

RETHINKING OUTSIDE THE TOOLBOX: REFLECTING AGAIN ON THE RELATIONSHIP BETWEEN PHILOSOPHY OF SCIENCE AND METAPHYSICS

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Abstract: In a recent work, ‘Thinking Outside the Toolbox’, we mounted a qualified defence of analytic metaphysics in the face of ardent criticism. While sympathizing with other philosophers of science in decrying the lack of engagement of metaphysicians with real science when addressing central metaphysical problems, we also wanted to acknowledge the role that analytic metaphysics has played in providing useful tools for naturalistic metaphysicians. This double-edged stance compels us to identify what feature it is that marks out as problematic some, but not all, analytic metaphysics, and this we thought we could do by appeal to something we call here the *compatibility principle*. It now strikes us, however, that the approach we took in that earlier work is fundamentally unstable. After giving a streamlined presentation of our earlier argument, we will identify where we take the instability to lie. From there we shall make a more nuanced proposal for how naturalistic metaphysicians should regard the work of their analytic counterparts.

1. Introduction

A couple of years ago, we were fortunate enough to be invited to comment on the reflections of Michael Dummett on the state of contemporary analytic philosophy.¹ We were asked, in particular, to comment upon his lament

¹ Michael Dummett was in turn invited to comment on our reflections in the same volume, but very sadly shortly after we finished writing our article he passed away.

regarding the present lack of engagement between philosophy and physics. As he put it,

What is a genuine case of regret is the paucity of dialogue between philosophers and physicists. The generality of philosophers know too little physics to dare to venture to treat of the philosophical problems it raises, or to take due account of physical theories when addressing problems on which they bear... Never before, I believe, have philosophy and the natural sciences been so far apart.²

We should emphasize that Dummett is similarly disparaging of 'scientistic' attitudes on the part of many scientists themselves – as he says, 'it is not from science that we know genocide is wicked, or that Michaelangelo was a great artist' – and also of the resultant 'shameful intimidation' of some philosophers, 'who hope that by humbling themselves before the sciences they will be entitled to share in some of their triumphalism.' But his frustration concerning the remove of analytic philosophy, and of analytic metaphysics in particular, from contemporary science is shared by many philosophers of physics, and we wanted to take the opportunity to consider how we ourselves stood with respect to the criticisms presented by our philosophy of physics colleagues.³

Our claim in that paper was that philosophers of physics – at least those who, like us, are interested in the *metaphysics* of physics – are not in any position to decry scientifically disengaged metaphysics *tout court*, because analytic metaphysics has proved a useful heuristic for philosophers of physics. Nevertheless, we also felt convinced that many of the examples philosophers of physics have cited in support of their anti-metaphysical stance raised genuine problems for metaphysics. What we therefore attempted to do was demarcate between the scientifically disengaged metaphysics that was *prima facie* somehow legitimate, and the scientifically disengaged metaphysics that we think

² Dummett 2012, p. 19.

³ Note that since our claim will be that the most extreme claims of both sides in this debate have to be tempered, what we have to say will also have critical ramifications for the avowed 'scientism' of some philosophers of science, such as Ladyman and Ross (2007).

ought to be condemned. Since then, however, we have come to regard the distinction as we drew it there as fundamentally unstable, and part of what we would like to do in what follows is to explain why.

In the ensuing, we'll therefore present a streamlined outline of the argument of our earlier paper, before going on to highlight the instability that we now perceive in it. In a nutshell, we have come to believe that the 'heuristic' justification we offered for (what we took to be) a subset of analytic metaphysics cannot but sanction all metaphysics whatsoever. However, while it might sound as though this casts analytic metaphysicians as (to speak crudely) the 'winners' of this debate – something that Dummett himself would no doubt have been unhappy with – we ourselves think it does no such thing. We think, rather, that this conclusion serves to highlight just how *conditionalized* the value of analytic metaphysics is from a naturalistic point of view. That conditionalized support for metaphysics, *conceived of as a tool for philosophers of physics*, may be compared with the criticisms we will by that point have mounted against metaphysics, *conceived of as many analytic metaphysicians themselves do*. Although the picture that results is a complex one, we think the comparison reveals that, whatever the positive spin that can be put on it, the naturalistic backlash against analytic metaphysics remains well-motivated and that metaphysics needs to recommit to science if it is to succeed in its own terms.

Before we proceed with all that, however, some terminological and dialectical remarks are in order. By 'analytic' metaphysics, we will mean metaphysics that is 'non-naturalistic'; by 'naturalistic' metaphysics, we will mean metaphysics that somehow 'engages with', 'is continuous with', or is in some sense 'informed by' science⁴. While we appreciate that these are metaphors and that spelling out what they, and thus 'naturalistic metaphysics' itself, actually amount to is non-

⁴ So, as an example of the former we include discussions of 'gunk' in mereology, and of the latter, we would include consideration of whether quantum mechanics supports monism; we will provide further examples below. Note that this distinction is made on the basis of the nature of the relevant considerations or discussion; one and the same metaphysician can work both sides of the divide. Note finally that if the reader is sceptical that there is a firm distinction to be drawn here, it is part of the *raison d'être* of this paper to problematize precisely that assumption!

trivial (cf. Chakravartty (2013)), for present purposes we will take it that there is good enough agreement at least on the extension of the term.⁵ Furthermore, the idea that naturalistic metaphysics is a legitimate form of enquiry by virtue of its relative ‘closeness’ to the sciences is not one that will be questioned in this work. The principal motivation for the current paper is to investigate the claims naturalistic metaphysicians have made regarding the diminished status of analytic metaphysics relative to that of their own; whether or not that latter status is itself legitimate is a matter for another day.

2. The Critical Background

As noted above, many contemporary philosophers of physics share the concerns that Dummett voiced regarding the insular nature of today’s analytic metaphysics. These frustrations have been expounded in articles and works by a number of philosophers of physics – see, for example, Maudlin (2007), Callender (2011), and Price (2009) – but the classic statement of the view is without doubt Chapter 1 of Ladyman and Ross’ *Every Thing Must Go*. As they put it, “one of the main contentions [of that work] is that contemporary analytic metaphysics, a professional activity engaged in by some extremely intelligent and morally serious people, fails to qualify as part of the enlightened pursuit of objective truth, and should be discontinued”.⁶ Reading through their opening chapter as well as the other works cited above, one finds several grounds cited for making such scathing claims regarding the work of their colleagues across the hall.

i. Metaphysics is *frivolous*. Leaf through a handful of recent works in metaphysics and you will soon find yourself on trips to possible worlds populated by zombies⁷, disembodied spirits⁸, unicorns⁹, dragons¹⁰, trout-

⁵ The fact that metaphysicians tend to self-identify as one or the other of course lends support to this claim.

⁶ Ladyman and Ross, p. vii.

⁷ Eg. Chalmers 1996

⁸ E.g. Yoshimi 2007.

⁹ Lewis 1986, 88.

