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Current Physics and 'the Physical'

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ABSTRACT

Physicalism is the claim that that there is nothing in the world but the physical. Philosophers who defend physicalism have to confront a well-known dilemma, known as Hempel's dilemma, concerning the definition of 'the physical': if 'the physical' is whatever current physics says there is, then physicalism is most probably false; but if 'the physical' is whatever the true theory of physics would say that there is, we have that physicalism is vacuous and runs the risk of becoming trivial. This article has two parts. The first, negative, part is devoted to developing a criticism of the so-called *via negativa* response to Hempel's dilemma. In the second, more substantial, part, I propose to take the first horn of Hempel's dilemma. However, I argue for a broad construal of 'current physics' and characterize 'the physical' accordingly. The virtues of the broad characterization of 'the physical' are: first, it makes physicalism less likely to be false; and second, it ties our understanding of 'the physical' to the reasons we have for believing in physicalism. That is, it fulfills the desideratum of construing our theses according to the reasons we have to believe in them.

1 Introduction

Physicalism is an ontological thesis about the ultimate constituents of the world.[1] In its strong version, physicalism claims that the world contains

[1] Some authors, e.g. Ney ([2006]), hold that physicalism could be better seen as an *attitude*, expressed by the commitment to construe one's ontology according to what physics says exists. By taking physicalism to be an attitude instead of an ontological thesis the problems derived from Hempel's dilemma are avoided, since an attitude is not true, false, or trivial. Here, I will not discuss this view, but rather I will focus on the issue of whether, as of today, physicalism

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nothing but physical entities. Other milder versions allow the existence either of some abstract entities or of entities that, while not physical, depend on, or are determined by, physical entities.[2] As is well known, however it is defined, physicalism has to confront a dilemma that results from the indeterminacy of the notion of the physical. This is known as Hempel's dilemma (see Hempel [1980]) and can be stated as follows: 'The physical' in physicalism may mean either something like, 'whatever current physics claims exists', or something like, 'whatever the true ultimate physics claims exists'. If we adopt the former option, then physicalism is most probably false, because current physics is most probably false.[3] If we choose the latter, then physicalism is quite an empty thesis, because we do not have any idea about what kind of entities the true ultimate physics will postulate. Moreover, it has been claimed that construing physicalism in this second way runs the risk of rendering it trivial, since it is possible that the final theory of physics will turn out to include, for instance, irreducible mental properties in its basic repertoire (see Chomsky [1995]).[4]

Some authors reject the idea that it is untenable to link the definition of the physical to current physics (see Melnyk [1997], [2003]), thereby claiming to disarm the first horn of the dilemma. The pessimistic meta-induction argument (see Laudan [1981]) suggests that our current theories are most probably false. In spite of this, however, Melnyk claims that it is possible to have a realist attitude toward our current physical theories based, for instance, on the fact that they fare better than their rivals. Analogously, we can have a realist attitude toward a physicalism linked to our current physical theories, given that it is more likely to be true than its rivals.

Melnyk's account has been severely criticized (see e.g. Wilson [2006]). However, I think that currentism, as this general approach is often called, should be seen as a live option. I concur with Melnyk's critics in that the meta-induction problem is fatal for Melnyk's currentism. We have plenty of inductive evidence to suppose that current physics (understood for instance as

can constitute an ontological thesis that is neither trivial nor false. Given that I think this can be done, I consider it unnecessary to adopt Ney's proposed change in the status of physicalism from ontological thesis to attitude.

[2] In what follows, I will be concerned with the strong version of physicalism.

[3] Wilson ([2006]) claims that it *is* false, since General Relativity and the Standard Model of quantum mechanics are incompatible.

[4] The triviality problem is that we cannot be sure that future physics will not incorporate as part of its own domain the entities that look problematic from a physicalist point of view, without reducing them—indeed, Chomsky ([1995]) suggests that we can expect just this of the ultimate physics. This means that if we define the physical according to what future physics will claim, we may be making physicalism trivially true, for it may be true even if problematic entities—prototypically, mental entities—are irreducible.

the set of claims to be found in physics textbooks) will be superseded by other physics. Yet, it is possible to understand 'current physics' in another, broader way, and identify it with just a core subset of the claims found in textbooks. In particular, my proposal is to construe current physics minimally. Thus construed, current physics asserts: first, that energy, momentum, electrical charge, and a few more properties are conserved quantities in all (or at least in a relevant class of) local interactions when the system considered is the whole universe;[5,6] second, that these quantities are possessed by bodies; and third, that their distribution and exchange are mediated by forces.

I will argue that this construal of current physics allows for an adequate definition of the physical in the physicalist debate. First, it provides the physicalist claim with content, for physicalism becomes the claim that what exists is energy, momentum, electrical charge, and a few more quantities (such as color charge); bodies that possess these quantities; and the forces that mediate their distribution and exchange. Second, this proposal is not such easy prey for the meta-induction argument: according to the proposal, the claims that constitute current physics are well-entrenched central claims, not just of our contemporary theories narrowly construed, but of a number of such theories that have been proposed as improvements over others. This means, minimally, that we also have some valuable inductive evidence to believe that our next theories will keep on including these claims. Third, this construal of physics enables us to tie the definition of the physical to the arguments we have to believe in physicalism. The basic reason we have to believe that there is nothing over and above the physical is that the physical world is causally closed. However, that the physical world is causally closed is something we can only justify if the physical is construed along the lines I propose; or so I will argue.

It is possible to claim that my suggestion of what we should take current physics to mean makes me ultimately a 'futurist' rather than a 'currentist'. That is, despite the fact that I present my position as one that embraces the first horn of Hempel's dilemma, some would understandably see it as a strategy that endorses Hempel's second option. They could claim that I construe 'the physical' as whatever a future physics says there is, on the assumption that such a future physics will keep on postulating that, e.g. energy and momentum are conserved quantities whose interactions are mediated by forces. This is something that seems to be implied by my apparent rejection of the meta-induction argument above. However, I do not reject the idea that there is some meta-inductive evidence that should lead us to distrust our

[5] The relevant class that I have in mind is the class of all local interactions in which spacetime is not involved as a putative bearer of energy (see below).

