
WHAT PHYSICAL PROPERTIES ARE

BY

DAVID SPURRETT

Abstract: This paper concerns the question of how to specify what is to count as physical for the purposes of debates concerning either physicalism or the completeness of physics. I argue that what is needed from an account of the physical depends primarily on the particular issue at stake, and that the demand for a general a priori specification of the physical is misplaced. A number of attempts to say what should be counted as physical are defended from recent attacks by Chris Daly, and a specific proposal due to David Papineau developed and extended. I argue that this approach is more than suitable for the debates for which it is intended.

1. The Problem with 'Physics'

Debates over whether a particular version of physicalism is true, or whether physics is complete, require some way of filling out criteria of being physical to be significant. There have been many candidates for this job.¹ There are also, though, a number of arguments to the effect that the job cannot be done, or at least that the existing crop of candidates are seriously defective.² A recent paper by Chris Daly argues that existing approaches are “unsatisfactory”, concludes that “there is no principled and well-defined distinction between physical properties and all other properties” and, further, that programmes in metaphysics assuming such a distinction should be “abandoned”.³

In what follows, I argue that even if we accept the most extreme version of Daly’s claim that the problem of distinguishing physical from non-physical properties is intractable, we should see that this difficulty does not prevent us from developing accounts of the distinction which are adequate for the purposes of the debates he urges us to abandon. Furthermore, there are good reasons for thinking that the problem is not intractable at

all, and that it only seems so because Daly's demand takes a particularly excessive form.

Before continuing it will be worth distinguishing physicalism from the thesis that physics is complete. There is a bewildering variety of forms of physicalism, differing over an equally diverse range of positions on supervenience, identity, reduction and more besides. In what follows I am not specifically concerned to defend any particular form of physicalism. Indeed, I would like to avoid discussing physicalism as much as possible, and focus rather on the more limited thesis that physics is complete, which I will refer to as the Completeness Thesis. The way in which the completeness issue is more limited in scope than that of physicalism is simple: if physics was complete that fact alone would not decide how things are with everything else, including the mental. So there might be nothing else, or whatever there is might be epiphenomenal, or relate to the physical along the lines of one of the many theories of identity, reduction, or supervenience presently on offer, and so on. Irrespective of that, *any* version of physicalism has to be committed to the completeness of physics, since without that premise, *inter alia*, mental events would not be "anomalous";⁴ mental states would not run the risk of being "nomological danglers";⁵ and there would be no arguments for the identity of the mental and physical via the rejection of overdetermination.⁶

Another way of making this point is to say that physicalism is typically a thesis about two classes of properties, one of them physical, where the non-physical class is supposed to be determined in some way by the physical class. This is the core idea of physicalism, the notion of "one realm of facts determining another".⁷ For such a position to be plausible at all requires that the determining class of properties, in this case the physical ones, be suitable for that role. And a crucial aspect of this suitability is causal isolation from the second set of properties: some class of non-physical properties (mental ones, say) cannot be supposed to be determined by physical ones unless the physical properties are not themselves determined by any mental ones. In the limit this requirement of causal isolation demands of the set of determining properties that it be entirely causally self-sufficient, that is *complete* in the sense at issue here.

Focussing for the most part on the completeness question does not make it possible to get away with not saying what is to count as physical. The thesis that physics is complete stands in need of an account of the physical as much as any particular version of physicalism. One of my major claims in what follows, though, is that what one needs from an account of the physical depends on the particular issues at stake. I hope to show this by using the Completeness Thesis as an example. This has the added advantage that by doing so I avoid getting too bogged down in considerations peculiar to specific versions of physicalism.

Daly sets up his discussion in terms of properties, which he characterises as ways an object is or might be. Daly specifically demands a rationale for drawing a distinction within the assumed class of contingently existing properties which divides the set of such properties into physical and non-physical sub-sets⁸ and which applies in all possible worlds. Let us assume, temporarily and for the purposes of argument, that there is indeed such a set of physical properties and call the set so defined *PP*. This is no small concession, and I return to this issue in my conclusion below. For the time being, though, I want to establish what is wrong with Daly's arguments besides this demand. While we're busy naming sets, let us also say that the set of physical properties at the actual world will be a sub-set of *PP*, which we can call *PP*_@.

Now, it is by no means self-evident that in order to have *any* debate over whether some property was or was not physical, or whether some proposition was true of physics at the actual world, for example that physics is complete, we would be required to produce criteria for membership of *PP*. There are, I suggest, a number of ways in which one might set about trying to distinguish the physical from the non-physical for the purposes of advancing some thesis concerning either category, or both. Most ambitiously of all one might attempt to set down principled criteria for membership of *PP*, which is the only possibility Daly considers. For some purposes, though, such as those where what is at stake is a thesis about the *actual* world, it could well be sufficient to give some definiteness to the boundaries of *PP*_@. Indeed, depending on the particular thesis in question it could well be sufficient to specify some suitable *sub-set* of the actual physical properties. (As we will see in a moment Smart advances a form of physicalism which asserts a relation between mental properties and *known* physical properties of the brain.) If the issue at hand concerns *alien* physical properties⁹ then one might attempt to give criteria for membership of some sub-set of *PP* which was not co-extensive with *PP*_@. Although Daly maintains that discussion relating to such sub-sets of *PP* are hostage to the need for general criteria for being physical, without which any form of physicalism is in danger of being trivial,¹⁰ it is by no means clear that this is the case. *Without* knowing what would decide whether *any* property was physical or not, it is clearly possible to make significant statements about, say, the difference between worlds where one large scale structure of space-time prevails, and worlds where another does.

Before defending in more detail my claim that debates concerning physicalism, or the completeness of physics, need not be "abandoned", and more specifically that the ways in which it is indeed necessary to lay down criteria for some property being counted as physical varies depending on the specific philosophical thesis at stake, it will be worth considering some of the likely obstacles facing any attempt to say what should count as physical.

2. *Why it Seems So Difficult*

There are two major difficulties facing any attempt to give a basis for a distinction between physical properties and non-physical properties. The first arises because there is little or no reason to think that present-day physics has discovered all there is to discover concerning physical properties. Consequently, any attempt to develop a distinction along lines suggested by present physical knowledge seems doomed to be inadequate, and any claim about the scope or status of physics based on such a distinction seems equally doomed.¹¹ A short look over the history of physics shows that this is, on inductive grounds at least, likely, since over the course of that history new entities and forces have been added to physics from time to time, and others abandoned. This means that having identified *physical* with the set of properties admitted by physics at any given earlier time would have meant disqualifying subsequent discoveries from indicating the existence of formerly unknown physical properties.