¹⁰ *Ibid.*

turkeys¹¹, writer-cucumbers¹², gunk spheres¹³, and – in a chummy in-joke – the mereological fusion of David Lewis and a talking donkey¹⁴. Even the most unrepentant of analytic metaphysicians should be willing to concede that it at least *looks* bad that such paraphernalia is the stock-in-trade of today's metaphysicians, given their pretensions to be engaged in a noble intellectual pursuit. An obvious reply at this point would of course be that, if one were to rummage through the literature in philosophy of science then one could also pull out examples of such fantastical creatures as evil demons slamming doors open and shut and people with electron microscope eyes.¹⁵ Nevertheless, one could plausibly claim that the use of such exotica in the latter case is merely to illustrate a thesis that could very well be stated without it; in the former, however, the idea that a gunk-sphere or a zombie is somehow very much a 'real' possibility does essential work in the arguments in which they are cited, since their very possibility is often taken to refute a rival thesis. As such, taking these preposterous entities ontologically seriously is crucial in the analytic context, and the seriousness that we feel able to impart to metaphysics correspondingly diminished.¹⁶

ii. Metaphysics relies too much on *intuition trading*. Rather than coherence with any body of theory outside itself, metaphysics often depends heavily on appeals to intuition in order to justify its claims. Nowhere to our mind is this better exemplified than in the debate around van Inwagen's 'special composition question'. When thinking about the general conditions under which a pair of objects could be said to form a whole, van Inwagen considers such options as stitching, gluing, and making contiguous, and asserts in each case that our intuition tells against regarding the resultant putative composite as a legitimate object.¹⁷ These consultations of his intuitions moreover do the lion's share of the

¹¹ Lewis 1991, 7.

¹² Elder 2013, 75

¹³ Sider 1993.

¹⁴ Hawthorne and Uzquiano 2011

¹⁵ Maxwell 1962.

¹⁶ Indeed, 'zombie' is one of the most cited terms in Chalmers' book, since his anti-reductionist thesis depends strongly on their possibility.

¹⁷ Van Inwagen (1990)

work in his argument for the notorious claim that there are no composites except composite living things. It should be underlined that few people in metaphysics buy into van Inwagen's theory: Ted Sider, for example, takes it to be refuted by his intuition that 'surely there is a gunk world in which some gunk is shaped into a giant sphere, and another where some gunk has the shape of a cube. Surely, there are gunk worlds that most of us would describe as containing objects much like objects from our world: tables and chairs, mountains and molehills, etc.'¹⁸ In other words, Sider's intuitions are invoked to counter van Inwagen's intuitions, but whether the former count as any weightier than the latter is impossible for us to decide.

Again, we can concede that every theory, whether in philosophy or science, is going to have to have rely on intuitions at some point. According to many accounts, scientists, for example, have hunches about what hypotheses to test, or which approximation methods might work – hunches that often prove very fruitful even if they ultimately cannot say why¹⁹. Similarly, many programs in naturalistic metaphysics often begin with intuitions that more received metaphysical pictures are not adequate to modern-day science (this is certainly the case with the structuralist metaphysics to be discussed below). But it seems that there is an asymmetry in the role of intuition in each case: in the scientific case, and arguably in the naturalistic case, the intuitions are functioning only as a starting point, a guide to what to try and justify by other means²⁰; by contrast, in the van Inwagen case intuition itself has an essential justificatory role. Given that we no longer have God in the picture to underwrite the veracity of these intuitions, and given moreover the litany of errors that intuition has led us to, it is hard to avoid the conclusion that the reliance upon them for justification is a deeply problematic aspect of present-day metaphysics.²¹

¹⁸ Sider 1993, p286. 'Gunk' is a term for matter that is resolvable into mereological parts ad infinitum.

¹⁹ Although the role and overall significance of such hunches may be considerably less than such accounts presume, particularly given the role of heuristic factors discussed in numerous analyses of scientific discovery and pursuit.

²⁰ Here one might invoke some form of the discovery-justification distinction.

²¹ Cf. Putnam 1962.

iii. Metaphysics has become altogether too *domesticated*. A curious feature of analytic metaphysics is that, over a period roughly contemporaneous with that in which it became decoupled from physics, it became preoccupied with the *ontologically fundamental*.²² It was not that long ago that analytic philosophy was dominated by ‘ordinary language’ considerations, and ordinary objects in turn.²³ But for reasons that we won’t attempt to chart here, the concern with ordinary objects was largely replaced with an express concern with the fundamental in particular.²⁴ Thus in the contemporary literature one finds assertions that the fundamental level can be resolved without remainder into a separable ‘mosaic’ of local matters of fact²⁵; side-taking over Markosian’s debate concerning whether the ‘fundamental building blocks’ of matter should be regarded as ‘pointy’ or rather ‘maximally continuous extended’ simples, akin to tiny bits of plasticine²⁶; and debates over the modal implications of fundamental physics properties, such as quark color and flavor, played out in terms of whether or not quarks can be permuted among one another in space²⁷. But the claim regarding the ‘mosaic’ is simply asserted as if quantum mechanics never happened²⁸; the debate over the structure of fundamental entities is conducted as though that between Democritus and Anaxagoras remains fit to serve as the model; and the debate over the modal profile of the fundamental physics properties is conducted as though these properties and the laws they feature in are the same in all relevant metaphysical respects as their classical counterparts.²⁹ In sum, in each case it is simply *assumed* that the most fundamental regimes of the world can be regarded as a sort of ‘doll’s house’ version of the world of everyday experience. But while few pretend to have a satisfactory positive picture of what

²² See e.g. Paul 2012 for an explicit statement of this view.

²³ The ‘descriptive’ metaphysics associated with Strawson’s *Individuals* is an example of what we have in mind.

²⁴ Callender 2011 gives some important parts of the story.

²⁵ Lewis 1986; Kim 1998.

²⁶ See e.g. Markosian (1998)

²⁷ Lewis (1986), 163.

²⁸ Recall our point about the division between ‘analytic’ and ‘naturalistic’ metaphysics: Lewis of course did acknowledge that quantum mechanics might have an impact on the ‘mosaic’ account but the point remains that neither he nor many other metaphysicians explored the nature or extent of that impact.

²⁹ For commentary on this last debate, see McKenzie forthcoming.

fundamental reality is like, we *do* know that it is very hard to maintain that it is like the way that these classical pictures dressed up in modern physics clothing present it.³⁰ Even a passing acquaintance with the science pages of the newspaper would suffice to establish that.

Since it is this last set of criticisms that directly concern the relationship of metaphysics and physics, it is this set that we, as philosophers of physics, feel most confident in asserting. In what follows, therefore, we will take the fact that analytic metaphysics is overwhelmingly wedded to an outdated ontological picture to constitute the core criticism of it. Indeed, it is this feature which Ladyman and Ross themselves are most frustrated by. As they put, “mainstream contemporary analytic metaphysics” is ‘no longer ‘informed by real physics” and “has, like the nineteenth-century metaphysics against which Russell revolted, become almost entirely a priori”. It is principally on these grounds that they hold it should be “discontinued”.

This is fighting talk! But we should be absolutely clear at the outset that philosophers of physics such as ourselves, Maudlin, and Ladyman and co. are all likewise inclined to metaphysical speculation, albeit, we claim, of an avowedly ‘naturalistic’ sort. It therefore seems only fair to ask whether such philosophers of physics are really in any position to baldly assert that other approaches within the discipline ought to simply be drawn to a halt. To cut to the chase, our feeling is such a sweeping claim is ultimately unjustified. And we think that we can cite some facts about how philosophy of physics is done in support of that view.

