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ON CHARACTERIZING THE PHYSICAL

ABSTRACT. How should physical entities be characterized? Physicalists, who have most to do with the notion, usually characterize the physical by reference to two components,¹

1. The physical entities are the entities treated by fundamental physics with the proviso that
2. Physical entities are not fundamentally mental (that is, do not individually possess or bestow mentality).

Here I will explore the extent to which appeals to fundamental physics and to the NFM (no fundamental mentality) constraint are appropriate for characterizing the physical, especially for purposes of formulating physicalism. I will motivate and defend a version of an account incorporating both components.

1. THE APPEAL TO PHYSICS

1.1. *Motivations*

Physicalism, roughly formulated, is the view that all broadly scientific entities are nothing over and above physical entities.² Physicalists widely disagree on how to fill in the nothing over and above clause, but widely agree that, as a first pass, the physical entities should be characterized by reference to fundamental physics (henceforth, just physics). So, for example, Hellman and Thompson (1975, pp. 553–554) say:

A thesis that qualifies as ontological physicalism [...] asserts, roughly, that everything is exhausted—in a sense to be explained—by mathematical-physical entities, where these are specified as anything satisfying any predicate in a list of basic positive physical predicates of [the relevant object language] *L*. Such a list might include, e.g., ‘is a neutrino’, ‘is an electro-magnetic field’, ‘is a four-dimensional manifold’, and ‘are related by a force obeying the equations (Einstein’s, say) listed’, etc.³ (pp. 553–554)

The appeal to physics reflects, in part, the circumstances motivating materialism's evolution into physicalism. Materialism, roughly formulated, is the thesis that all broadly scientific entities are nothing over and above material entities, where the latter are characterized as being extended, impenetrable, conserved, such as to (only) deterministically interact, and so on. The material entities ultimately supposed to serve as an ontological basis for all else are those existing at relatively low orders of constitutional complexity – entities that are, as I'll put it, "relatively fundamental". But contemporary physics has reported that the relatively fundamental entities have few, if any, of the characteristics of the material; and thus materialism has been rendered a has-been. Its foundationalist spirit has survived in physicalism, however, reflecting (as Crane and Mellor, 1990 tell the story) a move from an *a priori* to an *a posteriori* characterization of the entities supposed to serve as the ontological basis for all else. In particular (though this will not be the end of the story), the foundational entities – now, the physical entities – are to be characterized by physics, the science treating of relatively fundamental entities, rather than by definition alone.⁴

Besides providing an alternative characterization of the relatively fundamental entities, the appeal to physics is motivated by two empirical factors. First is the success of contemporary physics, presently typically understood as constituted by the quantum gauge theories comprising the Standard Model (treating the electromagnetic, weak nuclear, and strong nuclear interactions), and by General Relativity (treating gravitation). While it remains unclear how to integrate these theories (see section 1.2.1), their predictive and explanatory success in their respective domains is not in question. Anti-realist concerns aside (as per usual in the physicalism debates), this success inspires confidence that physics provides an appropriate (if still imperfect) ontological handle on the relatively fundamental entities, and so motivates characterizing the physical by appeal to physics.

Second is the success of explanatory ontological accounts of one or the other variety, indicating that various entities treated by the special sciences are nothing over and above (in whatever relevant sense) various entities treated by physics. So, for example, the chemical phenomena that some (e.g., Broad) took to be emergent (as contra physicalism) are now taken to be accounted for in terms of quantum phenomena; and the biological phenomena that some (e.g., Driesch) took to support vitalism (as contra physicalism) are now supposed accounted for in terms of molecular phenomena (which in turn are taken to be accounted for in terms of physical phenomena). Indeed, it is commonly supposed that with few (if any) exceptions, the physical goings-on account for all the rest:

There are four fundamental interactions. Gravity holds our feet on earth and the earth in orbit; it is responsible for the large-scale properties of the universe [...]. Electromagnetism binds electrons and nuclei into atoms and atoms into molecules; it is responsible for all physical and chemical properties of solids, liquids, and gases. The strong interaction binds quarks into nucleons and nucleons into atomic nuclei. The weak interaction is responsible for the decay of certain nuclei. (Auyang, 1999, p. 46)

The appeal to physics in characterizing the physical thus codifies the primary evidence in favor of physicalism, though of course the truth of this thesis is still under dispute, especially as concerns the status of mentality.

1.2. *Hempel's Dilemma*

The question immediately arises what physics – current or future (in the limit of inquiry, ideal) – is at issue in a physics-based account of the physical.⁵ Hempel's dilemma (see Hempel, 1969, 1980) aims to show that neither will do for purposes of formulating physicalism.

1.2.1. *The first horn: current physics*

The point of the first horn is clear: one should not characterize the physical by reference to current physics, for since current physics is almost certainly both incomplete and at

least in part inaccurate, a current physics-based physicalism will be almost certainly false.

Though most see this result as establishing the untenability of a current physics-based characterization of the physical, Melnyk (1997) makes an interesting case to the contrary. In particular, he suggests that just as scientific realists may endorse their realism in spite of the failings of current physics, so may physicalists endorse a current physics-based physicalism in spite of these failings.

Melnyk first defines what he calls the “SR attitude”:

(SR) To take the SR attitude toward a hypothesis is (1) to regard the hypothesis as true or false in virtue of the way the mind-independent world is, and (2) to assign the hypothesis a higher probability than that of its *relevant rivals*.

where a hypothesis’ relevant rivals are defined as follows:

(RR) Hypothesis H_1 is a relevant rival to H_2 iff (a) H_1 is sensibly intended to achieve a significant number of H_2 ’s theoretical goals; (b) the hypotheses, H_1 and H_2 , fail to supervene on one another; and (c) H_1 has actually been formulated.

Per RR, the relevant rivals to a hypothesis H will not include the bare negation of the hypothesis $\neg H$, since $\neg H$ could not sensibly be intended to achieve the theoretical goals of H . But then, since taking the SR attitude toward a hypothesis only requires regarding it as more likely to be true than its relevant rivals, and since these rivals will not include $\neg H$, one can take the SR attitude even toward a hypothesis that is very likely false. Similarly, Melnyk suggests, for a physicalism based in current physics:

[G]iven that a physicalist is simply someone who takes the SR attitude toward physicalism, the mere fact that the history of physical theorizing makes physicalism unlikely to be true provides no reason by itself to abandon being a physicalist; one can remain a physicalist, just so long as physicalism, though unlikely, is still more likely than its relevant rivals. (p. 632)

The immediate problem with Melnyk’s suggestion concerns his claim that the scientific realist’s attitude toward their

avored theories is appropriately captured by SR. While Melnyk is correct that taking the realist's attitude doesn't require that S assign H a high probability, neither does it require assigning H a probability higher than those of its relevant rivals. In particular, since the Standard Model and GR are inconsistent,⁶ current physics is, strictly speaking, false; and it makes no sense, given the standard axioms of probability, to speak of a false theory as being more likely than its relevant rivals. So the realist's attitude toward physics cannot be understood in terms of SR, and nor can the physicalist's toward a current physics-based physicalism.