On the other hand, approaches which stipulate that physical properties are just those properties which would “in principle” need to be included in ideal explanations or descriptions of processes presently recognised as physical, or in accounts of the composition of entities presently regarded as physical, seems to allow *whatever* properties turn out to play the required role to be counted as physical. This is hardly a way of discriminating between kinds of properties, and tends to make physics complete and perhaps even some forms of physicalism true by definition. This is, broadly, the danger noted by Chomsky in connection with the question whether mental phenomena could be given physical explanations:

We can, however, be fairly sure that there will be a physical explanation for the phenomena in question, if they can be explained at all, for an uninteresting terminological reason, namely that the concept of physical explanation will no doubt be extended to incorporate whatever is discovered in this domain, exactly as it was extended to accommodate gravitational and electromagnetic force, massless particles, and numerous other entities and processes that would have offended the common sense of earlier generations.¹²

There are, then, two dangers which threaten the project of saying what is to count as physical: those which have the consequence of making either physicalism or the Completeness Thesis obviously false or trivially true. This is only a dilemma given the implausible assumption that these are the only options, and there are various ways of attempting to deal with the dangers just noted. Two examples illustrate this point.

First, Smart, who accepts that physical science is a work in progress, and that it is presently unknown exactly which categories future physics will find to describe the world. In opposition to Chomsky’s contention, though, he argues that “for the purposes of biology and philosophy of

mind we can tie ‘physicalism’ to the principles of *present day physics*’.¹³ Smart maintains that while there is no reason to think that the work of physics is over, there is also no significant reason to expect that physics will change in ways important for our understanding of the brain. I have no interest in defending Smart’s physicalism here, the point is simply that his move regarding what is to count as ‘physical’ is one way of making precise what is at stake in particular debates over the relationship between physical properties and others, in this case properties peculiar to living and thinking entities, while leaving some of the content of the distinction between physical properties and non-physical ones open. That Smart’s version of physicalism could turn out to be false is hardly an objection to the point I am trying to make, which is simply that he successfully gives significant content to the notion of being ‘physical’ for the purposes of advancing a specific thesis. Smart’s approach bites the bullet of relating physical properties to present physics, but does not make the thesis of physicalism trivially false by making the connection in a qualified way. It may in fact be false that current physics is unable to describe and explain brain processes, but it is not trivially false in the way that asserting current physics is equal to all descriptive and explanatory tasks would be. Effectively, Smart attempts to deal with the problem at hand by giving criteria for membership of some sub-set of $PP_{@}$, but a sub-set which is significantly related to the thesis he is advancing.

Second, Papineau, who takes another tack, biting the other bullet so to speak, and defining physics in terms of *whatever* categories might be needed to explain some group of paradigmatic effects taken as physical, thus making physics trivially complete. A crucial characteristic of his approach is that he further stipulates that no psychological categories are to count as physical.¹⁴ Just as Smart tied *physical* to present physics without making his claims trivially false, Papineau grants physics a great deal of open-endedness without making his physicalism trivially true, closing off Chomsky’s line of objection in another way. Papineau takes the claim that physics is complete *and* free from psychology to be an empirical one, and in the event that this combined claim is true his criteria for *physical* would end up delimiting something like $PP_{@}$, or, at least, that sub-set of $PP_{@}$ containing those properties which are in fact discoverable in the course of scientific investigation.¹⁵

I return to Papineau’s proposal in more detail below. For the time being I merely note, having considered both Smart and Papineau, that there manifestly are strategies for delimiting *physical* in such a way as to enable significant and discriminating theses to be advanced. Neither proposal is *prima facie* wrong-headed, and these approaches are not the only ones available, so the would be physicalist or defender of completeness is simply not confronted with an unavoidable “triviality or falsehood” dilemma. A notable characteristic of both Smart’s and Papineau’s approaches is that

neither seeks to lay down general criteria for membership of *PP*. Since both appear to succeed in stating non-trivial theses, the burden of argument that they *need* to do so rests elsewhere, with Daly and those who take a similar line.

My point here is not to claim, simply by producing two examples of approaches which seem to succeed at saying how physical should be understood for the purposes of advancing a specific thesis, that all allegations that it is not possible to pin down the notion of being 'physical' have been vanquished. That would be a poor excuse for an argument. Rather the purpose of this brief discussion has been twofold: to note the danger, and to suggest that it is not as alarming as it might at first seem. I take it only that I have done enough to justify not getting bogged down in an attempt to argue for the general claim that it is possible to draw the kind of distinction that is needed in favour of getting directly to business with specific proposals. In what follows I discuss a range of attempts to formulate the physical/non-physical distinction and consider Daly's critical challenges in more detail. Following this I offer some general suggestions concerning ways of delimiting sets of properties for the purposes of the kinds of debate Daly says should be abandoned. The one line of thinking aimed at giving criteria for membership of *PP* which Daly attacks but which I will not defend is that based on family resemblances.¹⁶ As Daly correctly points out, such an approach is likely to fare badly in the face of both physical properties not connected by suitable resemblances with other physical properties and non-physical properties which are so connected.

3. *Natural Kinds*

One strategy for characterising the physical might be to say that 'physical' is a natural kind, that is that there is some real difference (involving an essential feature or set of such features) between physical things, properties and relations, and non-physical ones, which we can find out in the course of practical and theoretical scientific investigation into the natures of things satisfying the constraints on the kind. Snowdon¹⁷ makes a proposal along these lines, which is criticised by Daly.

Snowdon does not adopt a particular theory of natural kind terms, but Daly seems correct when he reads Snowdon's suggestion along the lines of a well known account of such terms, due to Kripke and Putnam.¹⁸ On this view, natural kind terms pick out a real extension, where the extension in question typically takes the form of a physical microstructure, or at least some shared theoretical feature, and where suitable causal contact with these microstructures enables successful reference. More specifically, Putnam proposes that meaning can be defined on the

analogy of a vector with four components: syntactic marker, semantic marker, stereotype and extension. Ordinary linguistic competence does not presuppose knowledge of the extension, for example H₂O, of the word 'water', but rather:

It means that (*we say*) the extension of the term 'water' as *they* (the speakers in question) use it is *in fact* H₂O.¹⁹

Competent speakers do, though, according to Putnam, need to be masters of the markers (semantic and syntactic) and the stereotype, which in the case of 'water' might be "colourless; transparent; tasteless; thirst-quenching; etc."²⁰ On this view, then, there will be a real fact of the matter about the extension of a natural kind term which it may or may not be possible to discover, and which may or may not be known by any member of the community using the term. My purpose here is neither to defend nor endorse this account of natural kind terms, simply to see whether Daly's criticisms of Snowdon's application of it stand up.