3. The Heuristic Approach to Metaphysics

Our claim is that once we reflect on how philosophy of physics is produced in practice, we see that imposing a blanket ban on scientifically disinterested metaphysics would likely be counterproductive. As such, naturalistically

³⁰ Of course, different interpretations of quantum mechanics make reality look more and less classical. But quantum mechanics is not classical mechanics, and thus all of them will be non-classical in some respect.

inclined metaphysicians would be ill-advised to criticize metaphysics merely on the grounds of its disengagement from science.³¹

To flesh out this claim, we find it useful to explain how it is that we go about creating structuralist metaphysics of physics in particular. What makes this case so apposite – aside from the fact that it is the area in which we both work – is that structuralism is the metaphysical programme defended by Ladyman and Ross, the chief horsemen of the metaphysical apocalypse; and yet is a research program that is *up to its eyeballs* in all sorts of involved metaphysics. As such, it seems an appropriate ground for testing whether naturalistic metaphysicians such as Ladyman are trying to have things both ways. So to begin, let us briefly introduce what we understand by the doctrine known as ‘ontic structuralism’.

In a nutshell, ontic structuralism is the view that relational structure is ontologically fundamental. The doctrine proposes that if we take modern physics – principally, quantum theory and relativity – seriously, then the category of physical objects must be regarded as a derivative category, in contrast to the category of structure; or at the very least, that it can no longer be regarded as a category ontologically prior to that of relations and structure. It contends that the centrality of symmetry considerations in contemporary physics is a harbinger of deep ontological facts, that the identity conditions for both individuals and kinds are parasitic on structures in some essential way, and that global nomic concepts must replace more local, dispositional ones.

As even that cursory survey makes clear, ontic structuralism is characterized by a cluster of claims, any one of which is sorely in need of careful and sustained

³¹ To be clear, our claim is based on how philosophy of physics is, as a matter of fact, ‘done’, and thus on facts about how we do things in practice; it is not based on a prescriptive claim about how we *should* do things, at least not in the first instance. Some philosophers of physics have claimed in response to our argument that the way we present metaphysics as being done is incredibly inefficient, and that what we have effectively shown is that all metaphysics should be ‘made to order’ and not simply taken ‘off the peg’ in the way that we present. We ourselves are sceptical that metaphysics would proceed better in this way, at least in all cases; but our argument in any case proceeds from how things *are* done, for better or for worse. In any case, we’ll have more to say about this at the end.

defence. Indeed, structuralists seem to have their work cut out just articulating exactly what it is that these claims mean in the first place. Thus in order to maintain their position, structuralists have had to say, first, exactly what it is that they mean by the categories of ‘objects’ ‘structure’, and ‘relations’; they have also had to explain precisely what they understand by words like ‘fundamentality’, ‘priority’, ‘derivativeness’, and ‘symmetry structure’ in the context of physical ontology. With the meanings of these claims established (at least to some acceptable degree), they have then had to defend themselves against the gamut of objections that have been waged against them, including accusations of metaphysical incoherence, epistemic triviality, and their revival of a discredited Platonism. With so much work needing to be done, you might think, where did structuralists even begin?

The short answer to this question is that structuralists began by *looking at extant work in metaphysics*, and in our view that was as good a place as any to begin. To give some concrete examples, to articulate the core claim that structure is ontologically fundamental, structuralists have found it useful to draw on the work of Kit Fine, and in particular his work on ontological dependence.³² To articulate the relationship that they take to hold between symmetry structures, in particular, and the associated elementary particles, structuralists have found it helpful to borrow from work by Jessica Wilson on determinates vs determinables.³³ Ross Cameron’s theory of truthmaking has been invoked to communicate how radical structuralists interpret physicists’ talk about objects while denying that there fundamentally are any.³⁴ Simon Saunders has appropriated Leibniz’s principle of the identity of indiscernibles, revamping it *à la* Quine and extending to allow discernibility with respect to relations, to demonstrate the identity dependence of objects on relations in the context of quantum mechanics – taking it to articulate the ‘thin’, structuralist conception of object in the process.³⁵ And in the effort to defend structuralism against a well-known triviality objection, known as the Newman objection, David Lewis’ notion

³² McKenzie 2013, French 2010

³³ Wilson 2012, French 2014

³⁴ French 2014 (sect. 7.4.2.3), Cameron 2008.

³⁵ Cf. Saunders 2003; Ladyman and Ross 2007; McKenzie 2013.

of 'elite' or 'perfectly natural' properties has been taken to offer appropriate resources.³⁶

There are many other examples that we could cite in this connection.³⁷ But the key point is that all these metaphysical packages that have proved useful to appropriate in structuralism were not only (and by definition) created independently of structuralism, but were moreover (by and large) developed independently of *any scientific considerations whatsoever*. Despite their usefulness in the fundamental physics context, neither Kit Fine nor David Lewis, for example, are exactly famed for their engagement with science – indeed in the latter case, often quite the opposite. Cameron's version of truthmaker theory was developed to understand talk about tables and chairs, and Leibniz' principle of the identity of indiscernibles was originally articulated several centuries too early to hope to incorporate the principles governing the quantum ontology that it subsequently helped to illuminate. We therefore see that scientifically disengaged metaphysics has, at least in many cases, provided us with a set of resources for doing the sort of metaphysics that resolutely *does* engage with modern physics. As such, it strikes us that we can and should view at least *some* constructions of analytic metaphysics as useful tools for shaping our own naturalistic accounts. This view of analytic metaphysics as the source of a set of resources that can be applied, appropriated, and generally used and abused by philosophers of physics in the process of developing naturalistic accounts, we have dubbed the 'heuristic approach' to metaphysics.

Indeed, in our view there is a neat analogy between, on the one hand, philosophy of physics and analytic metaphysics, and on the other, physics itself and pure mathematics. Just as it was useful to Einstein that the theory of non-Euclidean geometry was there for the taking when the moment arose, so it was useful to

³⁶ See Melia and Saatsi 2006 for discussion, but also Saunders and McKenzie forthcoming.

³⁷ Outwith the context of structuralist philosophy of physics, we might mention how Meinard Kuhlmann (2010) has appropriated the trope ontologies of Keith Campbell and Peter Simons in the context of algebraic quantum field theory, and how Michael Esfeld, Mauro Dorato and others have appealed to the concepts of dispositional properties developed by Mumford and Bird to interpret the GRW approach to quantum mechanics (Dorato and Esfeld 2010).

eliminative structuralists that there has been developed a theory of dependence compatible with the elimination of the dependent entity. Likewise, just as it was useful for the development of particle physics that the theory of Lie groups was largely completed by the time the appropriately high-energy regimes could be probed, so it was beneficial to the defender of the Everett interpretation that a theory of personal identity that makes decision-making make sense in branching universes was already on the market³⁸. And just as it was fortuitous that the theory of imaginary numbers was fit for use at the advent of the quantum revolution, so it has proved useful that various metaphysical packages were in place to provide possible frameworks for its interpretation, including Saunders' form of Leibniz's PII but also theories involving haecceities.³⁹ Now, to be clear, nothing in this analogy is supposed to discourage the development of 'made to order' frameworks that engage (more or less) directly with the physics, such as the metaphysics of non-individuals and the associated formalism of quasi-set theory – any more than physicists should be discouraged from developing mathematics as and when new empirical situations arise.⁴⁰ But nonetheless, just as areas of pure mathematics subsequently proved useful in physics it cannot be denied that empirically disengaged metaphysics has in the past proved useful to philosophers of physics. And given that the deliverances of 17th century, rationalist metaphysician have been usefully appropriated by the philosopher of quantum physics, it seems it would be folly to try to predict in advance what will and will not prove similarly useful in the course of time.

In our view, then, scientifically disengaged metaphysics can and has performed a useful function in naturalistic contexts, since it provides us with raw materials from which our own theories can be developed. And once that much is conceded, we think that it becomes very problematic to baldly assert that it should be "discontinued". It seems, rather, that doing so would be to simply bite the hand that feeds us.