[6] The 'a few more properties' includes color charge, for instance, but is intended to cover all the other properties (if any) that enter the list of the conserved quantities at some point.

current theories, no matter how broadly we construe them. Rather, what I want to deny is that such meta-inductive evidence should make us think that our current physics, broadly construed, is *most probably* false. This can be turned into a prediction about what future physics will be like, but as I see it, such eventual future physics plays no role in my argumentation. Whichever camp one sees my proposal as belonging to, the thesis is the following: the physicalist thesis benefits from a minimal definition of the physical as including: energy, momentum, charge, and some other conserved quantities; the bodies that possess them; and the forces responsible for their distribution and exchange. This is beneficial for two main reasons: first, because it endows physicalism with some degree of verisimilitude (i.e. it cannot be claimed to be most probably false); and second, because otherwise we lose the link between the arguments we have for being physicalists and the thesis we are putting forward.

I will begin the discussion with a more committed view as to what current physics consists of. Later I will move on to the less committed account advanced here, which, nonetheless, I hope will not be devoid of content. I will certainly try to stay clear of what many seem to take as the most promising account in the task of defining the physical: the *via negativa* strategy. My idea, along with that of Dowell ([2006]), is that it is not necessary to mention the mental in the definition of the physical. This is indeed a good thing, as endorsing at some point the *via negativa* inevitably entails inheriting its problems; which I will explain before moving on to present my own proposal.

Thus, the first section will be devoted to developing some criticisms of the *via negativa*. After that, I will present the general idea I want to explore, namely, that a broad construal of 'current physics' may sidestep the problems inherent to Melnyk's approach, and that at the same time this construal provides us with a notion of 'the physical' that is linked to the reasons we have to believe in physicalism. The third and fourth sections will attempt to provide a first characterization of current physics and of 'the physical' that seems to fulfill both of these *desiderata*. It will be a characterization that has meaningful content and is supported by our arguments for physicalism, in particular, by the argument from the causal closure principle. Unfortunately, the discussion will show that such a characterization is not likely to be true. The final section argues for an even more abstract construal of current physics and 'the physical'. I will try to show that this second characterization is not devoid of content and that it does not suffer from the same problem of the first; it is not likely to be false. Thereby, if I am right, this second characterization meets the demands we place on a definition of the 'the physical', and also has the virtue that it is linked to the reasons we have to believe in physicalism.

2 The *via negativa*

In the recent debate concerning how to characterize the physical, some philosophers have tried to avoid Hempel's dilemma by refusing to link the formulation of physicalism to any particular physical theory, current or future. Of special interest seems to be what is known as the *via negativa* (see Crook and Gillett [2001]; Montero and Papineau [2005]; Wilson [2006]; Worley [2006]; Montero [2009]).[7] This maneuver consists of defining the physical negatively, that is, by contrasting it against a class of entities that is better defined. The class in question is the class of mental entities. We may not know which physical entities there are, or what it is to be a physical entity, but we are on safer ground as regards what constitutes the mental domain, such as beliefs, desires, *qualia*, etc. So physicalism can be defined as the claim that there are no irreducible mental entities in the world, i.e. that beliefs, desires, etc., are not part of the fabric of the world unless they are shown to consist of something else. It has been suggested (see Worley [2006]) that this overall strategy may have some psychological grounding, for we separate the mental and the physical domains very early on (see Bloom [2004]). Thus, it seems that even the psychological facts should make us think that the mental/physical distinction is a safe dichotomy to rely on for definitional purposes.

This strategy is fine as far as it goes. That is, as long as the physicalist is concerned only with the mental. If the issue of physicalism is an issue about the mind–body problem, then it is perfectly acceptable to have the physical defined as 'non-mental'.[8] However, physicalism must be, or at any rate I take it to be, a more robust thesis. A physicalist defends not only that there are no irreducible mental entities, but also that there are no irreducible spirits, astrological forces, acts of divine intervention, telekinesic principles, and so forth. Moreover, some physicalists would affirm that there are no geological or biological irreducible entities.

[7] The *via negativa* is a general strategy that does not necessarily entail the rejection of Hempel's dilemma. The *via negativa* is also adopted by futurists who want to evade the accusation of triviality. For instance, Wilson ([2006]) presents an account according to which the physical is defined as: '(i) the physical entities treated by fundamental physics, with the proviso that (ii) physical entities are not fundamentally mental'. According to Wilson, it is impossible to have a good definition of the physical without the second part of the definition, which she calls the NFM constraint (see also Brown and Ladyman [2009]). In contrast, Crook and Gillett ([2001]) endorse the *via negativa* only as part of a longer definition of the physical with which they try to avoid Hempel's dilemma by not relying on any particular view on physics, but only on the metaphysical doctrine of materialism. As long as Crook and Gillett's definition takes the mental to be the only contrast class worth considering, it shares the problems of the general *via negativa* approach. In particular, as Pineda ([2006]) claims, their definition is compatible with biological emergentism or even with vitalism.

[8] Although it is possible to object that 'the mental' is (at least) as ill-defined as 'the physical'. This is not a line I am going to pursue, but I think this criticism of the *via negativa* is right. It is typically assumed that irreducibly mental means irreducibly intentional and/or qualitative, but in fact there is no consensus as to what the intentional and the qualitative are.

Now, how is the *via negativa* supposed to work when the physicalist is concerned with domains other than the mental? One option is to define the physical negatively and *contextually*, according to the debate one engages in. That is, 'physical' would mean non-astrological when the discussion was focused on astrology, non-biological when the debate concerned the ontological status of biological entities, and so on. Another possible approach is to define the physical negatively and *universally*, that is, as the non-mental, non-astrological, non-biological, etc. However, neither of these approaches looks promising. Since we lack an inventory of the classes against which we want to contrast the physical, the second option looks hopeless. Even if we forget about astrology and other such beliefs, it is impossible to specify the class of things against which we want to define the physical. We cannot simply use the list of the current special sciences, for it is possible that new sciences will emerge. Furthermore, the problem is not solved by including as yet non-existent fields and referring to, for example, 'whatever is not treated by the future special sciences'. As the triviality problem makes clear, it may not be a 'future special science' that postulates things such as the existence of mental entities, but this idea may form part of future physics itself. Meanwhile, the first approach entails the problem that physical would be turned into a context-dependent term; its meaning would vary with the context of the debate. For instance, a physicalist would have to exclude mentality from the fabric of the world in a debate on the mind–body problem but not exclude it in a debate about astrology, since in the latter context physical would just mean non-astrological.