Melnyk has responded (p.c.) that even if current physics is in fact inconsistent, such that a perfectly rational being should assign it a zero probability, it is not obvious that we imperfectly rational beings should do so, for we may be mistaken in any belief that a set of claims is inconsistent. It is odd to vindicate a current physics-based formulation of physicalism ultimately by appeal to our presumed inability to fully understand any theory, but in any case it is implausible to suppose that our rationality is so imperfect that we must always be circumspect in assigning zero probabilities to apparently inconsistent sets of claims. Supposing we understand the meaning of inconsistency then our imperfect rationality is up to the task of determining that the set $\{P, \neg P\}$ is inconsistent (hence has zero probability), for any P (even P s whose content we do not know, or cannot understand); and while judgments of inconsistency of more complex sets of claims may require understanding something about the content of the claims (if only that they have a certain logical form), we can surely be sure that some such sets (e.g., the set $\{P, Q, P \wedge \neg Q\}$) are inconsistent (hence jointly false). To hedge regarding such obvious inconsistencies would be more irrational than not. But the inconsistency between the Standard Model and GR is of the order of these simple examples; so even if we are sometimes obliged to be circumspect in assigning zero probabilities to apparently inconsistent sets, we are not so obliged here.⁷

One might wonder whether this difficulty attaches specifically to Melnyk's implementation of his strategy for deflecting Hempel's first horn, as involving the assumption that realists take the SR attitude towards their favored theories. Why not rather suppose that the realist takes these theories to be approximately true, and moreover more approximately true than their relevant rivals – hence worthy of acceptance, even if, strictly speaking, false? Call this the SR* attitude. The SR* attitude seems acceptably rational, and a physicalist could take this attitude towards a current physics-based physicalism. Melnyk considers but rejects this approach, on grounds that there are no working accounts of approximate truth:

[O]ne could say that a physicalist is someone who holds that physicalism, while literally false, is nevertheless closer to the truth, a better approximation to the truth, than its rivals. But [this suggestion] can only be as good as the account of verisimilitude or approximation to the truth on which it relies, and these notions are notoriously hard to explicate satisfactorily. (p. 624)

The problem with appealing to approximate truth in characterizing the physical is not, however, the lack of a satisfactory account of verisimilitude – after all, the notion is pretheoretically available, and physicalists have no obligation to provide accounts of every notion entering into their thesis. The problem is rather that such an appeal, however understood, undermines taking the physics at issue in characterizing the physical to be (only) current physics. The commitment to physicalism as more approximately true than its relevant rivals presupposes that current physics is more approximately true than its relevant rivals; for if not, then physics would not provide the best route to characterizing the relatively fundamental entities entering into the physicalist's thesis. But if current physics is not true, but only approximately true, then (as per fn. 5) some future physics will do a better job of characterizing these entities – that is, will be more approximately true. Hence, there is effectively no motivation for the physicalist to characterize the base set in their

foundationalist ontological thesis as *only* adverting to current physics. Even if current physics is approximately true, reference to future (and in the supposed limit of inquiry, ideal) physics is needed in recognition of the fact that current physics hasn't yet gotten it entirely right.

That said, there are good reasons for taking current physics to also play a role in characterizing the physical (to be discussed in section 1.2.3). For now let us turn to the second horn of Hempel's dilemma, which is initially directed against characterizing the physical by appeal only to future (in the limit of inquiry, ideal) physics.

1.2.2. *The second horn: future (ideal) physics*

It's not completely clear what the point of the second horn of Hempel's dilemma is supposed to be.⁸ On one reading, the worry is that a physicalism based (only) on future (ideal) physics does not have determinate content, since we don't know what entities future (ideal) physics will treat:

[E]ither physicalist principles are based on current physics, in which case there is every reason to think they are false; or else they are not, in which case it is, at best, difficult to interpret them, since they are based on a "physics" that does not exist – yet we lack any general criterion of "physical object, property, or law" framed independently of existing physical theory. (Hellman, 1985, p. 609)

On another reading, the worry is that such a lack of determinate content will render physicalism trivially true:

[I]f one uses an ideal or future physics, then the resulting physicalism will be unacceptably vague or indeterminate. And the nature of this second horn has been further elaborated, for Chomsky has argued that using a future physics will result in a physicalism that is a trivial doctrine. (Crook and Gillett, 2001, p. 334)

In my view neither the no determinate content nor the triviality readings of Hempel's second horn represent genuine worries. First, it is incorrect to suppose that characterizing the physical by reference to future (ideal) physics will render the resulting physicalism devoid of determinate content. The appeal to physics in any physics-based account presupposes,

at a minimum, that physics is a scientific theory, and moreover one treating only of relatively fundamental entities, existing at orders of constitutional complexity that are low relative to (for example) molecules, proteins, plants, and people (see fn. 4). These characteristic features will attach to future (ideal) physics and thus bestow some determinate content on the associated physicalism. Second, these features will also prevent physicalism's being trivially true, for they indicate that future (ideal) physics will not treat of entities that are not relatively fundamental.⁹ Even if a future physics-based account of the physical placed *no* restrictions on what features the relatively fundamental entities treated by future physics could have, the question of physicalism's truth would still depend on the entirely separate question of whether all the relatively non-fundamental entities not treated by future (ideal) physics were or were not over and above the relatively fundamental entities treated by future (ideal) physics. Hence a future physics-based account of the physical isn't in danger of trivializing physicalism.¹⁰

If there is a point to the second horn, it is rather the inappropriate extension worry: that an account of the physical based in future (ideal) physics doesn't rule out the remote but presently live possibility that physics might eventually posit entities that are intuitively physically unacceptable. Most problematically, future physics might posit entities that are fundamentally mental – that is, such as to individually possess or bestow mentality, like the conscious sub-atomic particles posited by pan- or proto-psychists (who suppose that all or some fundamental entities are fundamentally mental), or the mental forces posited by emergentists (who suppose that some non-fundamental entities are fundamentally mental). So for example, Loewer (2001, p. 40) starts by characterizing the second horn of Hempel's dilemma as a worry about triviality (“[If the ‘physical’ in [physicalism] means facts expressible in the language of the complete physical theory of the world (if there is one), then that threatens to make [physicalism]

trivial unless some conditions are placed on what makes a theory ‘physical’”), but immediately fills in:

If it were to turn out that to account for certain clearly physical events physicists needed to posit fundamental intentional, or phenomenal, properties, then the resulting theory would not be physical.

Similarly, in discussing the second horn of Hempel’s dilemma, Papineau (2001) says: “[I]t isn’t crucial that you know exactly what a complete physics would include. Much more important is to know what it won’t include [...] the sentient, say, or the intentional [...]” (p. 12). By these lights, the worry with a future physics-based account of the physical is not that such an account renders physicalism devoid of determinate content, but rather that what determinate content it does bestow is compatible with physical entities’ being fundamentally mental. Nor is the worry with such an account that it renders physicalism trivially true, but rather that it threatens to sanction as physical, entities whose posit intuitively should render physicalism false.

The inappropriate extension worry, though genuine, has a straightforward answer. The guiding idea is to allow that some appeal to future (ideal) physics is needed (since current physics is at least in part inaccurate and incomplete), while recognizing that physicalists need not and should not hand over *all* authority to physics to determine what is physical. (This is the rest of the story that Crane and Mellor began telling.) After all, physicalism is the descendant of materialism; and materialism is not only a foundationalist thesis but an anti-dualist one, in that mentality – typically understood in terms of the two traditional “marks of the mental” – qualitative experience and intentionality – is supposed not to exist at the (relatively fundamental) foundations.¹¹ Physicalism’s inherited anti-dualist pretensions are reflected in this view’s typically being characterized as incompatible with the posit of fundamental mentality (as a feature either of fundamental entities, as on panpsychism, or of non-fundamental entities, as on emergentism):¹²

- Kim (1996) specifies the basic physicalist commitments as including claim that there are “no fundamental mental entities”.
- In discussing Poland’s (1994) account of the physical, Campbell (1997) says “I think this [account] would be slightly improved with a *caveat* that a dynamics which introduced forces with immanent purpose, and hence teleological causation at the base level, would not sustain a program maintaining the spirit of physicalism” (p. 224).
- Chalmers (1996) rejects the suggestion that he endorses a version of physicalism (in spite of his allowing that the mental may in the future be accounted for by an expanded physics) on grounds that his view admits “phenomenal or protophenomenal properties as fundamental” (p. 136).
- Montero (2001) says that “most physicalists would take it that panpsychism – the view that mental properties pervade all aspects of the world – is incompatible with physicalism” (1999, p. 185), and that “physicalists aim to refute dualism [...] the view that mentality is fundamental” (2001, p. 67).