Snowdon's general project in the paper to which Daly refers is an attempt to formulate materialism (or physicalism — he uses the terms interchangeably) and dualism. Snowdon contends, on this point agreeing with Stroud, that a priori approaches to explaining the predicate 'physical' are unlikely to succeed.²¹ I return to Snowdon's reasons for this shortly, but for the time being note only that he takes the limitations of a priori approaches to indicate the need for an elucidation of 'physical' which is "sensitive to the empirical exploration of the physical world".²² Rejecting attempts to tie 'physical' to current physics, for reasons along the lines of those noted above in section (2), and also eschewing entirely indiscriminating gestures at physics "*as it ultimately evolves*" Snowdon instead proposes that:

We apply the term 'physical' to a range of objects, for example, tables, chairs and stones, which we think we encounter in perception. The term is intended to mark out their most basic and shared essential features. That is, 'physical' is an extremely basic natural kind term, a term for the most all-embracing (natural) kind with which we are acquainted. The discovery (if such is possible) of the essence of the kind is a posteriori. So, on this suggestion, the term's restrictions flow in the same way that those of natural kind terms do in other cases.²³

This suggestion is rather compressed and short of detail, but the idea would seem to be that we can plausibly be taken to have, already, a fair sense of what we can call the *stereotype* of 'physical', which, along the lines of the Kripke–Putnam view, would fix the extension even if we do not know, and may indeed never know, the essence particular to the extension of the word. There is something fundamentally correct about

this too, since we clearly can, and do, have a cluster of activities and programmes under the broad heading of 'physics' *without* knowing what or how much any of these programmes may eventually discover.²⁴ It is Daly's demand that we pin down *PP* before we even get started which is at fault here.

For Snowdon's purposes this seems fair enough, since the two forms of dualism he goes on to identify are united in denying that the physical natural kind will turn out to form the foundation of all phenomena, either because the mental will be found to have its ground in something immaterial, or because mental phenomena "are themselves amongst the fundamental features of the world".²⁵ In the event that physics is not complete in the sense explained above, because one of Snowdon's forms of dualism was correct, it would be the case that physics is unable, even in principle, to provide a causal ancestry for at least some physical occurrences. Whatever its other merits, Snowdon's approach does enable him to advance the theses which he is attempting to advance.

What of Daly's criticisms of Snowdon? For some reason Daly identifies as Snowdon's "conclusion"²⁶ a remark to the effect that "we can explain being physical as being the way (whatever it is) that all these objects (for example tables and chairs) fundamentally are, given that they are objects with the capacity to exist independent of perception and are in space (and so on)".²⁷ As it happens that particular remark, rather than being a conclusion, is an attempt by Snowdon to forestall an imagined idealist objection by tactically modifying the formulation which I quote above. Nonetheless Daly objects to this "conclusion" that many paradigmatically non-physical entities have been supposed to exist in the absence of perception, including "Platonic Forms, Fregean Thoughts, God, and Cartesian souls".²⁸ The point is well taken, and bears comparison with a remark made by Snowdon one page before the sentence Daly lights upon. As noted above Snowdon is in agreement with Stroud regarding the implausibility of a priori approaches to the problem, and notes in this regard that:

... it is hard to be confident of even the most general notions, such as occupation of space, that, as understood, they *must* apply to all physical objects, given the surprising entities physicists are prepared to endorse. On the other hand, even if we could articulate such a highly general, and a priori defensible, property of all physical entities, it is unlikely that it could yield a sufficient condition for being physical. After all, Locke held that spiritual substances had a location, but were not physical.²⁹

It is abundantly clear that Snowdon's point, regarding objects being in space and independent of perception, refers to tables and chairs, and is directed at his hypothetical idealist opponent, rather than being offered in an attempt to lay down some strict a priori criterion for all and only physical objects. Furthermore, he gives reasons for not making such an

attempt. In any event it is surely worth noting that Snowdon's point against the imagined idealist is, clearly, that the *stereotype* (or nominal essence) of 'physical' objects involves being in space, not that spatiality is a general condition for all physical properties, or that being in space is an a priori requirement for being part of the extension of physical. Since Snowdon does not actually make the claim Daly accuses him of, it should be possible to set aside Daly's attempt to show that the requirement that physical objects be in space is doomed to circularity.³⁰

Following his general suggestion concerning 'physical' as a natural kind, Snowdon goes on to propose that a "property is a physical property if it can be instantiated in a domain consisting only of physical objects" and that "a state of affairs is a physical one if it involves or consists only of physical objects instantiating physical properties".³¹ Daly objects that this would seem to require properties which are not readily thought of as physical ones (such as biological and psychological properties) are to be made physical by definition in the event that it turns out that they can be instantiated in a domain consisting only of physical objects.³² He also complains that even if this is the kind of thing which might indeed turn out to be true, it is not the sort of thing which should be trivially true.

To the extent that it is reasonable to take Snowdon's proposal as an attempt to lay down general and pre-emptive criteria for being physical there might be something in this. Since, however, Snowdon's project was merely to state clearly what was at issue between dualism and materialism it is difficult to see where the problem is. Snowdon is surely correct to say that a dualist (as he describes the two main variants of that doctrine) would not accept that mental properties could be instantiated in a domain consisting only of physical objects. And if they *could* be, that would indeed make them physical by definition for the purposes of his discussion.

For all its brevity and minor flaws, Snowdon's proposal is on to something important, which is that we can at least try to characterise 'physical' by linking the extension of the term to an ongoing project. He marks this point by saying, as already noted, that we need a characterisation of 'physical' which "allows its elucidation to be sensitive to the empirical exploration of the physical world".³³ What I want to do now is look at an approach suggesting that our ongoing investigation of the 'physical' can be driven by a focus on paradigmatic physical effects rather than physical objects.

4. *Paradigm Effects*

Daly also considers a proposal, mentioned above in section (2) and due to Papineau, to the effect that some "pre-theoretically given class of paradigmatic physical effects, such as stones falling, the matter in our arms

moving, and so on” can be postulated as independently given, and physics characterised in terms of “all the categories that are needed to explain those paradigmatic physical effects”.³⁴ Daly has three major objections to Papineau’s approach: that it is too narrow, too broad and, for good measure, that it is circular.