Some would say that this is not a real problem for the *via negativa*; the debate physicalists are mostly engaged in is the mind–body problem. It can even be claimed that it is the *only* debate that concerns them (see Wilson [2006]), so the problem of how to define the physical against other contrast classes does not arise. However, this is not quite right. There are at least two arguments against such a claim: one has to do with 'alien entities' and the other with special sciences.

First, if what we want is a definition (or something that approximates a definition) of the physical, then we have to take into account not just *actual* debates, even less current academic debates, but also *possible* debates. Moreover, it seems that the discussion about the status of astrological or divine entities *vis à vis* physical entities is not just a possible debate, but a lively real debate. Now, it seems possible to deny this. It can be argued that the debates concerning astrology, divinity, telekinesis, and so on may look like metaphysical debates on a par with the physicalist debate concerning the mental, but in fact they have a very different status. Issues such as whether there are irreducible astrological entities are not even a possible subject of debate for physicalist philosophers, as they are contested in different arenas.

In effect, it seems that we can exclude the existence of this kind of entities offhand, on account of their belonging to practices that are not scientific; not explanatory or predictive. If this were so, there would be no need for the metaphysician to get involved in the issue of the relationship of such entities with the physical world. However, things are not that clear.

On the one hand, even if we assume that folk psychology is explanatory and predictive enough,[9] mind–body physicalism arises in connection with issues in the philosophy of science as well. In particular, we engage in a metaphysical debate because we have a problem with psychology. Specifically, it seems to clash with other, well-supported theories, such as physics. Physics is said to hold that all physical effects have sufficient physical causes, while psychology purports to explain some of these effects by means of another kind of property. In principle, given this problem, we could exclude the existence of mental entities on purely scientific grounds. We do not do so principally because, regardless of this and other possible problems (such as the apparent irreducibility of psychological properties) we seem to be convinced that mental properties exist.[10] As a result, we take it that mental phenomena are real and then wonder whether they pose an unsolvable problem for physicalism. Other phenomena simply do not reach that stage in the discussion. However, in different possible circumstances we, or another *us* in another culture, could be convinced of the existence of astrological forces or acts of divine intervention, and we would have to deal with these alleged 'alien entities' in the arena of metaphysics.

On the other hand, one can wonder whether the rejection of the existence of alien entities, be they ghosts, gods, or telekinetic powers, is really based on the lack of predictive power or of falsifiability of the theories that posit them. Without entering the debate as to whether there is a good falsifiability demarcation criterion, I find it plausible to hold that our rejection of alien entities is very often grounded on the same kind of reasons we have to deny that there are irreducible mental properties. For instance, in his *Cosmos* series, Carl Sagan ([1980/2002]) rhetorically asked how the planets could bring about changes in our behavior given that none of the existing forces could mediate a causal connection between planets and people's behavior. That is, he was not claiming that astrology lacked a certain epistemic virtue, but that 'astrological facts' were not explainable in terms of our current physical knowledge. This certainly resembles the claim of a physicalist who rejects the existence of

[9] See (Churchland [1984]) for a criticism of folk psychology's predictive and explanatory capacities.

[10] It can be said that we arrive at this conviction, *contra* Churchland, because mental predicates form part of a theory that is explanatory and predictive. But this is clearly not the case of *qualia*. We would believe in their existence even if, as epiphenomenalists claim, they are explanatorily idle.

irreducible mental properties on the grounds that everything that exists must be accountable for in terms of physics. What I mean to say is that, regardless of whether the issues of astrology, religion, and so on can be fought in another arena, they can also be fought, and are indeed fought, in the same arena where the discussion about mentality takes place. I take this to demonstrate that the import of the physicalist thesis is not restricted to the mental domain and so, ultimately, the physical cannot simply mean 'the non-mental'.[11]

The second reason why the physical cannot be just the non-mental is more straightforward. As has been explained, the physical is also contrasted with the geological, the biological, etc. Reductive physicalists claim that the only entities that exist are physical entities. Non-reductive physicalists are more willing to concede the existence of entities which supervene on physical entities. In either case (that is, regardless of the final ontological position one adopts), physical entities are contrasted with the entities postulated by higher level sciences. Moreover, some of the opponents of the reductive physicalist claim that there are irreducible biological or geological properties. So the physical has to be defined against the biological and geological for the debate to make sense. In the light of all this, it seems that the *via negativa* is quite a problematic approach to the issue of physicalism.[12]

3 On Current Physics

The *via negativa* is not the only way to escape Hempel's dilemma. However, once the weaknesses of the *via negativa* are taken into account, I think the physicalist has no better option than to confront Hempel's dilemma.[13] My proposal is to embrace the first horn of the dilemma without getting trapped. As I mentioned above, Melnyk ([1997]) also commended this approach. However, my proposal is different. I think that a lot of the discussion on physicalism may hinge on what we understand by 'current physics'. If current physics means our contemporary theories of physics (Relativity Theory,

[11] I understand that the opening paragraph in Montero's ([2003]) supports my claim: 'Does God exist? If the physical world is causally closed, then it seems that a nonphysical God who causally affects the physical world cannot exist.' Against this reading of what Montero's words imply, Wilson ([2006]) claims that the issue of God's existence is, after all, an issue about whether there are irreducible mental properties. I think such a position requires more explanation than is given. However, I also think that Montero could just as well have continued to ask about astrology, for instance, without giving the impression that she was speaking about a different kind of thing: 'Do planets have astrological powers? If the physical world is causally closed, then it seems that non-physical astrological powers that causally affect the world cannot exist.'

[12] So too are more sophisticated tactics such as Crook and Gillett's ([2001]). Crook and Gillett define the physical as that which is not irreducibly mental and which is not composed of other entities. However, this implies that if there are biological irreducible entities, they are physical.