Given that physicalism is an anti-dualist doctrine, then while (in response to the first horn of Hempel’s dilemma) the physics-based boundaries of the physical may stretch, they cannot stretch so far as to encompass fundamental mentality. Hence physicalists (and their rivals) have good reason to impose the NFM (no fundamental mentality) constraint on their operative account of the physical.¹³

NFM constraint imposed, there is no immediate problem with characterizing the physical by appeal to future (ideal) physics: the definitive features of physics and the imposition of the constraint ensure that a future physics-based physicalism will be neither trivially true nor in danger of absorbing its traditional dualist rivals. As a first pass, then:

The physics-based NFM account (1st pass): An entity is physical if and only if

- (i) it is treated by future (in the limit of inquiry, ideal) fundamental physics, and
- (ii) it is not fundamentally mental.

1.2.3. *Appealing to both current and future physics*

Though Hempel's dilemma poses no insuperable problem for a physics-based account of the physical, the first-pass account is less than satisfactory. For one thing, the appeal to future physics is inspired by the fact that current physics is to some extent inaccurate and/or incomplete; but similar considerations would apply to any version of future physics antecedent to ideal physics. Hence, even supposing that there is no problem with supposing that physics "at the limit of inquiry" will eventuate in a true, complete theory, an ideal physics-based formulation of physicalism is in danger of floating free from any present reason for believing it. Relatedly, while a physics-based account of the physical needs to be flexible enough to incorporate future developments in physics, one may question (as Melnyk does, in motivating his account) whether it makes sense to dispense with reference to current physics altogether, given that it is the successes of current physics that motivate characterizing the physical in terms of physics in the first place.

The distinct motivations for appealing to current and to future (ideal) versions of physics are not, however, incompatible. We can preserve the epistemological motivations for grounding physicalism in current physics, while acknowledging that current physics will need to be revised, by allowing as physical any entities that current physics treats approximately accurately; for reference to such entities will, we may reasonably assume, percolate through future versions of physics. Similarly, whether or not one is comfortable with the notion of ideal physics, one can allow as physical any entities that future versions of physics treat approximately accurately. So component (i) of the first-pass physics-based NFM account should rather be

An entity is physical only if

- (i') it is treated, approximately accurately, by current or future (in the limit of inquiry, ideal) versions of fundamental physics.

Though current physics does not posit the existence of any fundamentally mental entities, this does not get the physicalist off the hook so far as imposing the NFM constraint is concerned, for the aspects with respect to which current physics is inaccurate or incomplete might be just those that require the posit of fundamentally mental entities. As a second pass, then, we arrive at the following account of the physical:

The physics-based NFM account (2nd pass): An entity is physical if and only if

- (i') it is treated, approximately accurately, by current or future (in the limit of inquiry, ideal) versions of fundamental physics, and
- (ii) it is not fundamentally mental.

1.2.4. *Counterfactual physics*

One final refinement remains. Though physicalism is a thesis about the actual world, it would be nice if our characterization of the physical made sense of reasoning about what entities count as physical in counterfactual situations where the true physics is different from ours (see Stoljar 2001 for discussion), and relatedly, about whether physicalism would be true at such a world. The second-pass account fails to accommodate such reasoning, since on this account entities not treated (sooner or later) by actual physics can never count as physical. As a final pass, then, we should relativize our account of the physical to worlds:

The physics-based NFM account: An entity existing at a world w is physical if and only if

- (i') it is treated, approximately accurately, by current or future (in the limit of inquiry, ideal) versions of fundamental physics at w , and
- (ii) it is not fundamentally mental (that is, does not individually either possess or bestow mentality)

It is assumed here that anything that counts as physics at a world will share with actual physics the features of being a science treating of the relatively fundamental entities.

1.3. *The Metaphysical Basis of Physicalism*

Beyond Hempel's dilemma, one may yet worry that a physics-based account of the physical inappropriately characterizes (what should be) an ontological notion in epistemological terms.

Consider the alternative account of the physical endorsed by Crook and Gillett (2001), according to which the physical entities are, roughly, the contingent non-mental ontologically basic entities. Such an account, one might think, is preferable to a physics-based account. After all, physicalism is an ontological thesis. Notwithstanding that physics treats the relatively fundamental entities, why not leave out the theoretical middleman and characterize the physical in terms of the entities themselves (adding in, as Crook and Gillett do, the NFM constraint)?

Since physicalism is a foundationalist ontological thesis, the entities at the foundation should be characterized in ontological terms. That said, it's not clear that the appeal to physics is inappropriate for this purpose. First, if the characterization of the foundational entities is to go beyond the bare description of these as existing at relatively low orders of complexity (and as satisfying the NFM constraint), we have little choice but to appeal to physics; relatedly, without a more specific characterization we are unlikely to be able to test the truth of physicalism. Second (again, anti-realist concerns aside), the success of physics provides warrant for thinking that to characterize the physical in terms of physics *is* to characterize the physical in ontological terms, especially given that the account at issue adverts to future or ideal versions of physics.

Still, one might suppose that an appeal to physics leaves room for an ineliminable gap between metaphysics and epistemology, resulting either from limitations on our scientific capabilities or on our accessibility to relatively fundamental entities, that would remain even in the limit of inquiry. In that case, one might be concerned (following Barbara Montero, p.c.) that if any of the relatively fundamental entities turn out to be outside the scope of physics, then a phys-

ics-based physicalism would thereby be false, even if the inaccessible entities were intuitively physically acceptable (in particular, in not being fundamentally mental).

Some (following Poland 2003; Dowell this volume) might respond to the possibility of an ineliminable gap by accepting that physicalism would be falsified in such a scenario, on grounds that any entities that could not be integrated into some version of physics should not be deemed physical. I prefer rather to put such skeptical possibilities aside, as failing to take the appeal to physics in the proper metaphysical spirit. This appeal is to be understood sufficiently generally that it provides a basis for a contentful, testable, appropriately flexible formulation of physicalism (as well as physicalism's best rivals). It is not also required that it provide such a basis in the face of every skeptical scenario, whether this involves brains in vats, insuperable cognitive limitations, or entities that are in-principle inaccessible.

2. THE NFM CONSTRAINT

I turn now to objections directed at imposing the NFM constraint.

2.1. *Objection: Unsystematicity*

One might wonder whether imposing the NFM constraint leads to an unsystematic account of the physical. The NFM constraint is motivated by the inappropriate extension reading of Hempel's second horn, and more generally by intuitions to the effect that physicalism would be falsified if there turned out to be fundamentally mental entities. But intuitively, physicalism would also be falsified if we were to find that entities at relatively low orders of constitutional complexity were moral or freely acting agents, or that aesthetic responses involved a new fundamental interaction or force. Similarly (recalling Driesch and Broad) for chemical, biological and other non-mental, seemingly higher-order features of reality. Finally, one might also think that the posit of

entities with miraculous causal powers would falsify physicalism. So shouldn't those endorsing a physics-based account of the physical impose, in addition to the NFM constraint, *no fundamental morality, no fundamental free will, no fundamental aesthetics, no fundamental chemistry, no fundamental biology, and no miraculous powers* constraints? But then, the concern goes, the resulting account of the physical will be unsystematic and *ad hoc*; for what are mentality, morality, aesthetics, chemistry, biology, and miracles supposed to have in common, that rules them out as being physical?

