism*, and Platonism is presumably an abstract object (in particular, a proposition), and fictionalists don’t believe in abstract objects.) (Balaguer, this issue, pp. 104–5)

Notice that counterfactuals are doing a lot of work for Balaguer in cashing out the notion of truth in the story of mathematics. For example:

(CF) ‘3 is prime’ is true in the story of mathematics if ‘there had actually been a plenitudinous realm of abstract mathematical objects, then it would have been the case that 3 was prime’.

Many Platonists reject plenitudinous or full-blooded Platonism as involving too bloated a commitment to abstract entities, as it holds that any mathematical object which can exist, indeed exists (Balaguer, 1998). Others find it a welcome improvement over orthodox Platonism. In any case, I have several concerns. First, it is highly controversial to claim that there is a nearby world where Platonism is true, while Platonism is false in the actual world. Platonism, if true, seems necessarily true.

In addition, in the target paper, I argued that it will not help the physicalist to appeal to primitive modality (p. 21). Are there better options available? Debates over the nature of modality involve careful reflection over ontological commitment to possibilia, and theorists often seek to avoid taking modality as primitive by cashing out modal claims in terms of something that is said to be less controversial, such as linguistic entities, immanent universals, particulars of some sort, abstract entities, etc. A well-known example of a promising, and physicalism friendly, view is D.M. Armstrong’s combinatorial theory of modality, which appeals to immanent universals and thin particulars (Armstrong, 1989b). Linguistic ersatzist views are also popular. According to these positions, ersatz worlds are much like stories or theories, being built out of the words and sentences of some world-making language. Such represent by virtue of stipulated meanings of the words and sentences (Lewis, 1989).

Linguistic ersatzism will not help the physicalist. Meaning cannot be a viable way to cash out the nature of the base as entities in the base would ultimately be grounded in something intentional or semantic. Armstrong’s combinatorialism, on the other hand, is very much in keeping with a physicalist worldview, so this initially seems like a more promising angle. Yet appealing to sparse universals or thin

particulars doesn't help. For one thing, according to Armstrong, the list of sparse universals is delivered up by a completed physics, and the thin particulars are simply that which instantiates them. The sparse universals/thin particulars are what the Problem of the Base suggests need explaining. *Prima facie*, the Problem of the Base suggests that the fundamental physical entities seem to be abstract — so simply supplying more abstract seeming entities just moves the bump in the rug. The original problem asks: why are such entities physically kosher? For another thing, consider (CF). What possible world is there where Platonism is true, according to combinatorialism? Platonic entities aren't actual; I suppose they would be what Armstrong calls 'alien' entities, if he would countenance them at all. But according to combinatorialism, modal statements involving alien entities have, as truthmakers, actual entities, which are immanent universals and thin particulars (Armstrong 1989b; Schneider, 2001).

Further, Balaguer's alternate version of fictionalism strikes me as resting on an implausible claim about what the story of mathematics is. He explains: '...according to the fictionalist view I'm describing here, the relevant story of mathematics is the claim that *plenitudinous* Platonism is true' (p. 107). The story of mathematics plausibly includes mathematical axioms and practices, and it is difficult to stomach that these things are not involved in the story, but, instead, the story is that a philosophical theory is true, one that invokes a highly specific and controversial type of Platonism at that.

I hope my remarks alleviate some of Balaguer's concerns. (But, as with all of the replies, I long to discuss all this with them in person, over a steaming cappuccino.) Finally, let's consider the intriguing commentary by Philip Goff, which leads us full circle, back to proto-mentalism and Hawking's fascinating question.

Goff on Fictionalism and Russellianism

Philip Goff considers general issues at the heart of philosophy of mathematics, and how they bear on physicalism. For instance, he writes: 'The mere fact that an entity we think of as concrete has mathematical properties does not seem to me to threaten its claim to be concrete' (Goff, this issue, p. 51). I agree, but my concern is, rather, that the Problem of the Base arises when the abstract properties seem to be essential to the nature of the entity. But shortly thereafter, he ventures a stronger claim: '...even if a putative concrete entity *E* has a mathematical property as part of its essence, I submit that this

does not in itself threaten *E*'s claim to be a concrete entity' (*ibid.*, p. 52). But his example of Plato's on the three aspects of the soul seems to assume the notion of number (i.e. 'one', 'then another'), and so I suspect Goff is merely explaining number in terms of number, which seems circular. (For a longer discussion, see my discussion of Campbell's trope-based nominalism, where a similar position is ventured — p. 23). But the Problem of the Base doesn't plague Goff's panpsychism in any case. As the target paper said, the panpsychist, idealist, and panprotopsychist are free to embrace a mind-dependent nominalism. All the power to them.

But what if the physical properties are just logico-mathematical properties? Here, Goff suggests a surprising route for the physicalist: that she reduce the concrete to the abstract, embracing a purely abstract reality! I suppose a physicalist of this stripe could argue that abstract entities are physical because, say, a commitment to abstracta is at the heart of contemporary microphysics. And then, with the Pythagorean, she could embrace a Mathematical Universe Hypothesis, saying: it's all mathematics, through and through. This is quite an answer to Hawking's question, one which places abstract entities at the heart of reality, no more. But both Goff and I think this approach is ontologically threadbare for the same reason: reality is at rock bottom causal or nomic. There are different ways to flesh this out (e.g. primitivism about laws), but, as noted, I opt for a powerful qualities view of properties, according to which properties have their causal powers essentially. Because categoricity is also at the heart of my property natures, on this view, I avoid the problem Goff raises with causal structuralism (Goff ,this issue, p. 54). Goff and I also agree that noumenalism is a serious threat for the physicalist, although our reasons differ. My worry is that if nominalism about mathematics is unavailable, as I suggest, the physicalist will need to be a Platonist, and the underlying nature of concrete reality threatens to be unknowable.

Goff urges that a fictionalist hold that the mathematical statements that characterize physical reality are true (as opposed to being untrue or just being true in the story of mathematics). But this would require the success of projects to nominalize different branches of physics, such as quantum mechanics. In the target paper, I had expressed a concern with Field's nominalization of quantum mechanics, which needs space-time regions. In his commentary, Goff responds that emergent space-time would pose a problem for non-physicalists as well.

This leads us full circle, back to our original discussion of what kind of entity (or entities) lie beneath mathematized physics; that illusive ontological dragon that, in Hawking's words, 'breathes fire into the equations'. To be sure, I think emergent space-time is a *huge* problem for those who place experience at the ground level (panpsychists, idealists). If there is no time at this level, how could there be experience, which seems to require duration? And without experience at the ground level, why say there are minds or subjects at that level? In contrast, space-time emergence seems unproblematic for a panprotopsychist view, which merely takes fundamental properties to be protomental; on this view, experience and minds (selves, subjects) arise only at the level of matter and space-time. The basic protomental ingredients could, in fact, be just those ingredients that underlie all space-time: the physicist's fundamental properties that are, in a sense, protospacial and prototemporal. The panprotopsychist may turn out to have the right kind of truthmakers for her mathematical statements then, and they are the very same ingredients that physics poses.

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