[13] Pettit ([1993]) proposes to substitute 'the physical' for 'the microscopic'. It is a proposal that introduces the problem of making physicalism likely to be unsupported (see footnote 27 below). The same can be said of any proposal that buys into the so-called 'layered model' of the sciences, such as Crook and Gillett's ([2001]) and Pineda's ([2006]) mereological accounts

Quantum Electrodynamics, etc.) in all their detail, as Melnyk seems to assume, then we can take it for granted that physicalism is false—that is, Hempel's first horn holds. However, current physics may be taken to stand for something more abstract, such as a set of claims that forms a constitutive part of a general research program, a paradigm or something of the kind. Now, if current physics is interpreted in this way, then physicalism is on much safer grounds, or so I will argue. By defending physicalism in this way, first, we have that current physics is committed to fewer claims and, more importantly, it is committed to those claims that are better supported than any others. The result is that current physics thus understood is more likely to be true, and that it cannot therefore be said that physicalism is most probably false. Second, as I will explain, we are now in a position to see that the physicalist claim construed this way is more likely to be true because it is the definition of physicalism that emerges from the reasons we have to believe in it. I hope that this point will be understood in the discussion that follows; let me advance a brief explanation.

Some authors claim that the main reason we have to believe in physicalism is that we believe that the physical world is causally closed (Papineau [2001]; Kim [2005]). I agree with them: there is no other argument for physicalism that can be as straightforward as the much discussed 'exclusion argument' (see Kim [1993]).[14] So physicalists should try to justify their belief in the causal closure of the physical world. One way to do this, probably the best, is to ground the belief on some well-established claims of physics. I will try to explain which claims of physics can be used to support our belief in this 'causal closure principle' (CCP), and so, which claims support our physicalist *credo*. My proposal will be that the CCP—in fact, a weaker claim than the CCP—can be grounded on the following two claims: (i) that some quantities, especially energy and momentum, are typically conserved in local interactions when the closed system considered is the whole universe, and (ii) that forces mediate the distribution and exchanges of these conserved quantities.

[14] It may be objected that we do have better, inductive, reasons to believe in physicalism. The development of science can be seen as an accumulation of mechanistic lower level explanations of higher level phenomena. However, I do not think that physicalism can be easily established on these inductive grounds. Emergentists, for instance, read the inductive record in a very different way. Their view is that as science advances, it discovers more and more complex phenomena which cannot be accounted for in terms of lower levels (Kauffmann [1995] and his followers are a case in point). Dupré ([2001]) and Cartwright ([1999]) would also deny that there is the inductive evidence required to argue for a physicalist thesis. It is not my intention to side with any of these sceptics, but only to point out that the inductivist argument has to face important objections. A second objection to the line of argumentation proposed here is that I rely on the CCP to establish physicalism, and some authors hold that there is no place for causation in fundamental physics (see, e.g. Norton [2003]). Now, if this were right, surely it would not be possible to claim that the CCP is true. However, it would be possible to hold instead that every physical *explanandum* has a sufficient physical explanation. I think my argument is just as valid if we substitute the CCP for a principle of explanatory comprehensiveness.

Now, what I suggest is that we should construe our physicalist thesis so as to be in a position to argue for it. This means that it should be a thesis that we can support by appeal to the CCP, which ultimately means that it will be the claim that everything that exists comes down to a list of conserved quantities, bodies that possess them, and forces that mediate their exchange. However, note that the two claims to be used in grounding the CCP are such central principles of current physics that they can be used to characterize it in a broad way. So they play a double role: they can be used to characterize current physics, and they can be used to ground the CCP and thereby, physicalism. Thus, a physicalist thesis linked to a broad construal of current physics has the virtue of also being linked to the reasons we have to believe in it. I think this is as it should be; we should not endorse stronger theses than our arguments entitle us to. Admittedly, this results in a restrictive reading of the physicalist thesis, which is unlikely to be shared by all the philosophers who have claimed to be physicalists in the past. However, this is a drawback I am prepared to accept (see the discussion in the final section).

In the remainder of the article, I will argue this in more detail. As I have already said, my two main claims can be stated as follows.

(i) There are some laws and claims which can be taken as characterizing features of current physics and which allow for a broad construal of it.

(ii) Such claims are precisely the ones that can be used to support our belief in physicalism.

4 Current Physics: First Construal

The first claim states that we can identify current physics in a way that abstracts away many of the details of contemporary theories. Such an identification of current physics will be provided by a nucleus of laws or principles that seem to be essential to contemporary theories. Many philosophers of science have distinguished between what is peripheral or accidental to a research program and what is constitutive of it. Kuhn ([1969]) spoke of a disciplinary matrix, Lakatos ([1978]) of a nucleus of laws and methodological principles, and Quine ([1951]) of claims that occupy the centre of the theory. In all these cases there are seen to be laws and claims which are more central than others, and it can be argued that such central laws and claims serve to individuate theories (although perhaps only partially[15]).

Now, just which laws of physics could fulfill this role in contemporary physics is quite a difficult question to answer. One sensible first (or

[15] According to Kuhn, for instance, these laws and claims are only one part of what defines a paradigm. As is well known, the other constituents of a disciplinary matrix are exemplars, guiding metaphors, and some metaphysical commitments.

preliminary) approach to doing so is to include two claims in the answer. First, that energy (or mass-energy), momentum, charge, and a few more are quantities that are universally conserved. And second, that the exchange, variation, and, in general, distribution of these quantities are mediated by forces, which can be gravitational, electromagnetic, weak (or electroweak), or strong. It is possible to be much less specific, and identify current physics with the claims that there are conserved quantities and that their variations and distribution are governed by forces. However, I believe that this would be too minimal a characterization, for it would include theories that we do not consider 'current physics' on intuitive grounds, such as some counterfactually possible Cartesian or Epicurean dynamics.

Suppose that we agree that it is reasonable to construe current physics in this way (that is, as including conservation laws and the commitment to explain the distribution and exchange of the conserved quantities in terms of gravitational, electromagnetic, weak, and strong forces). What we now have is a characterization of physics (and with it, of the physical) that allows us to explain why physicalism is probably true; as I hope to make clear in the remainder of this section.