³⁸ Of course, this is not to say that the relevant mathematics was developed entirely independently from the physical context (see Bueno and French forthcoming).

³⁹ See French and Krause 2006.

⁴⁰ Ibid.

4. Reining in the Metaphysics

The above considerations in support of analytic metaphysics undermine the most extreme claims regarding scientifically disengaged metaphysics. But it must now be acknowledged that there seems to be a tension in what we have said so far. We opened up this paper with a litany of grievances that philosophers of physics have had against analytic metaphysicians, and it seems to us that these remain as strong grounds for deploring analytic metaphysics as currently practiced. We then said, however, that analytic metaphysics had played an important role in naturalistic metaphysics, and that it is to be valued for that reason. So are we with the analytic metaphysicians, or against them?

However – and not unusually for a dichotomy – this last ultimatum is much too simplistic. It should be obvious that disavowing blanket statements to the effect that *all* contemporary work in an area is worthless and should be abandoned is compatible with regarding *some* of that work in precisely that way; and it was such a differential attitude that we ourselves proposed in *Thinking Outside the Toolbox*. But if this is the attitude that one wants to take, then one is clearly obliged to say what it is about the offending cases that *makes* them offensive, and what it is about the acceptable cases that gets them off the hook. So given that the considerations of the last section suggest sanctioning some metaphysical projects, although we have as yet no clear reason to say all, let us make a normative distinction to siphon such projects into two classes, which we shall (somewhat artlessly) call ‘Type I’ and ‘Type II’:

Type I: metaphysics that is scientifically disinterested and that, at least *prima facie*, doesn’t *need* to be so interested, or even that might *have* to be so disinterested⁴¹;

⁴¹ In this paper, we are staying quiet on the issue of whether there is a body of metaphysics that can be regarded as legitimate enquiry but to which science could not contribute in principle, so that such metaphysics would *have* to be scientifically disinterested. This issue however is discussed in more detail in McKenzie, ‘The Plurality of Priority’ (in preparation). See also Bealer 1987.

Type II: metaphysics that is disinterested but that *should not be*.

Clearly, Type I metaphysics is the metaphysics that we want to protect, want regarded as *legitimate*, despite its disengagement from science; Type II is that which we wish to be cast to the flames. But while it seems clear that there is a normative distinction to be drawn here, the grounds on which the distinction is to be drawn are less so. How are the two types to be identified?

Since the aim, presumably, is to come to some sort of reflective equilibrium in our judgments, let's start off just trying to characterize the two types extensionally. Beginning with metaphysics of Type I, it seems clear that this category pertains to the 'good' metaphysics that we think can be defended, and if we go with what we've said about the role of analytic metaphysics in structuralism then it seems that *anything that has demonstrated its usefulness in naturalistic contexts* should be filed into this category. Thus into Type I go Leibniz's PII, Fine's theory of ontological dependence, and whatever it was that Lewis said about 'eliteness' that helped block the triviality objections to structuralism.⁴² Into Type II, by contrast, will get filed the metaphysics that we vilified at the outset – so that, at the very least, Lewis' assertion that the fundamental level can be regarded as a 'mosaic' of local matters of fact, Markosian's debate over whether the fundamental entities are pointlike or continuous, and the debate in modal metaphysics over whether quarks can freely recombine, will all feature here.⁴³ These, recall, were regarded as problematic on account of the fact that they were not paying sufficient attention to science.

Whatever it is that ultimately grounds the distinction between two classes, it strikes us that the above examples should be classed as they are. So now we must ask *what it is* about, in particular, those examples classed as Type II that makes it the case that they *should* have engaged with some relevant science, even

⁴² As we shall see below, however, the 'elite' properties are taken to have more features than this in Lewis' system, and not all the claims Lewis made about them will end up in being classified as Type I.

⁴³ Lewis' assertion that has of course come under withering attack by many philosophers of physics; see e.g. Maudlin 2007.

though they did not, given that we don't insist on any and all metaphysics doing so?

In a nutshell, the reason that these projects in particular strike us as the sort of thing that *should* engage with science even though they do not is simply that they *putatively refer to things that itself science is directly concerned with*.⁴⁴ After all, these projects are all taken to concern the *ontologically fundamental*, and given physicalism – commitment to which “is about as close to a bit of orthodoxy as one will find in contemporary philosophy”⁴⁵ – metaphysicians themselves will claim that the fundamental regimes of the world are going to be described by physics, or at least that they will be if they are to be described at all. But it seems obvious that one cannot simply *postulate* that things described in physics have such-and-such features: one has to actually *check* that they do in fact have those features, or at least that they can be reasonably claimed to, and moreover that one must be willing to give up on the idea that they do have those features if the physics seems to contradict it. Moreover – at least when we wrote *Thinking Outside the Toolbox* – it struck us as *entirely uncontroversial* that one should demand of metaphysicians that they incorporate the relevant findings of science regarding the entities they are interested in, *whenever there are such findings*. After all, here we are simply echoing Dummett's lament that ‘the generality of philosophers [fail to] take due account of physical theories when addressing problems on which they bear’. And how could one possibly take issue with *that*?

To a first approximation, then, let us say that the problem with the metaphysics that results in its being classed as of the problematic, Type II sort is that it violates the *compatibility principle*:

The compatibility principle: the constraint that any metaphysical theory invoking entities x and deployed at some time t should be compatible with at least some independent, well-supported, overall ‘serious’ scientific theory that directly describes or that is otherwise relevant to those entities, should such a theory exist at that time.

⁴⁴ We might say that they concern *physical* ontology in addition to what would normally be regarded as the *metaphysics* of that ontology.

⁴⁵ Hall 2010.

To repeat, this principle (or something like it) should strike one as *prima facie* basically unobjectionable. But let us make a few further comments about it. Firstly, the principle is clearly to be regarded as a first approximation: we do not ultimately want to formulate a principle so strong that philosophers can only ever hope to be supplicants at the door of science, never ever to be permitted to contradict received scientific views on what it is that science is telling us. Nevertheless, we think we can expect such cases to be the exception rather than the rule; so let us insist on adherence to the compatibility principle as formulated above in at least the vast majority of cases. Secondly, whether or not a project in metaphysics is legitimate or not – that is, is to be cast as Type I or not – is a feature that can change with time. That seems right: what was defensible metaphysics in the 18th century will not in general be defensible today. Thirdly, given the difficulties in interpreting physical theories, respecting the compatibility principle still leaves an abundance of space for metaphysicians to disagree on how to conceive of fundamental ontology. That is of course unfortunate from a certain point of view, but also strikes us as philosophically ‘healthy’.

Fourthly, however – and most pertinently for current purposes – while we intend the compatibility principle to disqualify many metaphysical projects from being legitimate objects of serious debate, it is nevertheless in other respects generous. For example, if one could claim that no conceivable answer to the special composition question could be regarded as incompatible with the science that we currently have, then debate over this question may (at least thus far) be regarded as belonging in the legitimate, Type I class. If there are more robustly naturalistic metaphysicians who feel that that just means the compatibility principle, while excluding some things, does not exclude enough, then recall that we are here *trying* to make space for scientifically disinterested metaphysics, given our observations regarding the practices in philosophy of physics; those who think that is too lenient are of course welcome to develop more demanding proposals. Note, however, that the problems we raised for the special composition question concerned not the *incompatibility of science* with assumptions made about the debated ontology, but rather the *reliance on*

intuition when conducting debates about it.⁴⁶ Thus the problems voiced above concerned not so much the assumptions made about *what* was debated, so much as the *way* in which the debate was conducted and the associated standards of evidence. And while the reliance on intuition certainly does strike us as problematic, we are also acutely aware that we do not have a well-developed epistemology of metaphysics in general (nor, indeed, of mathematics), and as such we fear that if we disqualify the debate over this question *merely* for its reliance on intuition, then we run the risk of throwing out the naturalistic baby with the analytical bathwater.⁴⁷ In any case, that discussion over what (epistemological) principles should be added to our (ontological) demand of compatibility with science is one for another day.