To start, at least some aspects of this worry may be turned aside. Given that chemical and biological features of reality can, in actual fact, be ontologically accounted for in terms of configurations of relatively fundamental entities that are not themselves chemical or biological (as all parties to the physicalism debates seem generally prepared to agree), there is no need to explicitly rule these out as being relatively fundamental; and similarly for other features (e.g., liquidity and fragility) that all parties agree are uncontroversially nothing over and above configurations of relatively fundamental entities not having the features in question.¹⁴

But as it remains controversial whether features like moral agency, free will, aesthetic response and the like are susceptible to such configurational accounts, it is not yet clear that such features won't get in on the physical ground floor. One strategy (following Spurrett and Papineau, 1999; Papineau, 2001) would be to allow that the 'physical' may be understood as incorporating more or fewer constraints, in turn entering into different formulations of physicalism (as claiming that the mental is nothing over and above the non-mental, or that the moral is nothing over and above the non-moral, and so on). But in denying that 'physical' is univocal, this strategy seems to invite, not avoid, the charge of unsystematicity. In order to avoid this charge what is needed is the identification of some commonality between the seemingly diverse entities that are to be excluded as fundamental (that is, as being

possessed or bestowed by relatively fundamental entities), that accounts for their mutual exclusion.

As it happens, the prospects for doing this appear good. For it is plausible that most, and perhaps all, of the entities whose posit as fundamental would intuitively falsify physicalism, and whose posit as fundamental remains a live possibility, have in common that mentality is a precondition of their existence, in a strong sense according to which their existence is to some degree constituted by mentality.¹⁵ So, for example, it is plausible that anything that is a moral agent must possess mentality, in that moral agency requires that one can grasp moral concepts and truths (if such there be), and engage in decisions to act (or not to act) accordingly; but graspings of concepts and truths, and acts of decision-making, are mental phenomena.¹⁶ Similarly for whatever not-explicitly-moral agency might be at issue in free will: paradigmatically, to choose is to choose between unrealized possibilities; but both the grasping of possibilities and acts of choice are mental phenomena. It is also plausible that mentality is constitutive of the having of aesthetic response, in that such response involves grasping aesthetic concepts and truths (again, supposing such exist) and perceiving aesthetic states of affairs; but such graspings and perceivings are mental phenomena.

Much more would need to be done to provide a full defense of these claims, but since it is very plausible that moral agency, free will, and aesthetic response are to some degree constituted by mentality there is surely some warranted confidence that such a defense could be given; and similarly, one might think, for other phenomena whose existence at the relatively fundamental foundations (still) intuitively poses a problem for physicalism. Supposing so, then this commonality would provide a unified explanation, appealing only to the NFM constraint, of why a variety of seemingly diverse entities should be ruled out as relatively fundamental on any adequate account of the physical.

What about miraculous powers – must they be ruled out with an additional constraint? It seems not. First, the charac-

terization of physics as a *scientific* theory might rule out such powers (as per Dowell this volume, section 4.1). Second, the NFM constraint might rule out such powers. Whether this is so depends on what it is for a power to be miraculous: miracles violate laws, but what is the source of the violation? Traditionally, miracles are brought about by force of will of sentient beings (gods, angels, saints, sorcerers), in which case the having of miraculous powers presupposes mentality, and such powers will be ruled out by the NFM constraint. Third, if miraculous powers are not ruled out by physics, and can occur without mentality – if there can be non-mental subatomic “spoilers” – then my sense is that neither physicalists nor their rivals would find it problematic were such entities to be deemed physical. In any case, no further constraint besides the NFM constraint needs to be imposed.

2.2. *Objection: Compatibility*

2.2.1. *Stoljar’s argument*

In discussing Hempel’s dilemma, Stoljar (2001, section 10) considers and rejects the inappropriate extension worry associated with its second horn, on grounds that physicalism is not incompatible with panpsychism. He first acknowledges the worry and the associated intuition:¹⁷

Imagine the possibility of panpsychism, i.e., the possibility that all the physical objects of our acquaintance are conscious beings just as we are. Would physicalism be true in that situation? It seems intuitively not.

Then rejects the usual explanation of the intuition:

[But] the mere possibility of panpsychism cannot really be what is at issue in this objection. For no matter how implausible and outlandish it sounds, panpsychism per se is not inconsistent with physicalism (c.f. Lewis 1983). After all, the fact that there are *some* conscious beings is not contrary to physicalism—why then should the possibility that *everything* is a conscious being be contrary to physicalism?

Finally, Stoljar offers an alternative explanation of the intuition:

So what is at issue in the objection is not panpsychism so much as the possibility that the paradigms or exemplars in terms of which one characterizes the notion of the physical might turn out to be radically different from what we normally assume.

Neither Stoljar's argument for the compatibility of physicalism with panpsychism (more generally, with fundamental mentality) nor his alternative explanation of the intuition of incompatibility succeed. Taking the last point first, the intuition is not explained by the fact that "paradigms or exemplars of the physical might turn out to be radically different from what we normally assume", for physical (in particular, quantum) goings on *have* turned out to depart radically from previous assumptions, yet such surprises have not given rise to intuitions about the falsity of physicalism. Relatedly, there are all kinds of entities that physics might posit that would radically depart from present expectations – say, particles whose behavior under the influence of certain fields traces out incredibly complex geometric patterns – but whose posit (unlike the posit of fundamentally mental entities) intuitively would not falsify physicalism. This difference in intuitions needs to be explained; Stoljar's explanation doesn't explain it; and the assumption that physicalism and panpsychism are incompatible (hence that the NFM constraint should be imposed) does explain it.

Nor does Stoljar establish that an alternative explanation of the intuitions is needed. His argument is:

1. That there are *some* conscious beings is compatible with physicalism
 2. Given (1), there is no principled reason not to allow that the possibility that *all beings* are conscious is compatible with physicalism
- ∴ Panpsychism is compatible with physicalism.

The problem with this argument is that (1) is ambiguous; when disambiguated, then (2) may be seen to be false.¹⁸ To see that (1) is ambiguous, recall that there are two ways for the posit of an entity to be compatible with physicalism: first, by being a physical entity (hence, perhaps among other

things, a relatively fundamental entity), and second, by being an entity that is not relatively fundamental, but is nonetheless nothing over and above physical entities. Taking these different routes to physical acceptability into account, premise (1) in Stoljar's argument needs to be disambiguated, as either:

1' That there are some relatively non-fundamental conscious beings is compatible with physicalism

or

1'' That there are some relatively fundamental conscious beings is compatible with physicalism.

Now, it is uncontroversial that (most) physicalists believe "that there are *some* conscious beings is compatible with physicalism"; but this is because they think that consciousness (like mentality generally) is nothing over and above configurational physical goings-on (as per the first disambiguation), not because they think that any physical entities are themselves conscious (as per the second). Hence the distinction between being a relatively fundamental being and a relatively non-fundamental being provides a principled ground for physicalism's being compatible with there being some (non-fundamental) conscious beings, yet incompatible with all beings – including relatively fundamental beings – being conscious. So premise (2) in Stoljar's argument is false. Correspondingly, Stoljar's argument fails to establish that physicalism is compatible with panpsychism, or more generally, with the posit of (any) fundamentally mental entities.