As has been noted by several authors, most conspicuously Papineau ([2001], [2009]), and as I mentioned in the previous section, the main reason we have to believe in physicalism is the CCP. This principle states that every physical effect (i.e. caused physical event) has a sufficient physical cause. Stated in this way, it does not exclude the existence of other events that are physically causally irrelevant or that causally overdetermine physical effects. However, we can assume that nature is simple and thereby rule out the possibility of massive overdetermination. Furthermore, it is admissible to ignore the possibility that there are non-physical events that do not interact with the physical realm, as the anti-physicalists typically claim that non-physical events end up altering the physical world. So it might look as if the CCP does a good job in establishing physicalism on its own.[16]

The problem, of course, is that the CCP cannot determine what the physicalist thesis amounts to. It tells us that the physical realm is causally closed, but does not address the problem of what the physical realm is. We are back to our doubts about the physical, and it is no coincidence that a good deal of the discussion about the physical takes the CCP as its starting point (Spurrett and

[16] This does, however, open up the possibility of the anti-physicalist being an epiphenomenalist, and the possibility of epiphenomenalism should be addressed in a separate debate. That is, in order for the CCP to establish physicalism, we first have to rule out the possibility of epiphenomenalism. We also need to exclude the possibility of physical effects being causally overdetermined by physical and non-physical causes. To the best of my knowledge, the possibility that non-physical causes work in *tandem* with physical causes, and are indeed correlated by natural law, has been little discussed. I consider that the best reason we have for rejecting such a possibility is the application of methodological parsimony: Occam's razor.

Papineau [1999]; Montero [2009]; Gillett and Witmer [2001]). However, it is possible to dig deeper into this principle; to ask what reasons we have for believing in it and, I hope, come up with a definite sense of what the physical is.

Putting all this in a nutshell: claim (i) above states that there are some tenets that characterize current physics and allow for it to be broadly construed, while claim (ii) holds that these same tenets support our belief in physicalism. It has been proposed that the tenets in question involve conservation laws and a list of forces. The immediate task now is to show that the CCP, which has been presented as our main reason for believing in physicalism, is indeed supported by these central principles that identify current physics. After tackling this, I will give some reasons for believing that the construal of current physics that has been proposed until now does not do a good job of providing a definition of the physical. The task will then be to show that some other claims (different from those that have been used up until now) can also characterize current physics in a broad and non-empty way, and support the CCP.

5 The Causal Closure Principle

There is some discussion about why we should believe in the CCP. Authors such as Bishop ([2006]) and Dupré ([2001]) have proposed that our belief is unfounded, whereas Papineau ([2001]) has provided an enlightening explanation as to why we have come to believe in it. I think that it is possible to build an argument, or a family of arguments, that links our current knowledge of physics, broadly construed, to Papineau's historical approach (see Vicente [2006]). As I say above, current physics can be characterized by a belief in certain conservation principles and in the existence of certain forces that are responsible for variations in the conserved quantities. These two beliefs can ground our belief in the CCP, and thus can support a certain definition of the physical as it occurs in such a principle.

Before I present the argument that uses these two beliefs to ground the CCP, there is an important terminological issue to tackle. The CCP deals with physical effects. Leaving aside the question of what physical means here, one can wonder what we mean by a physical effect. A change in the charge of a particle is a physical effect, for sure, but is the linear, non-accelerated motion of an object a physical effect? In this latter case things are more complicated. The question is not settled by simply taking a physical effect to be something physical that has a cause. For once again: it is clear that a change in the charge of a particle, as a result of a typical electromagnetic interaction, has a cause; but it is not so clear that the movement of a body far from the reach of any force has a cause in the same sense. What we seem to have in the latter case is an event whose explanation is mainly negative: the body moves in the way that it does precisely because it is subject to no interactions whatsoever.

Now, I take it that what we are committed to when we claim that the CCP is true is that all physical *changes* in bodies have a purely physical explanation.[17] The CCP is set against all kinds of interactionist dualisms and emergentisms; philosophical stances that typically claim that some non-physical properties can bring about changes in physical bodies. For instance, a classical Cartesian mental dualist typically holds that mental events can intervene in a physical causal chain and make something unexpected happen: produce a physical change, such as a bodily movement. If these are the kinds of claims that our use of the CCP is trying to rebut, then it is reasonable to understand that the CCP is a claim about physical changes to bodies; that is, that when we are talking about effects in this context, we mean changes in bodies that are caused. In fact, we can substitute the CCP as stated for another principle, CCP′, without any loss of effectiveness against anti-physicalism.

CCP′: every physical change in a body has a sufficient physical cause.

With this precision in mind, we can now turn to the argument in favor of this revised principle concerning causal closure. One possible way to construe it is:

(1) We can identify caused physical changes with variations in some conserved quantity possessed by a body;

(2) We can explain the notion of causing a physical change in terms of the notion of a force bringing about a physical change.

(3) We can establish that all caused physical changes have sufficient physical causes.

If the argument works, we will also have a definite notion of the physical, both for CCP′ and for physicalism: the physical includes conserved quantities, forces, and the bodies (or, in general, the entities) that instantiate such conserved quantities and are subject of such forces.[18]

The argument draws on two theories about what physical causation is: the first is Salmon–Dowe's CQ Theory (CQ stands for conserved quantities) and the second, Bigelow and Pargetter's ([1990]) 'action of forces' account. The

[17] The qualification that changes are changes in bodies is introduced in order to exclude from the debate changes in space–time location. That is, when I speak about physical changes I mean changes in properties that bodies have or possess. I think these are the changes that should concern us in the present discussion, as they are the kind of changes that anti-physicalists attempt to explain.

[18] I speak freely about bodies because it seems to be admitted by all parties in the debate that this is not a controversial notion (see Kim [1993]). The debate revolves around the kinds of properties that bodies can have. In any case, bodies here can be defined simply as bearers of conserved quantities. This entails that bodies are the ultimate bearers of conserved quantities, and also that bodies may be aggregates of conserved quantities, depending on whether one wants to say that aggregates can also possess conserved quantities (though they will possess them in a merely additive way).

first premise above states that a physical change is a change in a conserved quantity possessed by a body or, more liberally, it may be identified with an effect that involves such a variation. This means that physical effects are those effects that (at least) involve changes in momentum, energy, or charge.