At this stage, then, we take the compatibility principle to disqualify many extant non-naturalistic metaphysical projects as legitimate ways to occupy one's time, while not taking it to disqualify all such projects. And just to repeat, although we could appreciate the view that in demanding mere compatibility we have not gone far enough, it is our *aim* to formulate a principle that rules out certain projects while being otherwise lenient. Some such generosity is deserved, we have argued, given our observations regarding the appropriation of plenty of scientifically disinterested metaphysics in the service of philosophy of physics, observations that prompt taking what we have called the 'heuristic approach' to metaphysics.

As stated at the outset, however, we are now worried that this 'half-way house' attitude to metaphysics is fundamentally unstable. In particular, we are worried that insistence on the compatibility principle is actually inconsistent with the heuristic approach to metaphysics. Since the compatibility principle strikes us as completely unobjectionable, and since (something like) the heuristic approach

⁴⁶ This of course is not to say that there are no conceivable *ontological* objections that one could make to the debate around the SCQ; see for example the criticisms in Ladyman and Ross (2007, p. 21), and McKenzie and Muller (unpublished). Our point here is simply that the problems *we* cited above concerning the debate around this issue were not these same problems.

⁴⁷ Empiricists of course will be perfectly happy with this conclusion, but as naturalistic metaphysicians we are operating under the assumption that metaphysics that is somehow 'continuous' with science is in better shape.

to metaphysics seems likewise unassailable given the history of philosophy of physics as practiced, this situation strikes us as verging on the paradoxical. But before we explain what we take this perceived instability to consist in, and what we think we should say in the face of it, it will be helpful to discuss how metaphysicians themselves have responded to the allegation that their work violates (something like) the compatibility principle, and that it is deeply problematic in consequence.

5. Metaphysicians Defend Metaphysics

A common response of metaphysicians to the claim that their work flies in the face of science is, in a nutshell, to simply deny that they *are* talking exclusively or even predominantly about the entities that are described in science, in spite of what may be initial appearances. According to them, while science can talk only of what is actual, what *they* are discussing are *possible* entities, and as such things of which science, as an investigation into the actual, knows only a tiny fragment.

Such a move is an expression of a general shift that has taken place in metaphysicians' own conception of metaphysics over the course of the 20th century: whereas the classical view of philosophy is as the search for what is necessarily the case, metaphysics is now more often characterized in terms of an investigation into possibility generally. That this is the case is made explicit in places in the 'metametaphysical' literature: according to Conee and Sider, for example,

Metaphysics is about *the most explanatory basic necessities and possibilities*. Metaphysics is about *what could be* and *what must be*. Except incidentally, metaphysics is not about explanatorily ultimate aspects of reality that are actual...⁴⁸

Similarly, according to Lowe:

⁴⁸ Conee and Sider 2005, 203.

metaphysics may [...] be characterized as the science of the possible, charged with charting the domain of objective or real possibility [...] All metaphysics is implicitly modal, because it is primarily concerned with kinds of things are possible or compossible, and only subsequently with what kinds of things are actual.⁴⁹

But if this is how analytic metaphysicians now conceive of their discipline, then it is easy to see how one may be led to believe that any apparent conflict with the compatibility principle may be effaced at a stroke. To be explicit: while today's metaphysicians are predominantly focused on the ontologically fundamental, and while the vast majority are physicalists when it comes to the actual world, when accused of conflict with actual science those metaphysicians may claim that the fundamental entities they are theorizing about *are entities of another world*. The net result of this, it appears, is that *nothing* discussed in metaphysics need ever fall foul of the compatibility principle, and all metaphysics is automatically recast as the legitimate, Type I class by our criterion.

How compelling is this move? Does the idea that metaphysics is 'the science of the possible' represent a get-out-of-jail-free card for analytic metaphysicians in the face of the complaints of Ladyman *et al.*?⁵⁰ We ourselves are pessimistic. Here we will enumerate just a few reasons why we remain distinctly unimpressed by this move.

i. **It's unconvincing.** Lewis' assumption of locality, Markosian's debate over maximally continuous vs 'pointy' matter, and the debate over the recombining of quarks all have one feature in common: they all assume manifestly classical concepts when debating what they regard as fundamental. But if metaphysics is all about possibility space generally, then *why does*

⁴⁹ Lowe 2011, 100; 106.

⁵⁰ This phrase is first used, to our knowledge, in Russell (1919); given the earlier quote from Ladyman and Ross concerning Russell's revolt, this situation is somewhat ironic! For an example of the contrasting view, see Bealer 1987.

*everything look so classical?*⁵¹ Presumably, if we take possibility space seriously then somewhere in it there are entities at least as complicated as the Lorentz-invariant smorgasbords of probability functions that one finds in quantum field theory. Why, then, are entities of comparable complexity not discussed and debated? Could it be that metaphysicians are only *saying* that they are interested in possibility generally to mask their unwillingness to forfeit the classical assumptions that make their life *so* much easier?

ii. **The literature suggests that conceivability implies possibility.** Most of the cases cited as possibilities and taken seriously as such in analytic metaphysics – such as the existence of infinitely continuous matter or the existence of gunk – do not follow, or at the very least are not presented as following, from systematic modal assumptions. Rather, they are taken to be possibilities merely because they can be conceived. But to hold that whatever can be conceived of is possible is to assume the ‘conceivability implies possibility’ link that has been subject to much scrutiny, especially in the wake of the work of Kripke.⁵² As such, we feel that the burden of proof is very much on the metaphysician who would claim that the mechanisms through which humans conceive things in thought may be relied upon to provide us with evidence for what is metaphysically, and not merely epistemically, possible. Furthermore, the very fact that Lewis made such an impact on modal metaphysics suggests that metaphysicians themselves would ideally like to be more systematic in their theorizing than they would be were they to merely exercise their imaginations, given that Lewis explicitly rejects the idea that “every seemingly possible description or conception of a

⁵¹ And again we take the point – noted by a referee – that Lewis took his pointillism to be a contingent thesis. Nevertheless, as we have said, many metaphysicians have happily ploughed this particular furrow without taking into account that the thesis might not only be contingent but actually false.