2.2.2. *Dowell's IFT account*

A different argument for the compatibility of the physical and the fundamentally mental may be found in Dowell's (this volume) discussion of her physics-based IFT ('integrated fundamental theory') account, which characterizes the physical simply by appeal to ideal physics. Dowell motivates her account by calling attention to the definitive characteristics of physics:

A fully fleshed-out version of a formulation in terms of ideal physics must go on to identify what makes a physical theory physical. [...] [T]he best method for fleshing out such a view begins by tying being a physical theory to being a theory with the hallmarks of scientific theories and then identifies physical theories among the scientific ones by their characteristic subject matter, roughly, the world's most fundamental elements. (p. 26)

As earlier noted, such characteristics suffice to answer the indeterminate content worry associated with Hempel's dilemma. Dowell's response to the triviality worry adverts to her understanding of scientific theories as essentially enabling predictions and explanations:

[O]n the present account anything whose existence and behavior can neither itself be explained and predicted nor figure in explanations and predictions is incapable of being integrated into the complete and ideal theory in the present sense and so is non-physical and its existence falsifies physicalism. Given this, the content of physicalism in the present, science-based sense is both determinate and falsifiable and so that content is not trivial [...]. (p. 41)

In particular, an IFT-based physicalism would be falsified by the existence of entities with miraculous powers, and hence is not trivially true.

Dowell's characterization of the physical does not, however, rule out that physical entities might be fundamentally mental.¹⁹

There's nothing in the very idea of a posit of our complete and ideal scientific theory of our world's most fundamental elements that rules out that some mental properties are among those posits. That means that, on the present view, it is not *a priori* that no mental property is among the basic physical ones. (p. 27)

A physics-based IFT account thus renders physicalism compatible, in principle, with pan- or protopsychism,²⁰ and more generally does not avoid the inappropriate extension worry associated with Hempel's second horn.

Dowell notes that some might see this consequence as constituting a *reductio* against her account, but resists this assessment (and associated call for the NFM constraint to be imposed) for two reasons. First, she has an alternative

explanation for why people have thought that the physical could not be fundamentally mental: “[W]e should ask: Why do we think its turning out that quarks are conscious is its turning out that physicalism is false? The answer, I think, is that we think it incredible that our ideal physical theory should say so” (fn. 28). In her view, those accepting the NFM constraint have inappropriately taken an unlikely *a posteriori* possibility to be a definitional constraint, such that it is *a priori* that the physical could not turn out to be fundamentally mental. Second, she challenges those who reject her deflationary explanation to provide an account of the source of the supposed *a priori* incompatibility, that shows why one can’t maintain that it is rather *a posteriori* that the physical is not fundamentally mental. In what follows I will address Dowell’s challenge, though not quite in the terms she sets it.

2.3. *The a Posteriori Basis for the NFM Constraint*

Unsurprisingly, I reject Dowell’s deflationary explanation of the intuitions motivating the NFM constraint, for the same reasons I reject Stoljar’s similar explanation; namely, that this explanation cannot be correct, for there could be (have been) entities that we would (did) find “incredible” for physics to posit, but which would not (did not) give rise to intuitions that physicalism was (would be) thereby falsified.

Must I now provide “an argument showing that there is some unobvious *a priori* incompatibility in our concepts of the mental and the basically physical” (p. 45)? I hope not, since in my view there isn’t likely to be any such argument.

There are three sources of pessimism here, none of which has anything to do with the NFM constraint. The first stems from the observation that constraints on empirical concepts do not seem to eventuate from *a priori* deliberation, understood²¹ as involving attention to some sufficient spectrum of ways the world might turn out. The second stems from concerns about the methodology of such deliberation.²² My own concerns along these lines are analogous to doubts (c.f. Salmon, 1990) that the expectedness value in Bayes’s theorem

can typically be calculated: that as a matter of pathetic fact, we cannot assume that we are equipped to imaginatively consider the full range of ways the world might go relevant to the deliberation at issue, at least so far as empirical concepts are concerned. The third stems from concerns that, were we appropriately equipped, we would find that little, if anything, would be incompatible with any given empirical concept (besides the usual suspects – e.g., that entities falling under the concept concurrently fall under the concept's negation). The second and third sources of pessimism suggest that, even where we think a constraint should be imposed on a given concept, there is unlikely to be any sound *a priori* argument to that conclusion. The first source of pessimism indicates that in any case we shouldn't expect there to be any such argument, but rather should be looking elsewhere if we want to assess what constraints should be imposed on a given empirical concept (and why). Before I say where I think we should be looking let me illustrate the above concerns by reference to the simple case of *being an acid*.²³

It was originally taken to be a constraint on *being an acid* that acids contained oxygen. Nonetheless, a substance was later discovered that was both judged to be an acid, and which didn't contain oxygen – namely, hydrochloric acid. What is going on in such a case? Why did early chemists initially impose the constraint, and later chemists remove it?

One might try to understand this case first by taking the initial imposition to reflect that early chemists took it to be *a priori* that acids contained oxygen; then going on to explain the later removal as reflecting either (a) that while early chemists mistook an *a posteriori* unlikelihood for an *a priori* constraint, or (b) that while early chemists were right about the *a priori* incompatibility at issue, the term 'acid' later came to denote a different concept. It seems to me however, that attending to what early chemists took to be *a priori* about *being an acid* (rightly or wrongly) is an unpromising strategy for understanding the case. First, as is typical of empirical concepts, it is implausible that the constraint initially imposed

on *being an acid* was the result of any sort of *a priori* deliberation. Second, due to imaginative limitations, any such deliberations would have been doomed to fail: surely early chemists could not have foreseen the specific future trajectory whereby causal features came to be dominant in applications of the concept *being an acid*. Third, even if early chemists had been equipped with the requisite foresight, it is unclear that their deliberation would have eventuated in there being *anything* that was incompatible with *being an acid* (besides the usual suspects). Just as certain compositional constraints imposed on acids were eventually discarded as a result of “ways the world went”, what prevents any given constraint from being similarly discarded or replaced in response to various pressures? More generally, why think of any two empirical concepts that appear to be incompatible (but which are not contraries, etc.) that no possible future trajectory renders them compatible?

To bring the point home: while I am happy to accept the features Dowell canvasses as constraints on *being a fundamental physical theory* given our present conception of and intended use of this concept, surely there are reasonable future or possible trajectories of scientific investigation according to which physics allows the posit of relatively non-fundamental entities, or entities whose behaviors cannot be subsumed under anything recognizable as natural law, or entities whose behaviors cannot be integrated with the behavior of other physical entities, etc. Consider the feature of physics according to which the entities it treats must enter into explanations and predictions. In contemporary physics we have already given up deterministic for quantum indeterministic laws, which allow the occurrence of specific quantum events that are neither predictable nor explainable. How far from this is the posit of events not subsumed even by probabilistic laws? And how far from this is the posit of angels that are predictably unpredictable: that predictably violate whatever law strikes their fancy? Hence one not very useful way for me to throw the ball back in Dowell’s court would be to

challenge her to provide an argument that there is an *a priori* incompatibility in our concepts of physics and of non-law-governed behavior. Such an argument is no more likely to be forthcoming in her case than in mine.