The first criticism is that Papineau’s criteria are too narrow, since they may suffice at best to “pick out only the class of actual physical properties”.³⁵ There are two ways of reading this criticism. On the one hand it might be taken to suggest that Papineau’s approach would only pick out the general physical properties of the actual world, so that the properties instantiable under some or other alien physics would not be included. On the other hand, Daly gives an example of “*being-a-solid-sphere-of-gold-with-a-diameter-of-one-mile*”³⁶ which indicates that he may mean that the set would be limited to the actually *instantiated* physical properties. In either case it is difficult to see that there is a significant problem. For a start, there is good reason to think that delimiting the actual physical properties is all Papineau was attempting to do, since his broad objective was to defend physicalism with respect to the *actual* world by means of an argument using the premise that physics is complete.³⁷ For such a project a procedure which specified the actual physical properties would be exactly what was needed. Indeed, it is difficult to see how, starting from actual physical effects and working backwards to the factors fixing their likelihoods, one could go anywhere except to other actual properties, which, with Papineau, we could agree for the purposes of argument to call physical. The gold sphere example, on the other hand, is clearly a red herring. Physics does not generally deal in particular properties of that sort, but can more plausibly be seen as dealing, or attempting to deal, with what Lewis³⁸ would call natural properties: that minimal catalogue of attributes in terms of which the descriptions of actually existing things can be analysed. On this view, were a gigantic gold sphere to be discovered it could be perfectly well understood in terms of natural properties, but it is inordinately perverse to demand that it actually be *anticipated*. That is akin to demanding of a theory of grammaticality that it come with a list of all possible grammatical sentences. Daly’s claim that Papineau’s approach is too narrow is itself in need of justification.

Nevertheless, Daly imagines that in order to meet this difficulty, if difficulty it is, Papineau might want to say that some property is a physical property if and only if there is at least one world at which that property is needed to explain an effect which is of the same type as one of Papineau’s class of paradigmatic physical effects.³⁹ This seems like a rather poor lifeline, since Daly does not explain why we should think that physical effects at other worlds will be suitably similar to those at ours for his modified procedure to capture what he or Papineau are after. We can agree, though, that even if Daly’s proposal does not necessarily

give us criteria for membership of *PP*, it would point to some set of properties more extensive than *PP*_@. But Daly then argues that his proposed modification of Papineau's position has the defect that it would make *any* property needed for explaining physical effects into a physical property, including, for example, mental properties at worlds where dualism was true, and hence where some paradigmatic physical effects had mental causes. Quite so. It is unclear why this is supposed to follow from modifying Papineau's approach though, since, as noted, that approach precisely *sets out* to make physics trivially complete by characterising as 'physical' *anything* needed to fix the likelihoods of the paradigmatic physical effects. Physics can be trivially complete in this way without some or other form of physicalism being made trivially true only if further considerations are added. And, as already noted, Papineau further hypothesises, with precisely this issue in mind, that physics not make reference to psychological categories.⁴⁰ This hypothesis is empirical, and it is important to note that it gives a contingent edge to the question of the completeness of physics. If physics is complete by definition, then it cannot *also* exclude psychological categories by definition, and vice versa. This is so since at some worlds physical effects will indeed follow psychological antecedents in just the ways Daly suggests. A somewhat extended version of Papineau's approach is discussed in section (6) below, for now let us stay with Daly's criticisms.

Daly objects that Papineau's account of the physical properties of the actual world is too narrow in a second way. This, he argues, follows because the stipulation that physics contain only the categories that *need* to be brought in to explain the paradigmatic physical effects, has the effect that some physical properties are excluded:

Every paradigmatic physical effect which can be explained by reference to *density* can be explained by reference to *mass* and *volume* instead. It follows from Papineau's definition that *density* is not a physical property.⁴¹

There are at least two ways of responding to this criticism. On the one hand it might be possible to demand an explanation of how mass and volume could be referred "instead" of density. Density, after all, just is a function of mass and volume, so it is far from clear what Daly even means by the suggestion that an explanation which simply referred to mass per unit volume would not involve reference to what we call density. The most he can say is that we could use substantially the same description or explanation, but not bother to assign a name to the quantity resulting from measuring mass per unit volume. We could, but that is hardly a difficulty for Papineau's approach which concerns the properties, not what we call them. Perhaps, though, the problem here is with Daly's example.

An alternative response, then, would be to accept the criticism but ask what damage it actually does to Papineau's case. For this purpose let us set aside mass, volume and density, and imagine *any* property or set of properties which, for whatever reason, are not needed, in Papineau's sense, for the explanation of paradigm physical effects. We can imagine for good measure that these properties are ones that we would be strongly inclined, for whatever reason, to call physical. Recall also that Papineau's account of 'physical' is intended to contribute to establishing a completeness premise which plays a role in his arguments for a particular form of physicalism. Daly is concerned that the specific focus on only those properties which are *needed* to explain the class of physical effects will result in picking out some set of physical properties, itself forming a sub-set of actual physical properties. So what? For physics to be complete, according to Papineau, it must be the case that "all physical events are determined, or have their chances determined, by prior *physical* events according to *physical* laws. In other words we need never look beyond the realm of the physical in order to identify a set of antecedents which fixes the chances of every physical occurrence".⁴² If there is some set of physical properties which contains all the physical properties needed to set the likelihood of all physical outcomes, then, if nothing else, physics is complete in the required sense. Put another way, if we never have to "look beyond" some sub-set of the actual physical properties, then, trivially, we will never have to look beyond either $PP_{@}$ or PP either. If we bear in mind the particular point of Papineau's argument, it is clear that there just is no requirement for an exhaustive specification of criteria for membership of either PP or $PP_{@}$ here. Again, it is the claim that one *is* needed that stands in need of justification.

Daly's third and final objection is that we cannot decide *which* effects to classify with the paradigmatically physical effects needed to get Papineau's project off the ground unless we already have some criterion of being physical:

And since Papineau's account was meant to provide a characterisation of what a physical property is, his account proves circular.⁴³

This misses the point of Papineau's approach entirely. Simply to characterise physical properties *as* physical properties would indeed be as useless and circular as saying all members of PP are defined *as* members of PP . It is not the same thing, though, to accept that some properties are already known or commonly taken to be physical⁴⁴ and to characterise further properties of the same kind by specifying in a discriminating way what role those properties will play in a certain type of explanation. What we call 'physics' is the science which, *inter alia*, attempts to provide that kind of explanation. At any given world it will be a matter of fact

how much can be so explained, and hence a matter of fact whether or not 'physics' is complete (i.e. whether some 'physical' effects have non-'physical' causes), whether 'physical' so defined does or does not include psychological categories, and so on. In section (6) below I defend a modified version of Papineau's approach which I contend is immune to objections of the type Daly advances. First, though, I want to look at Daly's criticisms of one more proposal for delimiting the 'physical', which begins by characterising the discipline and activity of physics.