⁵² See Bird 2007. (This objection is of course related to the problems of reliance on intuition in metaphysics.) There is, of course, an extensive discussion of the relation between conceivability and possibility and of the manner in which the former might be defeasible (cf. Chalmers 2002, Yablo 1993). The upshot of such considerations – or so it seems to us – is a whole range of different frameworks of possibility, each dependent on the afore-mentioned relation plus defeasibility factors, in terms of which the modal claims of analytic metaphysicians should be indexed. How that then might bear on our account is a subject for another essay.

world does fit some world” (as of course he must if there is to be a role for his theory).⁵³ But if Lewis is to be our model of how to be systematic in our modal theorizing, then that offers up yet another reason as to why the ‘science of the possible’ move does not relieve metaphysicians of having to attend to actual science, for the following reason.

iii. Systematic theories of possibility space can be falsified by actual physics. Lewis’ possible world analysis is widely regarded as the best – indeed for some the only – systematic theory of possibility on the market. But the tenability of Lewis’ system rests on some non-trivial assumptions about fundamental properties: in particular, the assumption that all the fundamental properties are *intrinsic*. Such an assumption is crucial for Lewis, for only if properties are intrinsic will they be open to free recombination, and it is the principle of recombination applied to fundamental properties that is the generator of Lewisian possible worlds.⁵⁴ As such, the free recombining of fundamental properties is a *sine qua non* of his whole system. But if all the fundamental properties are to be intrinsic and freely recombinable, that of course means that all the *this-worldly* fundamental properties in particular must be; and by physicalism, that means that all the fundamental *physics* properties have to have these features. That the fundamental physics properties do indeed have these features is something Lewis himself never investigates or makes any real attempt to justify.⁵⁵ But there is in fact good reason to think that the fundamental physics properties are *not* in general freely recombinable, since

⁵³ Lewis p 87. Lewis himself claimed that buying into the conceivability implies possibility link “indiscriminately endorses offhand opinion about what is possible” (ibid.), but given the detailed literature on the nature of conceiving in this context we can imagine many philosophers taking issue with that characterization of the relationship.

⁵⁴ It is because this principle is taken to be expressible in language devoid of modal concepts that is taken to secure the reductive character of his theory – the feature standardly understood to earn it the accolade ‘best’ (cf Sider 2003, Sec. 3.5). Note that intrinsicity is not sufficient for free recombination, making the latter the stronger assumption.

⁵⁵ Once again, we acknowledge the point that, in response to quantum mechanics, at least in part, he does contemplate the suggestion that there might be actual fundamental non-spatio-temporal external relations. Nevertheless, see what he says at Lewis (1983), 16; (1986), 61.

there is good reason to think that they are not intrinsic – at least not *qua fundamental properties*.⁵⁶ Our support of this claim must here be confined to a thumbnail sketch, but our argument is basically this.⁵⁷

Our most fundamental framework for physics (at least at the moment) is quantum field theory (QFT).⁵⁸ In this framework, the magnitudes of physical properties, such as mass and electric charge, can change with the energy scale in a way that is described by the renormalization group equation (or ‘Callan-Symanzik’ equation). Furthermore, since spacetime is represented as continuous in QFT, according to this framework there is no limit to how high these energy scales can grow.⁵⁹ It follows that properties can be regarded as fundamental in this framework only if they stay mathematically well-defined, and thus finite in magnitude, in the infinite-energy limit. This turns out, however, to be an extremely demanding requirement, and there is reason to think that it is satisfied only if the property occurs in a *local gauge theory* containing *only a small number of fermion types*.⁶⁰ For example, it turns out that

⁵⁶ In our previous paper we argued for this conclusion on the basis of considerations from gauge theory – considerations that a respondent argued simply begged the question at hand (see Livanios 2012). While that criticism was correct and legitimate with respect to the original presentation of our argument, we nevertheless think that our conclusion still stands. What was missing from our earlier argument was an emphasis on the constraints that are placed on *fundamental* properties in particular: it is fundamentality constraints that necessitate the connection between the fundamental constituents of matter and gauge bosons.

⁵⁷ This argument is discussed in more detail in McKenzie (ms).

⁵⁸ It should be pointed out as well that we do not think that focusing our discussion on laws and properties as they are represented in quantum field theory in particular – and thus not some other assumed ‘possible’ physical framework – need beg any questions. For discussion, see McKenzie (2014), Section 4.

⁵⁹ The continuity assumption might of course be given up in a quantum theory of gravity. But for the moment QFT is the best we have, and naturalism enjoins us to take it seriously. There is also increasing optimism that gravity can be incorporated into the basic framework of QFT, though what exactly that entails for spacetime continuity is a complicated issue on which we won’t speculate.

⁶⁰ This is because these properties are required in order for a theory to be asymptotically free. While there is a more general class of fundamental theories (namely, the asymptotically safe theories), this is only class that is tractable enough for us to investigate at present. Again, see McKenzie (ms) for discussion.

the colour charge on a quark will behave as a fundamental property if, but only if, (1) there exist gluons in addition to quarks, and (2) there are at most 16 distinct types, or ‘flavours’, of quarks in the theory.⁶¹ Should there be more flavours present, the colour charge will diverge in the limit so that it can no longer be regarded as fundamental after all. It follows from all this that the fundamental physics properties cannot in general be regarded as intrinsic, at least not *qua fundamental properties*; for the very fundamentality of such properties can be sensitive to what exists in addition to any given bearer of them, in any world in which they occur.⁶² As such, we cannot simply postulate a world with fundamental physics properties, add and subtract objects and properties at random, and *a priori* maintain that what we obtain is a new manifold of fundamental properties. But that each free recombination takes us from one manifold of fundamental properties to another such manifold is the central postulate of Lewis’ world-building system. Quantum field theory, and the fundamentality considerations it engenders, thus seems to strike right at the heart of what many take to be our most successful modal system.

We think that this example makes salient the fact that *even if* we are happy to take metaphysicians at their word that they are engaged in ‘the science of the possible’, and *even if* we regard the investigation of metaphysical possibility space as a defensible academic enterprise in principle, it may yet be that the actual can veto crucial assumptions about what those possibilities are. As such, it remains that those metaphysicians who follow Lewis in engaging in systematic modal metaphysics have to pay attention to any respected, well-confirmed

⁶¹ See e.g. Srednicki (2007), 485.

⁶² Of course, in a fuller discussion we would commit to how exactly it is that we understand ‘intrinsic’ here: suffice to say for now that lone object-based analyses seem entirely inappropriate in this context and are more inclined towards the sort of dependence-based account expounded in Witmer *et al.* (2005). But all that is crucial for present purposes is that these facts about the renormalization group prohibit a conception of intrinsicity that would allow for free recombination: we cannot add arbitrarily many new flavors of quark to a world that is in other respects like this one and expect colour to remain fundamental. Thus if colour is fundamental, we cannot add or subtract objects from worlds in which it is instantiated in the way free recombination demands; and that is enough to prove the present point.

science that describes the actual portions of their modal ontology, since it may reveal those assumptions to be false; in other words, if they want their systems to be taken seriously then they should respect the compatibility principle.⁶³ So if the aim of appealing to ‘the science of the possible’ was to get around the need for compatibility, it seems that really nothing has been gained.

6. The Tension

This, then, is where we’re at. We’ve said that some scientifically disinterested metaphysics should be protected from naturalistic criticism, on the grounds that it has proved useful in a naturalistic context. We’ve said that nevertheless some metaphysics – namely, that which falls foul of the compatibility principle – should by contrast be condemned. We’ve also underlined that metaphysicians’ attempt to recast any compatibility-principle flouting metaphysics as merely ‘the science of the possible’ did not succeed in exonerating them from their failure to comply with the principle. What, then, is our worry?

In a nutshell, our worry is this. While we still deny that nothing in metaphysics is in principle incompatible with actual science, in the way that the ‘science of the possible’ move would hope, we worry that, *given our argument for taking the ‘heuristic approach’ to metaphysics, we are not actually in any position to demand compatibility in the first place.* The reason for this is that, ultimately, we have only the dimmest idea of what changes in physics lie ahead of us.⁶⁴ How, then, do we know that the current metaphysical models, even though they seem to be in contradiction with actual physics and problematic for that reason, might not themselves come to be useful in the course of time? And given that we have

⁶³ It may be worthwhile noting at this point just how much weaker the requirement that our theory of possibility be consistent with physics is than the demand that all possibility is physical possibility: were it not the case that the fundamental physics properties were intrinsic, some variant of Lewis’ recombinatorial thesis might have had a shot at structuring a possibility space with physically impossible worlds in it.