To sum up: considerations about what is *a priori* about the physical are effectively useless in determining whether physical entities should be subject to the NFM constraint. The question remains what, if anything, can legislate between accounts of the physical that differ in this respect.

A plausible answer is not hard to find, once we note that our characterizations of a given empirical concept (at a given time, broadly construed) do not float free of the relevant associations with the concept at that time – including, at a minimum, the relevant historical and pragmatic considerations. Plausibly, the original constraint on *being an acid* reflected the historically relevant fact that all the substances initially classified as acids contained oxygen; plausibly, this constraint was dropped in response to certain intended uses for the concept (as picking out entities capable of producing certain distinctive effects) becoming salient. If by ‘context’ we mean to include any considerations – historical, pragmatic, or otherwise – that are relevant, to determining the criteria of application of a concept at a given time broadly construed, then the suggestion is that these criteria (and associated constraints) are context-relative.²⁴

Attention to such relevant considerations provides a means of assessing whether a given constraint should be imposed on a concept, even in the absence of an *a priori* argument to this effect. For relative to a given set of relevant considerations, it often *will* be clear whether a given constraint should be imposed. Thus my strategy for responding to Dowell’s challenge will be to argue that the historical and pragmatic associations presently relevant to (determining the criteria of application of) the concept of the physical strongly support imposing the NFM constraint.

Before continuing, a remark about whether (as David Chalmers suggested) the dispute over whether physical

entities should be subject to the NFM constraint is primarily terminological. Supposing that Dowell's IFT account enters into a formulation of physicalism that is both contentful and non-trivial, why not distinguish two empirical concepts – say, $\text{physical}_{\text{NFM}}$ and $\text{physical}_{\text{IFT}}$, each of which enters into an interesting formulation of physicalism? I wouldn't object if there were two interesting notions on the table, each of which had some claim on being called 'physical'. But first, even if the NFM and IFT accounts are ultimately not in competition, it's worth keeping clear about how terms (including 'physical') already present in philosophical discourse are being used, and why; and more importantly, about what points of doctrine are at issue in existing debates involving these terms. And second, in any case I don't think the dispute between Dowell and myself is merely terminological; for as I'll now argue, there isn't any facet of the presently relevant considerations that the IFT account accommodates that the NFM account doesn't also accommodate, while the reverse is not the case. If I am right, there isn't any pressing need – at least at present – to countenance any but a physics-based NFM account of the physical.

2.3.1. *Historic considerations: materialism and physicalism*

The anti-dualist aspirations of materialism. As noted, physicalism is the heir apparent of materialism. And as we have seen, characterizing the physical by appeal to physics suffices to preserve materialism's foundationalist ontological pretensions, while the appeal to the NFM constraint suffices to preserve materialism's traditional incompatibility with its dualist rivals, as well as the non-eliminative materialist's strategy for accommodating the mental in terms of configurational non-mental goings-on.

Dowell might claim that an IFT-based formulation of physicalism can also preserve these historical associations, in spite of not imposing the NFM constraint, on grounds that, first, IFT physicalists may maintain that (as a matter of *a posteriori* fact) it is extremely unlikely that any physical

entities will turn out to be fundamentally mental and second, in response to this *a posteriori* fact IFT physicalists will be concerned (like materialists) to provide configurational accounts of mentality in terms of entities that are not themselves mental. Even so, given that an IFT-based formulation of physicalism is compatible with various of materialism's traditional dualist rivals, and given that there are no other relevant respects of similarity or difference between the NFM and IFT-based formulations of physicalism rendering them more or less similar to materialism, that the NFM-based formulation *guarantees* the preservation of materialism's anti-dualist aspirations indicates that the NFM account of the physical better accommodates the present historical associations with this notion.

Dowell might respond that an IFT account of the physical better accommodates a different historical trajectory involving physicalism. After all, Carnap and Neurath introduced the term 'physicalism' into philosophical discourse, and at the time (see Gates, 2001, p. 251), the term "seemed theirs to define". Indeed, there's little doubt that members of the Vienna Circle understood physicalism to involve a commitment to lawfully integrated fundamental theory, both as a concomitant of their thesis of the unity of science and as part of their preferred approach to scientific explanation as requiring laws (see Hempel, 1965). Relatedly, members of the Vienna Circle rejected Driesch's vitalism primarily because it failed to specify laws of vital phenomena; hence was not an acceptable scientific explanation; hence could not be appropriately integrated into physical theory (see Carnap, 1966).

But that some historical trajectory involves a concept – even a historically significant trajectory – is not sufficient to motivate taking that trajectory as relevant to the present criteria of application of the concept. Here the IFT account is at a disadvantage; for notwithstanding early physicalist concerns with the form and methodology of scientific theories, such concerns play very little role in the contemporary physicalism debates:

[C]ontemporary physicalism is an ontological rather than a methodological doctrine. It claims that everything is physically constituted, not that everything should be studied by the methods used in physical science. This emphasis on ontology rather than methodology marks a striking contrast with the ‘unity of science’ doctrines prevalent among logical positivists in the first half of the century. The logical positivists were much exercised by the question of whether the different branches of science, from physics to psychology, should all use the same method of controlled observation and systematic generalization. They paid little or no attention to the question of whether everything is made of the same physical stuff. By contrast, physicalism, as it is understood today, does not have these specific methodological implications. [...] You can be a physicalist about biology, say, and yet deny that biology is concerned with laws. (Papineau, 2001, p. 3)

The positivist’s preoccupation with lawfulness and scientific methodology, as opposed to ontology, is a presently ignored blip on the physicalist’s screen. I don’t mean to suggest that Dowell’s physics-based IFT account is intended to capture a positivist understanding of the physical; it rather seems aimed at capturing a scientific understanding of this concept. But her account is similarly concerned with the *form* rather than the *content* of the science treating of the entities serving as a basis for physicalist explanation. Insofar as contemporary physicalists are mainly unconcerned with formal considerations (for reasons that overlap, no doubt, with those responsible for the demise of positivist’s project), and are mainly concerned with ontological considerations, physicalism’s historical connections to the Vienna circle provides little support for characterizing the physical solely or primarily in terms of the methodology and characteristics of science (in particular, physics).

On the other hand, there is a case to be made for incorporating some general attention to our best sciences – in particular, physics – into our account of the physical. Indeed, I made such a case myself, in arguing that the predictive and explanatory success of physics enters into our confidence that physics provides a warranted route to characterizing the relatively fundamental entities. Hence it is that all parties to the physicalism debates should endorse a physics-based account

of the physical; and to the extent as physicalists are inclined to focus on the methodology and formal features of science, the physics-based NFM account provides a basis for doing so. But they should not forget, as Papineau reminds us, that contemporary physicalism is primarily an ontological doctrine – and in particular, an anti-dualist one.