5. *Physics and the Physical*

Poland has recently attempted to address the problem of characterising *physical*. He does so, after canvassing and rejecting a range of options,⁴⁵ by developing an account of physics as a science, including an explanation of what he takes to be the crucial universality of physics. While Poland rejects suggestions along the lines of Quine⁴⁶ and Lewis⁴⁷ to the effect that the aim of physics is to provide a supervenience base for other forms of description and explanation, his own account is best understood with supervenience in mind. Poland's complaint against Quine and Lewis is that they confuse the aims of physicists with those of physicalists.⁴⁸ He eventually characterises physics as follows:

... physics is the branch of science concerned with identifying a basic class of objects and attributes and a class of principles that are sufficient for an account of space-time and of the composition, dynamics and interactions of all occupants of space-time.⁴⁹

Daly objects that Poland's approach is insufficiently discriminating, and contends (in a manner reminiscent of his criticism of Snowdon) that Poland has no criteria which can justify the exclusion of psychology and economics from being parts of physics, since both make reference to the composition and interaction of occupants of space time (such as human beings and banks) and construct explanations of their dynamics.⁵⁰ He notes Poland's stipulation that 'all dynamics and all interactions among phenomena are constrained by fundamental physical principles'⁵¹ but maintains that this does not stand in the way of regarding the laws of biology, chemistry, psychology, economics, etc., as part of physics, since Poland's criterion of 'generality' is not properly explained. The two sentences in Poland immediately following the one Daly quotes are worth spending some time on:

But this does not mean that physics is concerned with complex phenomena with respect to *all* of their properties. For example, social phenomena are not of interest to the physicist *as* social phenomena, although they are of interest as occupants of space-time (i.e. in so far as they involve causal processes or entities which "take up space").⁵²

With a little unpacking this both enables Daly's criticism to be answered and shows some significant connections between Poland's approach and Papineau's. A little more detail from Poland could help here. Poland contends that it is "not incorrect to say that physics is a universal science",⁵³ a remark reminiscent of Snowdon's characterisation of 'physical' as "a term for the most all-embracing (natural) kind with which we are acquainted". Poland suggests that this universality can be understood by reference to general features of the questions physical theories attempt to answer:

- What are the fundamental constituents of *all* occupants of space-time?
- What are the fundamental processes that underlie *all* causation and *all* interactions between such occupants?
- What parameters are relevant to the dynamic unfolding of *all* systems in space-time and hence to *all* change?
- What is the nature of space-time itself, its origin (if it has one), and its destiny?⁵⁴

So would Poland really be required to grant psychology, say, a position within physics? The answer is that he would not in the sense that Daly suggests, but that there are worlds in which he would, just as there are worlds in which Papineau's trivially complete physics would include psychological categories. Daly is surely correct to point out that psychology includes dynamics and interactions, and that it involves consideration of the composition of the entities it studies, which are themselves occupants of space-time. But what Poland says on the matter gives a principled and non-*ad hoc* way of saying that psychology (or any other special science) is not *automatically* a part of physics. The two crucial points here are Poland's account of the generality of physics, and his stipulation that physics concern a class of attributes and principles which are *sufficient* for the purposes he details.

Some of the occupants of space-time are indeed social phenomena. But what does Poland mean by saying that physics is not interested in them *as* social phenomena? Let us first consider a case along the lines most clearly suggested by Daly's criticism, where it is *not* assumed that there are *sui generis* psychological entities and causes, but that psychological properties at least supervene on physical ones. Then the criticism of Poland would be an internal one, to the effect that even where there is in principle some physical description of a process, Poland's approach cannot give a principled criterion for not calling any other possible description a part of physics. But in this case the interest of physics according to Poland would be, as noted, in the fundamental constituents of *all* occupants of space-time, and the forms of interaction and causation typical of them. Poland specifies that the classes of objects, attributes and principles

which form the object of physics are “minimal with respect to the descriptive and explanatory purposes they serve,”⁵⁵ which is to say that forms of description which are possible but not essential are just not part of physics. Although we have seen that Poland denies the view that the aim of physics is to provide a supervenience base, we can see that for him the physicist would be interested in those things which might *turn out* to form the supervenience base of the phenomena, in this case psychological ones, to which Daly refers.

This answers Daly’s objection, but it is worth considering an alternative case where there are in fact irreducible *sui generis* causes of some type we would not intuitively want to call physical, for example mental causes, which have effects in space-time. Then it would follow that such things would indeed be part of the object of physics as Poland describes its interests. Then, in a similar way to what we saw with Papineau, we would still have a complete science which we had decided to call ‘physics’ but which would not permit inferences to any kind of supervenience thesis about the mental, which is what we would expect in such a case. Poland himself does not explicitly consider such cases, since he seems confident that there are no such causes to consider. For all that, he is careful to make clear that physicalism is significant in inverse proportion to the extent of what he calls the physical bases. More plainly, the less that is physical the more interesting it would be to say that other things supervene on the physical, or stand in some other relation of being determined by the physical.

Three accounts of ‘physical’ have, so far, been defended here: Snowdon’s “most general natural kind”, Poland’s “fundamental attributes of all occupants of space-time”, and Papineau’s “set of categories needed to explain paradigm physical effects”. I believe that Daly’s most important objections to each of them has been answered. Following his criticisms Daly opts for a roughly inductive, admittedly provisional, conclusion to the effect that it is “doubtful whether any satisfactory account will be forthcoming”.⁵⁶ I could opt for a similar induction here, but it takes no effort to imagine an indefinite exchange of criticisms and defences of specific proposals concerning the ‘physical’ with their own inductive conclusions concerning the prospects of future efforts. Rather I will try to draw a general moral from what has been said so far, while at the same time returning to and extending some aspects of Papineau’s approach as discussed above.

6. *Doing What You Need*

In one way and another I have been arguing that it is possible to sustain philosophical debates over the physical without having to specify criteria for membership of *PP*. (That is to say, without saying in any exhaustive

or pre-emptive way what is to count as physical.) All of the proposals which have been defended here, though, might seem to be poor alternatives to some kind of a priori characterisation of the 'real' boundaries of *PP* along the lines demanded by Daly. In each of the cases discussed, though, the criteria offered have been driven by the needs of the particular argument being made, whether by Snowdon, Papineau, Poland or for that matter Smart. And in all cases there has been a significant element of open-endedness to the criterion, allowing room for further enquiry on the part of the physical sciences.