⁶⁴ This isn’t of course to say that there are no principles we can expect to govern theory development: we should at the very least demand correspondence in the limit (cf Post 1971). But satisfaction of that requirement of course still underdetermines a great deal.

resisted the blanket condemnation of contemporary metaphysics by Ladyman and Ross on these heuristic grounds, how are we then not committed to sanctioning essentially a free-for-all in metaphysics, in which *any* metaphysics – as domesticated, juvenile, and intuition-driven as you like – is to be regarded as immune from criticism?

This conclusion leaves us somewhat aghast! And since it seems to us that one cannot reasonably deny *either* that philosophers of physics have utilized analytic metaphysics to their benefit, *or* that the compatibility principle is a reasonable requirement on theories, *or* indeed that what lies ahead in science is something that we cannot at this point predict, this conclusion too strikes us as somewhat paradoxical. Before turning to what exactly it is that we should say in the face of this seeming paradox, we sketch some responses the naturalistic metaphysician might offer to see off the metaphysical free-for-all that seems to beckon at this point. Disappointingly, however, we don't think that any of them really succeed.

The naturalist might first point out that

i. Analytic constructions never survive in philosophy of physics in the form they were originally given. Consider again the PII. While arguably ruled out by quantum mechanics in its original form, it resurfaced through the work of Saunders: following Quine, he extended the principle to cover both the 'intrinsic denominations' of objects as well as their relations to one another, and in so doing significantly changed the dialectic in the debate over quantum individuality.⁶⁵ This illustrates the fact that analytic constructions typically only function as a starting point for naturalistic metaphysics, for they are then altered and adapted in various ways to suit the needs of the physical situation. This, it might be claimed, blocks the idea that *the analytic constructions themselves* are actually useful in naturalistic contexts, because they generally need to be significantly altered; and if that is the case, then this blocks the idea that they should be valued insofar as we value naturalistic metaphysics.

⁶⁵ On how this Quinean form is not the same construction as the Leibnizian PII see Bigaj and Ladyman 2010.

But of course, this fact that analytic constructions are typically altered in various ways is perfectly consistent with our heuristic approach, in which we value analytic constructions as tools for the development of more tailor-made theories. After all, the mere fact that a tool is useful as a starting point only does not make it any less of a tool. A much better objection to the idea that even compatibility-principle flouting metaphysics might prove useful in the future is the widely-held belief that:

ii. Physics is likely only going to get less classical, not more.⁶⁶ And should it do so, it is obviously going to move further and further away from the kinds of initial intuitions that motivate analytic constructions. Thus insofar as a big part of the problem with contemporary metaphysics is that it is so stubbornly classical, if what prompts the worry that we are committed to a metaphysical free-for-all is that we don't know what physics will throw at us in the future then we are worrying about nothing.

While this point seems broadly compelling, we ourselves are less convinced that things are so simple. First of all, we should be clear that we still lack a demonstration that gravity is amenable to quantum treatment, so that at this point, for all we know, classicality might be a fundamental feature of the world.⁶⁷ But even if fundamental physics should turn out to be pervasively non-classical (as of course seems a pretty good bet), it remains that classical metaphysical concepts may be crucial for interpreting it. One obvious reason for this is that, insofar as the measurement problem has been the core conceptual problem in quantum theory, that conceptual problem concerns, in part, the relationship between quantum and classical ontology, and illuminating the nature of one term in a relationship can often illuminate the relation itself. Indeed, in this

⁶⁶ We might mention in passing that David Bohm was of the belief that the world was structured in alternating layers governed by classical and quantum principles, although he provided little by way of support for this claim! See Bohm 1957, chapter 4.

⁶⁷ And of course, the different interpretations of QM present it as being dissimilar to classical physics in various respects and to varying degrees, so that classical concepts whatsoever may well be useful in interpreting future quantum physics for that reason.

connection one need only think of the work of Wallace to appreciate how getting a better purchase on the nature non-fundamental, including classical, ontology can be illuminating in this way.⁶⁸

It might be objected at this point, however, that this is a red herring in this context: no-one ever thought that there need be anything problematic in principle about a metaphysics describing the classical as long as it is explicit that that metaphysics is *intended* to be about non-fundamental ontology.⁶⁹ Thus one might object that there is nothing in Wallace's metaphysics of the non-fundamental that gives license to the sorts of metaphysics we cited at the beginning. Nevertheless, and even though that latter metaphysics has misguided ambitions to directly describe the fundamental and thus seems to flout the compatibility principle as a result, we *still* think that such compatibility principle-flouting metaphysics may well have a useful function in naturalistic contexts. To see this, consider again the objections that have been made to Lewis' separability assumption. By now everyone knows that one cannot blithely maintain, as Lewis did, that separability is a fundamental feature of the world, because it is arguably so at odds with the basic structure of quantum mechanics.⁷⁰ However, in learning that, do we not thereby learn something important *about quantum metaphysics*? Is it not the case, in point of fact, that we actually understand *a great deal* of the metaphysical content of quantum mechanics precisely by understanding what classical metaphysical concepts do

⁶⁸ See e.g. Wallace 2010.

⁶⁹ While as we noted there has been a preoccupation with the fundamental in metaphysics, we ourselves do not think that an 'effective' metaphysics of the non-fundamental is in principle unnecessary or illegitimate; indeed, we think that the embrace of merely 'effective' ontologies in physics at least invites us to embrace a merely effective metaphysics of it.

⁷⁰ Though of course the extent to which this is true depends on what interpretation of QM is adopted; see e.g. Miller (2013); Belousek (2003). This is of course not to say that one should regard separability as thereby vindicated; the point is that one cannot *blithely* maintain it, partly because doing so is replete with other physical implications. We note also that it an approach to quantum mechanics in which the wavefunction is taken to evolve in configuration space is widely held to restore separability. But we ourselves are deeply skeptical about the viability of such an approach, primarily because such a space requires particle number to be well-defined at all times and this is not the case relativistically; on this, see Myrvold (ms).

not apply in that context, and on account of what principles? It seems to us at least that understanding that quantum physics is (arguably) *not* local and *not* separable in the way that classical metaphysics is is actually absolutely crucial to understanding the metaphysics of quantum physics, and it also seems to us that all but the most specialized philosophers of physics will struggle to fill in the details of a *positive* picture as to what the metaphysics of quantum physics is, beyond justifying and elaborating upon these negative claims. It therefore seems to us that while what philosophers of physics are ultimately aiming for is a *positive* picture of quantum reality, classical metaphysics can nonetheless furnish us with *negative analogies* that are crucial for understanding quantum metaphysics, and especially so while we remain in lieu of a clear positive picture.⁷¹ Therefore even though assertions such as Lewis's that the fundamental level exhibits separability fall foul of the compatibility principle, *recognizing that they do so* can be an important contribution to the metaphysical theories that are appropriate at the fundamental level. Thus, while clearly not every negative analogy stands a chance of being relevant and illuminating, it seems that even false metaphysics can in principle be useful in this sense. And that just seems to corroborate our worry that our heuristic justification can sanction even compatibility principle-flouting metaphysics.