2.3.2. *Pragmatic considerations: the mind–body problem*

That both materialists and physicalists attempt to account for existing mental entities in terms of configurations of entities that do not themselves individually possess or bestow mentality is no accident. Each is implementing a similar strategy for solving the mind–body problem: the problem of how to make sense of the relationship between mind and body, given that these seem so different, on the one hand, and yet are so clearly intimately ontologically (and causally²⁵) related, on the other. As Kim (2001) recently expressed the problem:

Why does pain arise when there is electrical activity in the pyramidal cell layers, and not under another neural condition? Why doesn't itch or tickle arise from pyramidal cell activity? Why should any conscious sensation at all arise when pyramidal cell activity occurs? Why should there be consciousness in a world that is ultimately nothing but bits of matter scattered over space-time points? (p. 274)

And as Nagel (1985) earlier put it:

What is needed is something we do not have: a theory of conscious organisms as physical systems composed of chemical elements and occupying space, which also have an individual perspective on the world, and in some cases a capacity for self-awareness as well. In some way that we do not now understand our minds as well as our bodies come into being when these materials are suitably combined and organized. The strange truth seems to be that certain complex, biologically generated physical systems, of which each of us is an example, have rich nonphysical properties. (p. 51)

Of course there are several strategies for resolving this problem (associated with physicalism, emergentism, proto- or panpsychism, and so on) but what I want to focus on here is

the question of how best to pose the problem itself. Arguably, the pragmatic consideration that is presently most relevant to the question of how the physical should be characterized has to do with the role this notion plays in setting up this still-perplexing problem (or its variants). In particular, given that we must now understand body in terms of the physical, an adequate account of the physical should make clear why the mental is so apparently different from the physical that there is at least a *prima facie* difficulty in reconciling them. An account of the physical that imposes the NFM constraint provides a basis for a difficulty-making difference: if physical entities cannot themselves possess or bestow mentality, then there is a *prima facie* difficulty in seeing how relatively non-fundamental entities ultimately composed of physical entities (that is, “complex, biologically generated physical systems”) can themselves be mental, given that their composing entities are not.

Could an account of the physical not imposing the NFM constraint also provide a basis for motivating the mind–body problem? One concern here is that an account of body on which the physical can be fundamentally mental solves the problem, rather than motivating it. If the physical can be fundamentally mental, the truth about how mentality occurs in complex systems needn’t be any stranger than the truth about how mass occurs in complex systems: in either case, the feature existing at the higher-level could be seen simply as an additive or other relatively ontologically innocent function of the same (or relevantly similar) feature as existing at the level of its parts. As per Dowell’s usual strategy, one might preserve the appearance of a *prima facie* incompatibility between mental and physical entities by reference to our finding it extremely unlikely, as an *a posteriori* matter, that the relatively fundamental entities might themselves be mental. But if this unlikelihood is supposed to be the only source of seeming incompatibility, this would be effectively to admit that the supposition that the physical is not fundamentally mental

– that is, the NFM constraint – is needed in order to properly motivate the problem.

Might Dowell's IFT account of the physical provide a different basis of seeming incompatibility between mind and body? In general, it seems not. On an IFT account, any *prima facie* incompatibility between mind and body must rather lie in an apparent difference in their aptitude for entering into a well-integrated system of laws. But most mental goings-on are plausibly sufficiently law-governed that there is not even an apparent difference between them and physical entities in this respect. In particular, both of the traditional marks of the mental – qualitative experience and intentionality – appear to be perfectly apt for integration into a system of causal and constitutive laws.²⁶ This is one reason why functionalism has gotten such a grip in the philosophy of mind; but of course one doesn't have to be a functionalist to observe that these aspects of mentality are law-governed. So an IFT account does not give rise to an interesting mind–body problematic as concerns qualitative and intentional mental entities. But of course such mental entities have been, and continue to be, among the entities for which the mind–body problem is most puzzling. In the pragmatic interest of providing a basis for the mind–body problem as involving qualitative and intentional mental entities, (and absent any better means of doing so), we should endorse at least one account of the physical which imposes the NFM constraint.

That said, there is one feature of mentality that does seem *prima facie* incompatible with lawful integration into a complete and ideal theory of the relatively fundamental entities; namely, free will. If free will involves choices that are genuinely outside of any nomological net, then it is hard to see how this feature could be well-integrated into any system of laws.

Even so, the free will–body problem doesn't provide any serious motivation for endorsing an IFT account of the physical in addition to one imposing the NFM constraint. Intuitively and paradigmatically, acts of free will have two

components: first, they involve acts of conscious decision-making, hence consciousness; second, the decisions are not determined by natural law. Both features are *prima facie* at odds with the physical, as characterized by a physics-based NFM account: the first (consciousness) because physical entities cannot be fundamentally mental, and the second (freedom) because physical entities are the entities approximately accurately treated by present and future (in the limit of inquiry, ideal) physics, hence (on the present understanding of physics) are subject to natural law. So the physics-based NFM account is not only already capable of motivating the free will–body problem, but moreover (unlike the physics-based IFT account) can motivate the problem as it attaches to the conscious, as well as the free, aspects of free will.

I am now done answering Dowell's challenge. To sum up a physics-based account imposing the NFM constraint preserves the historical associations of physicalism as the descendent of materialism and motivates the full spectrum of versions of the mind–body problem. By way of contrast, a physics-based account of the physical not imposing the NFM constraint (along lines of Dowell's IFT account) cannot accomplish all these goals; and what goals it does accomplish (preserving a historical concern with scientific methodology and motivating a free will–body problem) are either irrelevant to present concerns or else can be accomplished by the physics-based NFM account (or both). Even absent an argument showing that it is *a priori* that physical entities cannot be fundamentally mental, these advantages strongly support imposing the NFM constraint on our present account of the physical.

3. CONCLUDING REMARKS

The physics-based NFM account does everything we presently need an account of the physical to do: encodes our increasingly warranted confidence in physics as tracking characteristics of the relatively fundamental entities, avoids all

readings of both horns of Hempel's dilemma, preserves physicalism as the heir of materialism's anti-dualist mantle, and motivates the mind-body problem in all its many incarnations. What contemporary party to the physicalism debates could ask for anything more?

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NOTES

¹ See Hellman and Thompson (1975), Papineau (1993), Kirk (1994), Ravenscroft (1997), Papineau (2001), and Loewer (2001) for variations on this theme. These accounts appropriately assume that the physical entities are those existing at relatively low orders of complexity, so that, e.g., the identity theorist's claim that mental entities are identical to physical entities should be understood, more precisely, as the claim that mental entities are identical to physically acceptable entities (e.g., micro-structural properties), which will not be among the relatively fundamental entities treated by physics; and the claim that physics is causally complete should be understood, more precisely, as the claim that every physically acceptable effect has a physically acceptable cause. The account I will eventually endorse differs in certain key respects from any endorsed thus far.

² As per usual, the domain of quantification in this thesis ranges over actual broadly scientific entities (properties, substantial particulars, events, processes, etc.), initially excluding at least some possibilities (insofar as physicalism is taken to be a contingent thesis about the actual world – though see section 2.2.4) and perhaps also mathematical and metaphysical entities.

³ See also Davidson (1970), Lewis (1983), Pettit (1995), Kirk (1996), Armstrong (1997), Melnyk (1997), Ravenscroft (1997), Papineau (2001), Loewer (2001), Witmer (2001).

⁴ Here I assume that what entities a science treats corresponds roughly to the divisions in subject matter associated with the various fundamental and special sciences (which divisions track, among other things,

constitutional complexity). There might be other accounts of what entities a science (in particular, physics) treats, that allow, for example, that in addition to relatively fundamental entities, physics also treats of any complex configurations of relatively fundamental entities standing in relatively fundamental relations. However, more generous approaches obscure the insufficiently discussed question of what nothing over and aboveness comes to, as holding between relatively fundamental entities and complex configurations of such: it is at least an open question whether the notion of nothing over and aboveness in such cases is the same as when, for example, certain mental properties of a subject are supposed to be nothing over and above certain neurophysiological properties of that subject. So I will stick with the intuitive notion, which in the case of physics primarily tracks relative fundamentality. Two points of clarification are in order. First, the notion of constitutional complexity at issue in designations of relative fundamentality is not intended to rule out there being fields among the relatively fundamental entities, which serve as a constitutional basis for molecules, proteins, plants, and so on. It is, however, intended to rule out galaxies and the like as being relatively fundamental, so that astrophysics (like molecular physics) is a special science, to be distinguished from (fundamental) physics. Second, the qualifier 'relatively' in the expression 'relatively fundamental' is intended as compatible with physical entities' not being fundamental, for two reasons. First, many entities treated by physics are not themselves fundamental – e.g., protons. Second, notwithstanding physicalism's foundationalist aspirations, satisfying these aspirations does not entail commitment to there being a fundamental level (see Montero, 2005 for further discussion).