The task of providing a principled a priori criterion might have seemed simpler in the seventeenth century.⁵⁷ Mechanists thought they had good reason to limit the set of physical properties very severely, in Descartes's case to modes of extension, including size, shape and motion, but more usually to a slightly larger set at least including impenetrability. But it would be a mistake to be nostalgic about the good old days when philosophers thought they knew a priori what all material or physical properties were. The mechanists in question were not only wrong about the specific properties of matter, but wrong to think that those properties could be known a priori at all.

Another way of making the point that I have been making in various ways in the preceding discussion of Daly's criticisms is that we just don't *need* to know this. What I would like to do now, by way of extending this rejoinder into something constructive, is return to Papineau's proposal, and develop it somewhat with a view to settling the formulation question, and then moving on to see just how restricted a version of 'physics' might plausibly be seen as complete.

I begin by recalling an earlier account of 'physical', that proposed by Meehl and Sellars. They distinguish between two senses of physical for their purposes, one simply intended to capture something like 'scientific', or to express a general commitment to naturalism, and the second more specifically aimed at physical science. Their two characterisations are as follows:

physical₁: terms employed in a coherent and adequate descriptive, explanatory account of the spatio-temporal order.

physical₂: terms used in the formulation of principles which suffice in principle for the explanation and prediction of inorganic processes.⁵⁸

It seems reasonable to say of *physical*₁ that it is complete by definition. If there is some account of the spatio-temporal order which is coherent and adequate, then it would be complete in the sense at issue here.⁵⁹ Matters are somewhat different with *physical*₂. Meehl and Sellars's discussion is a defence of emergentism from a particular line of criticism due to Peper⁶⁰ to the effect that the doctrine of emergentism is faced with

an unresolvable dilemma. Meehl and Sellars, while not specifically arguing that emergentism is true, argue that it is immune from Peper's criticisms, and characterise the emergentist as one who denies that some phenomenon or other⁶¹ can be considered a part of *physical*₂ even though accepting it could be a part of *physical*₁. This makes it seem as though *physical*₂ could not possibly be complete by definition, unless it was also incapable of describing the entire spatio-temporal order by definition. Whether or not *physical*₂ is complete by definition really depends on how Meehl and Sellars want the "in principle" clause to be understood. Fortunately I don't need to work out how to do this, and I will assume a weak reading which does not make *physical*₂ complete by definition, so that the most significant feature of their account is the limitation of 'physical' to inorganic phenomena.

As we have also seen, on part of Papineau's account 'physics' is trivially complete: he begins by stipulating that anything which bears on the likelihood of any physical outcome is part of physics. For the purposes of the argument of the present section of this chapter I want to take the notion of a trivially complete physics as a premise. Doing this does not make physical science trivially complete: we cannot make our knowledge of the causal processes behind certain types of outcome complete with a wave of the hand. The point of Papineau's approach is ontological not epistemological: starting with some paradigmatic class of pre-theoretically given physical outcomes we say that anything which is needed (i.e. *whatever* is part of the causal ancestry of such outcomes) to fix the likelihood of those outcomes is part of physics. Whatever its relations to what we might otherwise call physics, the science picked out by this proposal ignores our intuitions in the interest of causal closure. Perhaps for the time being we can call it 'schmysics' to forestall objectors with worries along the lines of Daly or even Poland.⁶² Until further notice the present paper is about the question of the completeness of schmysics. *Prima facie* the range of things included in schmysics could turn out to be close to the range picked out by Meehl and Sellars's *physical*₁. Schmysics is trivially complete, and *physical*₁ seems likely to be complete by definition.

Earlier on I stated my intention to focus on the completeness of physics. Given that, this last move concerning the completeness of schmysics may well seem to have something of the flavour of a philosophical party trick. Certainly 'schmysical', as I have just suggested it might be conceived, is the name of a pretty uninteresting, if not entirely pointless, set of properties, and that for the simple reason that the criteria for membership of the set are remarkably indiscriminate. It's worth pointing out that they are not *completely* indiscriminate, since truly epiphenomenal properties, for example, which are not needed to fix the likelihood of schmysical effects, would obviously *not* be included. And the schmysical properties are not completely pointless, because by definition they are the ones that

do causal work with reference to physical outcomes. But there's more. Taking another cue from Papineau we can supplement the completeness by definition with some kind of exclusion hypothesis as well. In Papineau's case, as we saw, the conjecture was that 'physics' not need to make reference to psychological categories. Let's do the same with schmysics, so that we hypothesise that the schmysical, that which does causal work with reference to physical outcomes, will not include any psychological categories.

What needs emphasising is that it is not particularly important *what* exactly is excluded by the additional hypothesis. The first and most important point to note is that the proposed restriction that 'schmysical' not include some type of independently distinguishable properties *cannot* be true by definition in cases where schmysics *is* complete by definition. You can't have both. This means that for any given exclusion, it is an *empirical* question whether schmysics is both complete and devoid of the kind of property in question. (Since physicalism is usually a thesis about two classes of attributes, only one of which is *prima facie* physical, part of what makes the completeness premise interesting in *any* given case is exactly what it is that is excluded.) That is why the trivial completeness of schmysics is not a party trick – there's an empirical and contingent aspect to the proposal too. Returning to 'physics' for a moment, it's worth noting that in a sense all that is done by the current proposal is the conceptual inversion of some details of fairly traditional ways of thinking. As noted above, there are those who take it to be a matter of definition that 'physical' and 'mental' are opposed. For such thinkers the failure of the mental to fall within the domain of the physical is the trivial bit, and the question of the completeness of physics the difficult empirical question. With schmysics things are the other way around.

Having both the trivial completeness of schmysics and the contingent exclusion hypothesis helps specify the kinds of thing which might be expected to count as *evidence* for or against the view that the schmysical is both complete and free of whatever is excluded. So, for example, if Eccles⁶³ was right and particles in the brain accelerated from time to time for no discoverable *physical* reason, but these events also turned out to be correlated with independently identifiable psychological states, then that would tend to support the view that these outcomes *needed* reference to psychological categories in order to fix their likelihood. That would count against the combined thesis that schmysics was complete and free from psychology. Either the complete science would have to include psychology, hence sustaining no interesting schmysicalism about the mental, or we would have to admit that it was not complete.

If excluding something made schmysics more interesting (so that if it *was* true that the mental was not needed for a complete schmysics, then it would be possible to be a schmysicalist about the mental) then further

exclusions might reasonably be expected to make it more interesting, and perhaps controversial, still. Recall Poland's observation⁶⁴ that the significance of physicalism is inverse proportion to the extent of "the physical bases". The reason is clear: the less there is that is 'physical' the more interesting it is to say, on the basis of further argument from the completeness of the physical, that *everything* is, in some sense, dependent on the physical. As with physics so with schmysics.