Finally, it might be objected that

iii. The heuristic approach instrumentalizes metaphysics in a way that is patronizing to metaphysicians. Perhaps. But seeing that contemporary metaphysicians seem somewhat desperate to have their discipline regarded as akin to the sciences (as the adoption of the 'science of the possible' moniker itself suggests), and given the lack of obvious alternative accolades for analytic metaphysics in comparison with other contemporary disciplines, we believe that metaphysicians would be very willing to embrace our justification of

⁷¹ Furthermore, given that our concepts were acquired in the same classical environments that metaphysicians treat as exhaustive of reality, perhaps there is a claim to be made that the classical will always have some sort of privileged role in our metaphysical understanding (a conjecture that of course recalls Bohr). But we do not want to pursue this point here.

metaphysics in heuristic terms.⁷² Furthermore, our stance preserves the autonomy of metaphysics in a way that the approach of Ladyman and others does not. All that metaphysicians have to accept is the occasional raiding party from philosophers of science, keen (we hope) to see what they're up to and what they can use for their own purposes; or, putting it once again in less confrontational terms, all that they have to put up with is the perspective – which they don't even have to be made aware of – that as far as philosophers of science are concerned, what they are doing is filling up the toolbox for us.

7. Evaluation

In the wake of this defense of even compatibility principle-flouting metaphysics on the grounds that even that might come in useful in the course of time, we find ourselves at a point that has notes of Lakatos – in that we are claiming that no proposition of metaphysics may categorically be pronounced dead. And insofar as we are defending analytic metaphysics in general on the grounds that it may prove a useful heuristic for the philosophy of science, our position also invokes Feyerabend in that it suggests that the imposition of normative constraints risks choking off progress down the line. At this point, then, the conclusion that analytic metaphysics is simply off the hook, free to get back on with business as usual, seems ineluctable, and as such that the criticisms of so many philosophers of science must simply be withdrawn.

We think, however, that a closer look at the situation reveals this to be the wrong conclusion. Reminiscent of how one's *modus ponens* can be another's *modus tollens*, we think that the fact that this conclusion is even mooted draws attention to just how precarious our heuristic justification of metaphysics is. While we do,

⁷² Paul 2012 is another expression of the desire to see metaphysics as analogous to science. (We might add that seeing as metaphysicians have arguably had an insecurity complex about mathematics dating back to the time of Plato (see e.g. Moore 2012, *passim*), we think that the analogy with pure mathematics is something they will be more than happy to embrace too.)

to be sure, remain convinced that it is difficult for the naturalist to flatly condemn the work of analytic metaphysicians given the extent to which we have appropriated, and continue to appropriate, it in our own work, we think that the tension articulated in the previous section brings to light just how highly *conditionalized* that justification is. Thus note that insofar as any support can be given to either Type I or Type II metaphysics via the heuristic approach, that support is *conditionalized twice over*: it is conditionalized

- i. upon naturalistic metaphysicians continuing to take metaphysics down 'off the shelf', **as opposed to making it to order and developing it on their own**; and furthermore
- ii. upon those analytical constructions actually turning out to be relevant and useful to the interpretation of science as it evolves.

How likely is it, we must ask, that each of these conditions will be fulfilled? Regarding point (ii), we are not sure how much can be said given that whether or not it is fulfilled hangs on future scientific developments that we have already argued are difficult to foresee. And regarding point (i), it is clear that this too is going to hang on the trajectory of science, but we should note that it hangs on the trajectory of the philosophy of science as well. For whether or not (i) is fulfilled will depend on the extent to which utilizing extant packages instead of making everything to order is not a grossly inefficient way to go about things.⁷³ But whether or not it *is* grossly inefficient is going to be at least in part a function of the nature of the relevant future science, *and also* of our success in philosophy of science – for the extent to which highly classical constructions will be useful and relevant depends on how non-classical future physics will turn out to be, *plus* how successful philosophers of physics are in coming up with positive as opposed to purely negative interpretations of that physics (the latter, we have argued, being likely to be cashed out in terms of negative analogies with the

⁷³ Of course, if the packages are already there it would seem churlish not to use them. But that clearly cannot be cited as a justification for continuing to produce them in the first place.

classical)⁷⁴. And what the prospects are in either case is not something that we feel anyone is in much of a position to place bets on.⁷⁵

We think it follows from this that, while our heuristic considerations do in principle lend some support to analytic metaphysics, whether of Type I or Type II, that support is highly conditional and contingent on goings on both in science and in a naturalistic metaphysics of it. But now contrast the *support* we have offered empirically disengaged metaphysics, *conceived of as a tool for philosophers of science*, with our *criticisms* regarding metaphysics *conceived of as it is within the contemporary discipline* – namely, as the ‘science of the possible’. Recall that it was many analytic metaphysicians’ stated concern with mere possibilities that was supposed to relieve its practitioners of any duty to engage with physics. We argued that such disengagement was not in fact sanctioned on that basis, for this conception puts modal metaphysics at the heart of metaphysics, and systematic theories of modality, we have argued, can be falsified by actual physics.⁷⁶ We think that this shows that *even if* one conceives

⁷⁴ It may be, as a referee has suggested, that for whatever reason, philosophers of science simply refuse to use any tools from analytic metaphysics and of course, there would then be a sense in which analytic metaphysics could be described as having failed to be useful. Perhaps, then, we should be considering the tools that philosophers of science *could* be employing or *ought* to be. But this we feel we cannot do. Think of some of the reasons why philosophers of science might turn their backs on metaphysics. Ignoring mere churlishness or even other broadly ‘sociological’ reasons, a likely reason is that philosophers of science simply reach the point where the tools made available by metaphysics are not fit for purpose, whether through their inherent classicality or whatever. Under those circumstances, of course, the game, as it were, would be up, as would be the possibility of any further fruitful relationship between metaphysics and the philosophy of science. But in that situation, we can’t talk about what tools we ought to be using either – or at least, not for now.

⁷⁵ Though if it is objected that this makes for a ‘monkeys at typewriters’ evaluation of metaphysics, we could say that this is the case, at least to some extent, for science as well!

⁷⁶ Given what we have said about the future of physics being unpredictable, should we therefore not say that our argument that the fundamental properties such as colour charge are not intrinsic likewise could be falsified, so that Lewis’ theory, is, for all we know, still a live possibility? We ourselves think that such a move would be somewhat pathetic, but we are sure the reader can fill in the reasons why.

of metaphysics in these terms, then that is not enough to absolve metaphysicians of the responsibility to engage with science in a fundamental way.

Putting everything together, then, the following picture emerges. While there is heuristic support for analytic metaphysics if the latter is conceived of as a tool for philosophy of science, that support is highly conditional on contingent developments outside of it. If, however, we conceive of metaphysics as contemporary metaphysicians themselves do, then there are strong and seemingly categorical arguments for the idea that it has to engage with science. Whatever conditionalized support metaphysics gets from naturalistic metaphysics, then, it seems that metaphysicians must themselves concede that the systematic disregard of real science simply cannot continue if they are to take their own projects seriously. As such, it seems that the most central of the criticisms with which we opened up this paper remain as trenchant as they appeared then. Naturalistic metaphysicians were never telling anyone that they shouldn't do metaphysics. What we object to is only the idea that it should take place in a disciplinary vacuum.

But it has to be said that the picture we have painted is a complicated one, and that there are considerations pulling from both sides. As things stand, both those who would decry contemporary metaphysics and those who would defend it are doing so from crude defensive positions. What is needed is the development of more nuanced positions on the basis of which more productive engagement between the two factions might be achieved. We would hope that the perspective developed here and in our previous work will contribute to that engagement.

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