⁵ Here and throughout appeals to 'future' physics are intended optimistically, as indicative of physics's increasing tracking of the truth, ignoring the possibilities of wrong turns, inquiry-ending Armageddon, and so on.

⁶ In particular, the assumption in GR that spacetime has a well-defined curvature at every spacetime location is incompatible with quantum indeterminacy: determinacy in temporal location results in indeterminacy in energy (hence in mass; hence in curvature) at that location, and determinacy in spatial location results in indeterminacy in momentum (hence in mass; hence in curvature) at that location.

⁷ We are obliged to be circumspect with regard to whether future versions of these theories will be inconsistent, for perhaps they will eventually be reconciled. But that future versions of physics may be consistent doesn't vindicate a current physics-based account of the physical.

⁸ I'm not so concerned with Hempel exegesis (in fact, he clearly had the first of the readings I will discuss in mind) as with the question of what the worry could be, if it is to be directed at a physics-based account with minimal integrity (that is, one placing constraints on what could count as physics).

⁹ Hence I deny the claim, often cited as motivating the triviality worry, and often attributed to Chomsky as per his 1972, p. 98 and 1980, pp. 5–6 (though Chomsky’s considered position is more nuanced; see Poland, 2003), that any entities that couldn’t be explained by physics – even entities existing only at relatively high levels of constitutional complexity – would eventually be downwardly incorporated into physics. The suggestion is implausible, insofar as the various sciences treat of their preferred levels of constitutional complexity, and moreover there isn’t any evidence that downward incorporation is a methodological principle in physics (or in the sciences, generally speaking). In particular, clear cases of incorporation into physics – most notably, the case of electricity and magnetism – don’t show this, since the incorporated phenomena exist (and were taken to exist) at the same orders of constitutional complexity as other phenomena treated by physics.

¹⁰ This is true, so long as the physics at issue is understood as having the afore-mentioned characteristics. If it is not so understood, then triviality does become a threat, as on Poland’s (1994) account (on which physics is the science concerned with accounting for space-time and for the composition, dynamics, and interactions of all occupants of space-time), or any account on which future physics is assumed to be a “theory of everything”. (Poland (2003) has since endorsed a characterization of the physical which highlights the methodological characteristics of physics as a means of avoiding the triviality worry.) Again, there is no motivation to characterize (fundamental) physics, the subject matter of which is clearly restricted, in such an encompassing way.

¹¹ Hence it was that materialist accounts primarily aimed at giving accounts of mentality in terms of configurations of non-mental goings-on. So, for example, Democritan atomists gave a mechanical account of human perception in terms of atoms flowing from objects into channels associated with the sense organs, where collisions with other atoms give rise to sensation. Hobbes defined body as anything both existing independent of thought and having volume, and maintained that sensations are motions in a human’s body, and changes of sensation are changes of that motion. D’Holbach argued that no phenomena are outside nature, understood as a causally determined succession of arrangements of matter in motion; and he provided what appear to be the first behaviorist analyses of mental characteristics (including character and wit). Nineteenth century materialists (Moleschott, Vogt, Du Bois-Reymond) attempted to provide physicochemical explanations of mental functioning. Carnap and Neurath developed proto-behaviorist accounts of mental states. And Ryle argued that (attributions of) intentions, beliefs, desires, etc. should be understood as (attributions of) dispositions (understood as states of a material body) to behave in characteristic fashions in certain circumstances. See Campbell (1967) for details and many other illustrations.

¹² It is an interesting question, to which the answer is unclear, whether the NFM constraint is needed in order to rule out the possibility of entities of the sort posited by emergentists (e.g., emergent mental properties, or fundamental mental “configurational” forces or interactions) as being physical. One might think not, since emergent features or forces are supposed to exist or come into play only at relatively high levels of complexity, and physics only treats of relatively fundamental entities. On the other hand, such features or forces are supposed to themselves be fundamental, in which case they would seem to be apt to be treated by physics.

¹³ Another good reason will be provided in section 2.3.2.

¹⁴ Note that this strategy is highly dependent on facts about the actual world, and hence may not be available as a general means of imposing such constraints in cases of counterfactual reasoning about worlds where the physics is different.

¹⁵ To wit: it would not suffice for the sort of precondition of mentality at issue here that, e.g., moral agency could be instantiated in a non-conscious entity so long as a thinking being existed somewhere in the world. Thanks to Janice Dowell for discussion here.

¹⁶ Note that to say that moral agency presupposes mentality is not to take a stand on the question of how either moral agency or mentality are to be ultimately ontologically understood – e.g., as physically acceptable or not.

¹⁷ Stoljar moves in his discussion from talking about the inappropriate extension worry as directed at a physics-based account to a related worry directed at a paradigmatic object account of the physical, but since he takes his response to undermine both worries, I just focus on the application of his argument to the physics-based NFM account.

¹⁸ Another problem here is that the focus on whether some or rather all entities might be fundamentally mental is a red herring, for the intuitions associated with the inappropriate extension worry are present even if only one relatively fundamental entity is fundamentally mental; but leave this aside.

¹⁹ Similarly for the account of the physical in Poland’s (2003) “methodological physicalism”.

²⁰ One might wonder whether Dowell’s account is also compatible with emergentism as standardly construed, since emergent mental entities are standardly supposed to figure in explanations and predictions (and in particular, are supposed to be nomologically well-integrated with goings-on at the relatively fundamental level, such that emergent entities supervene on physical entities, are downwardly causally efficacious *vice versa* physical entities, and so on). Dowell preserves the incompatibility of an IFT-based formulation of physicalism with standard emergentism by deciding the question raised in fn. 12 in favor of ruling against the possibility that future physics will treat of emergent entities, since the latter (in spite of being themselves fundamental) are features of entities that are relatively

non-fundamental. I take it to be an advantage of the physics-based NFM account of the physical that it renders physicalism incompatible with (standard) emergentism, however this question is decided.

²¹ As per Jackson (1998) and Chalmers and Jackson (2001).

²² So, for example, Melnyk (2006) argues that no existent account of what it is to possess a concept or be competent with a term underwrites such possession or competence giving one *a priori* cognitive access to the content of the concept or term; and Stalnaker (2003) doubts that applications of the method give us information about our own semantics, as opposed to the semantics of the hypothetical worlds that are variously considered as actual.

²³ This case is discussed in Mill (1843) and Kitcher (1980). In what follows will gloss the use-mention distinction as applied to concepts and what falls under them.

²⁴ Note that it would be inapt to see such considerations as motivating a “context-relative” approach to determining what is *a priori* about a concept, at least to the extent that *a priori* deliberation about a concept is supposed to be able to proceed in relative ignorance of the contingent actual facts associated with the concept (beyond those required for achieving a grasp of the concept).

²⁵ Hence it is that the mind–body problem shades into the problem of mental causation.

²⁶ Davidson (1970) might be taken to dispute this, in claiming that there cannot be any psycho-physical laws. I’ll just say here that I don’t find his arguments for this claim convincing.

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