The same basic approach works just as well for debates other than those concerning the relationship between the psychological and schmysical. Depending on the thesis at stake we can impose variously strong constraints on what we allow to be part of the schmysical. Staying with the current exclusion principle for a moment we can see how this would work. In the event that there were *biological* properties (of living entities) which needed to be referred to in explanations of the paradigmatic physical effects in question, but not psychological ones, then what Papineau⁶⁵ might call 'physics' and I am calling 'schmysics' would be complete in the required sense, even though including parts of what we would usually call biology. From Papineau's point of view, and mine, this is only an objection to the extent that we are worried about the word 'physical', since a complete science of such a sort would still be philosophically significant as far as the place of the mental was concerned.

If, though, we wanted to make some kind of claim about the relationship *between* biological properties and schmysical ones along the same lines as we did with psychological properties, then we could simply make the exclusion more restrictive and generate a new empirical thesis to the effect that schmysics is complete and need never refer to biological properties. And as before there would be various kinds of evidence which might bear on the question. Nineteenth-century anatomists, for example, searched for evidence in the energy intake and consumption of living things that might show their access to additional forms of energy of some kind, and failed to find it.⁶⁶

Where has this taken us? Well, as it happens schmysics is now the trivially complete science of the causal antecedents of physical outcomes, which we hypothesise need make no reference to either psychological or biological categories. In other words, schmysics is about the inorganic, just like Meehl and Sellars's *physical*₂, which means that I can drop the charade, and start calling it physics again. We need not stop here, though.

The most restrictive version of the exclusion hypothesis that seems likely to have much application, then, would be one excluding *chemical* factors. There is a historical background for exactly this possibility. For a time it was thought that chemical phenomena required reference to forces of affinity between elements and substances of various kinds. If true, this would have meant either that a complete physics would have had to include chemical forces, or that a physics with no chemical categories

could not be complete. But the explanation of chemical bonding by quantum mechanics seemed to show that no such forces were required.⁶⁷ Similarly, various experimental programmes in the nineteenth century appeared to show that it was not necessary to suppose that additional 'vital' forces were required to account for biological phenomena from digestion to perception.

Spurrett and Papineau⁶⁸ considered the common overdetermination argument for physicalism, which starts with the completeness of physics, notes the fact of causal claims with non-physical antecedents, and argues, via the rejection of overdetermination for the identity of the non-physical with the physical. They argued that this form of argument need not be about physics at all, as long as there is some plausible candidate for the completeness premise. The present argument complements that one, by developing a contentful, empirical and for good measure plausible way of making the completeness premise about physics. In order to succeed at this task it was in no way necessary to meet the kind of requirements which Daly imposes on discussions of what is to count as physical.

7. *Conclusion*

Daly admits that he does not have a *general* argument for the thesis that no characterisation of *PP* is possible, and hence that his conclusion is "provisional", but nonetheless that on the basis of the failings of the approaches he discusses "it seems doubtful whether any satisfactory account will be forthcoming".⁶⁹ We have seen, first, that many of Daly's criticisms can be countered, and second, that there is no need to give a comprehensive characterisation of all contingently existing physical properties to be able to advance and defend significant theses concerning physics, the completeness of physics, and physicalism.

I noted in passing near the beginning of this paper that it was no small concession to allow the notion of there being a coherent set of physical properties like *PP* at all, but made the concession in order to focus on other difficulties with Daly's approach. Having dealt with those, though, it is worth asking whether Daly's demand makes much sense. By implication he wants the question whether some property is physical or not to be answered without reference to the other features of the worlds in which it can be instantiated.

It is far from clear, though, that what is a physical property at one world will be a physical property at any world in the sense which Daly seems to have in mind. Suppose two worlds, one in which Cartesian physics reigns and one where nature is Aristotelian. What considerations could the local epistemologists refer to in deciding whether to call a lump of Aristotelean earth matter 'physical' if it cropped up in the Cartesian

world? Or if some of the Cartesian *res extensa* showed up, with all its immunity to the notion of proper places, in the Aristotelean? What, indeed, if some of Boyle's inter-particulate void popped up in either the Cartesian or Aristotelean world? Whether a physical property is alien or not is indexical to a world. I suggest for the purposes of argument that whether a property is physical or not may, in some cases, be similarly indexical to a world or set of worlds.

So what if it was? That would have no bearing at all on the arguments advanced in section (6) above, which come with a built-in contentful and empirical account of the physical, and are primarily concerned with the actual world. This may seem somewhat parochial to those with heads (or stomachs) for metaphysics, but it only reinforces my point, which is that what you need from an account of the physical depends on the argument you are trying to make.⁷⁰

Philosophy Programme
University of Natal, Durban

NOTES

¹ See, *inter alia*, the works by Meehl and Sellars, Feigl, Oppenheim and Putnam, Smart, Poland, Snowdon, Quine, Lewis, and Papineau in the list of references below. There are especially extensive references to other approaches in the literature in the works by Feigl and Poland.

² See, *inter alia*, the works by Chomsky, Crane and Mellor, and Stroud in the list of references below.

³ Daly (1998), p. 196.

⁴ Davidson (1970).

⁵ Feigl (1958).

⁶ See, for example, Papineau (1993) and Kim (1998).

⁷ Hellman and Thompson (1975), p. 557.

⁸ Daly (1998), pp. 197–200.

⁹ Lewis (1983). Lewis (1983: 364) explains that an alien property at some world is one which cannot be instantiated at that world, and cannot be *analysed* in terms of the natural properties of that world.

¹⁰ Daly (1998), pp. 197–9.

¹¹ This point is frequently made, and is usually conceded by physicalists. See, for example, physicalists Poland (1994) and Papineau (1993), anti-physicalists Crane and Mellor (1990), and Stroud (1987).

¹² Chomsky (1972), p. 98. Also quoted in Daly (1998), p. 199.

¹³ Smart (1978), p. 339. Daly refers to Smart's paper in an endnote, in connection with a related proposal by Hellman (1985). See also Smart (1989), p. 80, where he asserts that he "shall not deny that there will be revolutionary changes in physics. Nevertheless . . . [they] . . . will have no impact on biology and psychology."

¹⁴ Papineau (1993), p. 30.

¹⁵ It could be pointed out here that in the event there were biological categories which were needed to account for some of the paradigm physical effects, Papineau's approach

would call 'physics' a science comprising both physics as conventionally understood *and* what we would call biology. Quite so. For a discussion of why this feature need not provoke any objections see section (6) below. Daly's criticisms of Papineau's proposal are discussed in section (5) below.