This idea is clearly inspired by so-called 'transference' or 'transmission' theories of causation. Such theories (beginning with Fair's [1979] proposal that causation reduces to the transference of energy and ending—to date—with Salmon–Dowe's CQ Theory) hold that physical causation is nothing but the exchange either of some particular conserved quantity (energy, in Fair's view) or of any one of a number of conserved quantities (Salmon–Dowe's account). According to Dowe's CQ Theory ([2000]), we only need two notions in order to explain physical causality. First, we need the notion of a causal process; a process which may enter into causal interactions and which is to be distinguished from the notion of a *pseudo*process.[19] His theory identifies the genuine processes with the worldlines of objects which possess conserved quantities. Then we need the notion of *causal interaction*. The CQ theory reduces this to the intersection of worldlines which involves exchange of conserved quantities. Thus, we can arrive at the idea that physical effects (i.e. the results of causal interactions) consist of variations of a conserved quantity possessed by a body.

Being able to adopt Dowe's CQ theory without qualifications in order to identify physical effects would be good for two reasons. First, it would give us a precise, definite idea of what it is to be a physical effect; by definition, physical effects would be variations in conserved quantities. Second, the argument for the CCP would run quicker than the one proposed here: the CQ Theory of causation plus conservation laws implies that all physical effects have physical causes.[20]

However, the theory is probably too ambitious. The consequence that all physical effects are variations in conserved quantities probably restricts the notion of physical effect too strongly. Some of the causal processes Salmon and Dowe speak about fall under our intuitive notion of an effect. For

[19] The notion of pseudoprocess was introduced by Salmon ([1984]). It refers to those apparent processes which can neither transmit nor receive marks. His most widely discussed example is that of a beacon rotating in the center of a circular building. A brief pulse of light going from the beacon to the wall is a causal process. If a red filter is placed in its path, the pulse turns red, and remains red from the point of intersection to the wall without further intervention. In contrast, the spot of light that travels around the wall is a pseudoprocess. It will turn red for a moment if, for instance, you place a filter at a point on the wall that the spot strikes, but from that point onwards, the spot will not be red without further intervention.

[20] It is possible to object that, e.g. conservation laws by themselves do not exclude the possibility of there being a non-physical form of energy that can be transformed into physical energy (e.g. Montero [2006]). This is true, but such a possibility can be excluded on other, inductive grounds. Quite simply, there are no traces of non-physical energy, and all increases or decreases in the energy possessed by one body correspond perfectly to immediately antecedent decreases or increases in the energy possessed by another.

instance, a planet orbiting the Sun is intuitively categorized as a physical effect. Yet, a regular orbit is not the result of an exchange of conserved quantities; the planet conserves both its angular momentum and its total energy (although there is a trade-off between kinetic and gravitational energy).[21]

The issue is different if instead of talking about effects we speak about changes in bodies. It seems that there are no clear counterexamples to the claim that physical changes in bodies involve variations in conserved quantities. Typically, there is a change in a body if there is change in its state of motion, in its charge or in its matter and energy. That is, there is a change in a body if there is a change that results in a variation of one of the conserved quantities it possesses. However, if we substitute the idea that physical effects are variations in conserved quantities, for the claim that only physical changes in bodies involve variations in their conserved quantities, we thereby lose a reason to believe in our claim: the claim is no longer supported by a theory of physical causation. However, perhaps it is better not to commit an argument for the CCP to a particular theory of causation. So what I propose is that this first step of the argument—that physical changes with a cause are variations in some conserved quantity possessed by a body—is considered as a working hypothesis, based on the idea that changes in conserved quantities are, at least, the most prototypical physical changes. This means, in particular, that they will probably continue to be considered as physical changes in successive physical theories. Certainly, they are the kind of physical changes that other, non-physical, theories attempt to explain.

The second step in my construal of the argument in favor of CCP′ is uncontroversial, I think. If physical changes are variations in conserved quantities, then it seems safe to identify the cause of those changes with the forces responsible for such variations in the conserved quantities.

Finally, the conclusion states that all caused physical changes have sufficient physical causes. That is, that any variation in a conserved quantity is the effect of a physical force. In principle, and according to what I have said so far, this means that any variation in a conserved quantity possessed by a body is the effect of one of the forces which physicists list as basic—which are currently three or four, but could be fewer. This is something physicists would probably agree on. However, there is a problem: if we want physicalism to survive current physics narrowly construed and to be rendered as probably true, we should try to be less committed to the contemporary list of forces. Especially since if a new force enters the list, our physicalist beliefs would most probably remain completely unshaken. In a nutshell, we have arrived at a

[21] There is an exchange of a conserved quantity in the movement of a planet orbiting the Sun, even if it were circular, which is linear momentum. However, it seems odd to say that the movement consists in (rather than simply involves) the exchange of linear momentum.

point where it becomes clear that the proposal has the typical problems of a 'currentist' proposal, including the problem that physicalism construed this way is likely to be false. What can we do? My proposal is to move on to another, more abstract, characterization of current physics and try to see whether it too can support CCP′. That is to say, I have now tried to show that a certain understanding of current physics, as a theory committed to conservation laws and a list of forces, is able to support the physicalist credo *via* CCP′. However, this construal of current physics is too specific to avoid the problems of currentism and so this first attempt fails. The question now is whether we can be less specific in the construal of current physics while the claims that we single out as constitutive of current physics still support CCP′.

6 Current Physics: Second Construal

I want to propose that we do not need to be committed to there being a definite number of forces. This move entails certain dangers, and in particular it runs the risk of converting the physicalist thesis into a vacuous claim. For, once we concede that physicalism is compatible with there being forces which are not gravitational, electromagnetic, strong, or weak, we seem to be in the position of saying very little about what the physical is. Moreover, we seem to face the charge of triviality, as we cannot be certain that the next force to form part of the physicists' list will not be an irreducible mental force, for instance.

This is where the defender of the *via negativa* would say that we need to rule out mental forces directly. That is, that we need to include in our definition of the physical a NFM clause,[22] whose role is to ensure that physicalism is not compatible with some mental force entering the physicists' list. However, I believe we can do without such a clause. I think we can rule out mental or, in general, alien forces, based on the evidential constraints they have to fulfill. Construed in this way, physicalism is indeed incompatible with the possibility of mental forces entering physics at some future time. It what follows I hope to explain this position.

Given conservation laws, physical changes can be brought about only by forces that conserve energy, momentum, and charge in all local interactions when the closed system considered is the whole universe (non-technically I shall call them 'conservative forces'[23]). This is the constraint that conservation laws place on any force. Is there room for alien forces in a world where these conservation laws apply? In principle, it seems that, for instance, there might

[22] See footnote 7 above.

[23] Technically, a force is conservative if the total work done by the force is zero as the point of application moves around any closed path.

be mental conservative forces. That is, even if we grant that any new force must be a conservative force (in my non-technical sense), we cannot exclude a new force that, as of today, we would want to call a non-physical force. Thus, we seem to be trapped in the second horn of Hempel's dilemma: we do not know what future physics is going to be like, and so it could be that the next force to be added to our list is what today we think is a prototypical non-physical force. There are two points to make here.

First, the typical story for a mental force depicts it as a creator of energy, not as an energy conserver. Mental forces, as well as astrological or divine forces, are usually said to provide physical energy; which presumably stems from the conversion of some odd stuff into a physical magnitude. So, if these are the kind of forces we have to consider, the conservation laws rule them out.

Second, although the proposed move opens up a space where the anti-physicalist can live as a matter of principle, it is extremely hard to imagine that physics will develop in such a way as to be forced to posit alien conservative forces. The currentist proposal which claims that there are exactly four forces is not acceptable because: (i) it is possible that new forces are discovered, and (ii) we would most probably believe in CCP′ and in physicalism even if they were. We can predict that we would still believe in physicalism and CCP′ despite the inclusion of new forces because, most probably, such new forces would not be alien conservative forces. So the basic reason to retreat from the proposal discussed up to now is that such a proposal entertains the possibility of the repertoire of *physical* (non-problematic) forces being enlarged. It is possible to insist that we cannot rule out the idea that the next force to enter the list is, say, a non-reducible mental force. However, is there any reason to believe that this will be the case? After all, whatever such a mental force might explain is already explained by the action of the forces already posited—at least as far as bodily movements are concerned.[24] So I think that not being committed to the necessary existence of only and exactly the forces posited by current physics does no harm to physicalism. For that reason, I do not consider it necessary to include an NMF clause, which in my view, would only muddy the waters.

Thus, I see no need to be committed to the existence of a particular repertoire of forces. In contrast, it seems that the physicalist should be committed to the existence of at least some of the conserved quantities that form part of the physicists' list. In particular, she should assert that the list includes energy and momentum, for these are the properties that are typically said to be affected by

[24] It may be argued that bodily movements are not the proper *explananda* of mentalistic explanations. However, the 'dual-*explanandum*' approach is full of problems (see Vicente [2004]). Moreover, it is typically endorsed by authors, like Hornsby ([1997]), who would be highly reluctant to talk about 'mental forces'.

non-physical causes.[25] Different conservation laws may not ground CCP′. For instance, Cartesian physics held that the quantity of movement (a scalar notion) was universally conserved. This opened up a space for the action of a non-physical force, for it allowed a variation in the path followed by an object (which intuitively looks very much like a physical change) to be the result of any kind of force, irreducible mental forces included. For instance, consider an elastic head-on collision between two bodies with equal mass and speed. The resulting physical effect is a change in the direction followed by each of the bodies. However, this effect is not a change in a conserved quantity in Cartesian physics, because what is conserved is not a vectorial property. This means that some changes in path could be effected by a free rider, and in particular that some of them could be the result of mental influence.[26] Leibnizian mechanics, which posits momentum as a conserved quantity, closes off this space: a change in the direction followed by a body is a change in momentum, so its cause must be the same as that which is responsible for its changes in the scalar quantity of movement—which is assumed to be a physical force.

Thus, what we need for the argument for physicalism to work is that conservation laws are such that we can characterize physical changes as changes in conserved quantities. First, because that provides us with a clear idea of what it is to be a physical change. Secondly, because physical changes which do not involve variations in conserved quantities look like an invitation to postulate the action of creative non-physical forces, i.e. forces that bring in *new* physical stuff. It is true that even so the anti-physicalist may still hold that there are non-physical forces which are responsible for variations in conserved quantities. However, we are in a position to assert that such a claim is false: for all we know, all variations in conserved quantities are brought about by one or more of four forces. Besides, it is highly implausible that, if a new force were to enter the list, it would be a mental, astrological, biological, or divine force.

To sum up, if what grounds our belief in CCP′ is the two-fold idea that physical changes are variations in conserved quantities and that the forces responsible for such variations belong to a limited set, then we are in a position to interpret the physical in CCP′ (and elsewhere) as including conserved quantities, bodies that possess these conserved quantities, and the forces that are responsible for variations in the conserved quantities.

There is one last thing to consider: I have just claimed that the argument requires that the conserved quantities in question are (at least) energy, and

[25] Perhaps an eventual discovery that charge is not conserved could give some support to some dualist position, so perhaps charge should also be included. I do not think, however, that an eventual discovery that color charge is not conserved in strong interactions could affect the physicalism debate at all.

[26] For a reconstruction of the Cartesian position see (Lowe [2000]; Papineau [2001]).

momentum. Now, does it require that they are in fact conserved? That is, does CCP′ require that conservation laws are true? It seems that the response is obvious: of course it does. The whole argument hinges crucially on the identification of physical changes with events which involve variations in conserved quantities. Furthermore, it is required that conservation laws are true in order to constrain the kind of forces that might exist. Yet, it is possible that our future physics denies that energy or momentum is universally conserved. According to what has been argued, this ultimately implies that our belief in physicalism may have an expiry date. This result is not problematic when considered generally. After all, physicalism is an empirical claim, and may turn out to be false. However, within our physicalism we need to have room for future possibilities. For instance, Hoefer ([2000]) claims that energy is not conserved in the General Theory of Relativity (GTR). Space–time substantivalists maintain that space–time can capture and give back energy. However, relationalists such as Hoefer claim that this is to assume too much: GTR only tells us that energy may be lost or gained. That the lost energy is absorbed by space is an assumption only backed by our belief in the universal conservation of energy.

Suppose Hoefer is right. We would then have that energy is not universally conserved, but at the same time our physicalist convictions would not be shaken. So it seems that something has gone wrong. The question of whether space is or is not a container of energy is not going to have any impact on our physicalist convictions. So it seems that in order to accommodate the possible outcomes of this discussion, it would be best not to be committed to energy being universally conserved. Now, is such a non-committal stance possible? It may seem that it is not, but let me try to sort this problem out. What the physicalist needs, according to the proposal developed here, is first to be able to equate physical changes with variations in energy, momentum, or charge. Next, we seem to require that energy, momentum, and charge are magnitudes which are universally conserved, that is, that they are conserved in *all* local interactions when the closed system considered is the whole universe.

However, it is possible to relax this last requirement. Perhaps we require less; only that energy and momentum are conserved in a relevant class of local interactions when the system considered is the whole universe. That is, we could allow for brute gains or losses of one or any of these magnitudes, while ruling out that this is usually the case. In particular, there are no brute gains or losses of energy or momentum in the local interactions that anti-physicalists want to explain. However, this is problematic, for how can we identify this relevant class of local interactions where energy must be conserved? Given what I have said in my discussion about the *via negativa*, it is impossible to give an adequate answer. The relevant class of local interactions includes not just the interactions mind–body dualists want to explain, it also includes the

interactions biological emergentists want to explain, those believers in telekinesis want to explain, and so on and so forth.

However, I do not think this is as damaging as it seems. We can take the relevant class in question to include all the local interactions in which space–time is not involved as a putative bearer of energy. This is the simplest way to make room for any eventual result of the substantivalist/relationalist debate. It seems that all physicists agree that energy is conserved in local interactions when the system considered is the whole universe. Where they may apparently disagree is with respect to whether space–time can be a bearer of energy. If this is so, then we should not be concerned with any other counterexample to the law of the conservation of energy. That is, we should not be concerned with more eventual failures of the law. Such failures are not on the physicists' agenda, as they take it that the law of the conservation of energy (just like the other conservation laws) is as well-supported as a law can be. Thus, I think we are entitled to define the relevant class of local interactions where energy is conserved in the way I have proposed. Doing so ensures the result that physicalists require, namely, that in the local interactions which are the target of non-physicalists, energy and momentum behave as conserved magnitudes. This result is all I need in order to defend my construal, avoid Hempel's dilemma, and thereby keep the argument going. For, we can still identify physical effects in those interactions with variations in conserved quantities (i.e. quantities that are conserved in them) and we can also claim that any force that mediates in such interactions must respect the conservation of these quantities (in the interactions in question).

Where does all this leave us? What characterization of the physical do we end up with? My final proposal is that we should construe current physics as the theory that asserts that energy, momentum, and charge are conserved quantities in all (or at least, the relevant class mentioned above) local interactions when the system considered is the whole universe; that these quantities are possessed by bodies; and that the distribution and exchange of these quantities are mediated by forces. Accordingly, the physical consists of energy, momentum, electrical charge, and some other quantities such as color charge, the bodies that possess them, and the forces responsible for their distribution and exchange.

7 The Continuity Demand

One possible objection to the present account worth considering is what I will call 'the continuity demand'. This demand is developed, for instance, in (Pineda [2006]). What Pineda claims in basic terms is that physicalism is an old metaphysical standpoint which can be traced back to antiquity. This being so, any definition of what physicalism consists of should be general enough for

all authors who have ever claimed to be physicalists to be able to share it. There seems to be an immediate consequence of trying to meet this continuity demand: definitions of physicalism that link the physicalist claim to current physical theories have to be discarded. The physical must be construed more broadly.

According to what I have proposed, the physical should be understood in a broad sense. However, it is a sense that certainly is not broad enough to meet the continuity demand; or former physicalists should be understood as claiming that there is nothing but a list of conserved quantities, the bodies that carry these magnitudes, and the forces that cause their variations. It is possible to argue that although what Pineda claims is sensible, it is too demanding. It is sensible because it does seem as though throughout time physicalists have been hinting at a similar, though not the same, thesis. This is an intuition that we should probably respect, all things being equal. The problem is that things are not equal: there is a trade-off between respecting the intuition and getting at a notion of physicalism that makes physicalism true (or probably true) and non-empty. The more inclusive we want to be, the more exposed we become to the danger of ending up arguing for a highly controversial thesis.[27] In this trade-off, I think the physicalist ought to attempt to come up with a probable thesis, rather than a comprehensive one, and the physical should be construed according to what the verisimilitude of physicalism requires.

To close, I want to add a brief final note on the dialectics of the physicalist/anti-physicalist debate. Physicalists attempt to rule out all possibilities of alien causes effecting any kind of physical change. However, it seems to me that this is to assume an unfair burden. The physicalist should be concerned just with those physical effects that anti-physicalists claim are the result of non-physical causes. Most, if not all, of such effects involve variations in the energy possessed by bodies. Thus, what the physicalist should do is show how any such variation in energy is mediated by a physical force. If we can do that, then the CCP and the physicalist thesis should be regarded as true by default, even in the absence of a definition of the physical.

[27] In the line of Crook and Gillett ([2001]), Pineda proposes that the physical should be defined in mereological terms and without relying on any particular view of physics. The differences between his proposal and Crook and Gillett's are two: first, he is not committed to there being an ultimate level of reality, and second, his 'NFM' clause refers to folk special science entities in general, and not just to mental entities. All kinds of self-confessed physicalists may be able to share this notion of the physical, and so it may look like a correct notion of the physical. However, leaving aside the NFM clause, if the physical is as Pineda claims, physicalism is likely to be unsupported. On the one hand, it can be objected (along with empiricist philosophers such as Dupré [2001] and Cartwright [1999]) that sciences in their current state do not provide any reason to believe that their entities are aligned in a part-whole hierarchy. On the other, it is possible to claim that the argument from exclusion loses much of its force when the physical refers to the micro-world (see Sturgeon [1998]).

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