¹⁶ Daly (1998), pp. 200–2. Daly attributes this view to Frank Jackson in his John Locke lectures at Oxford University in 1995, noting in turn that Jackson acknowledged the suggestion to be Papineau's.

¹⁷ Snowdon (1989).

¹⁸ Kripke (1972), Putnam (1975).

¹⁹ Putnam (1975), p. 269.

²⁰ Putnam (1975), p. 269.

²¹ Snowdon (1989), p. 152, Stroud (1987), p. 277.

²² Snowdon (1989), p. 152.

²³ *Ibid.*, p. 154.

²⁴ Note that on the Kripke–Putnam view we do not have to be especially perspicacious in our identification of the stereotype with which we begin our enquiries, since it is the ongoing investigation into the *extension* which carries the greater burden here. So, for example, no-one had to *begin* by thinking that diamonds and coal were basically the same in some chemically significant sense in order to find out about carbon.

²⁵ Snowdon (1989), pp. 156–8.

²⁶ Daly (1998), p. 203.

²⁷ Snowdon (1989), p. 153.

²⁸ Daly (1998), p. 204.

²⁹ Snowdon (1989), p. 152.

³⁰ Daly's objection hinges on the claim that the attempt to require that physical properties be in space is likely to collapse into circularity in one of two ways. On the one hand, if space is defined as a system of relations between physical objects, then the natural kind *physical object* would be partly explicated in terms of the notion of physical space. But that notion of space would in turn be accounted for in terms of the fact of space being a system of relations between physical objects, which would be circular. If, on the other hand, space is taken to be a physical object itself then the account of the natural kind *physical object* would be in terms of a particular physical object, which would also be circular. But there need be no circularity in either case. A system of relations could be a set of physical properties dependent upon some *other* set of properties. Alternatively, a collection of physical objects could have the property of being 'in' some other physical object which could itself be independently characterised.

³¹ Snowdon (1989), p. 154.

³² Daly (1998), p. 205.

³³ Snowdon (1989), p. 152.

³⁴ Papineau (1993), p. 30. Daly (1998), p. 206, notes that Papineau's proposal is similar to Feigl's characterisation of 'physical₁' and 'physical₂' in Feigl (1958), p. 377. Feigl's final formulation of physical₂ has it as embracing "the kind of theoretical concepts (and statements) which are sufficient for the *explanation*, i.e., the deductive or probabilistic derivation, of the observation statements regarding the inorganic (lifeless) domain of nature" (1958), p. 424. Daly does not note that Feigl's version is itself a modification of a proposal by Meehl and Sellars (1956). See section (6) below.

³⁵ Daly (1998), p. 206.

³⁶ *Ibid.*, p. 207.

³⁷ Papineau (1993), pp. 29–32.

³⁸ Lewis (1983), p. 364.

³⁹ Daly (1998), p. 207.

⁴⁰ Papineau (1993), p. 30.

⁴¹ Daly (1998), p. 207.

⁴² Papineau (1993), p. 16.

⁴³ Daly (1998), p. 208.

⁴⁴ As Daly himself does when giving “*being-5kg-in-mass*, *being-5-light-years-from-Neptune*, and *being-a-magnetic-field*” as examples of physical properties, and also giving some examples of non-physical properties, while attempting to explain what is at stake in delimiting *PP*, Daly (1998), p. 198. Strategies such as Snowdon’s and Papineau’s demand no more from our everyday sense of ‘physical’ than Daly is prepared to allow for the purposes of formulating many of his own arguments.

⁴⁵ Poland (1994), pp. 107–85.

⁴⁶ Quine (1979), pp. 163–4.

⁴⁷ Lewis (1983).

⁴⁸ Poland (1994), pp. 120–2.

⁴⁹ Poland (1994), p. 124.

⁵⁰ Daly (1998), pp. 210–1.

⁵¹ Poland (1994), p. 125, quoted in Daly (1998), p. 211.

⁵² Poland (1994), p. 125. It is not clear why the sentences in question are neither quoted nor referred to by Daly.

⁵³ Poland (1994), p. 125.

⁵⁴ *Ibid.*, p. 125.

⁵⁵ *Ibid.*, p. 124.

⁵⁶ Daly (1998), p. 213.

⁵⁷ A point noted in, for example, Stroud (1987), pp. 265, 267.

⁵⁸ Meehl and Sellars (1956), p. 252.

⁵⁹ For the purposes of the present point I am fudging the fact that Meehl and Sellars’ *physical_i* is not framed in terms of causal relations, but rather explanation. Since they incline to a deductive nomological account of explanation, this is not an especially significant issue.

⁶⁰ Peper, S. (1926).

⁶¹ Their particular examples are “raw feels” and the like, Meehl and Sellars (1956), p. 252.

⁶² I stipulate that there are no schmysical effects which can be independently characterised: the ‘schmysical’ is that which is needed to account for *physical* effects, taken as pre-theoretically given in the sense of Papineau. Physical effects are schmysical by fiat.

⁶³ Eccles, J. (1980).

⁶⁴ Poland (1994), p. 114.

⁶⁵ Papineau (1993).

⁶⁶ This is not the place for a discussion of the relevant history, but the accounts given by Coleman (1977) and Hall (1962) give useful surveys of the issues.

⁶⁷ For example Schlick (1953) states emphatically that the laboratory production of Urea in 1828 by Wöhler “refuted once and for all the doctrine that the synthesis of organic compounds requires a special force”, p. 524.

⁶⁸ Spurrett and Papineau (1999).

⁶⁹ Daly (1998), p. 213. Daly’s approach is well described by Snowdon’s remark on Stroud (1987): “He, at most, tries out some ways and rejects them, and has no argument to show that there cannot be an elucidation of ‘physical’.” Snowdon (1989), p. 152.

⁷⁰ This paper was first presented under the title “For the Completeness of Physics” at a one day conference on the Completeness of Physics at Senate House, University of London, on 23 May 1999. In that incarnation, as the title suggests, the paper also included material

defending the thesis that physics is complete. For present purposes the principle burden of argument is the rebuttal of Daly's criticisms of various attempts to say what is to count as physical. I am grateful to David Papineau and Keith Hossack, who commented on an earlier draft of this paper, and to Deepak Mistrey and Catherine Whitfield who read a later version.

REFERENCES

- Chomsky, Noam (1972). *Language and Mind*. New York: Harcourt Brace Jovanovich, Inc.
- Chomsky, Noam (1980). *Rules and Representation*. Oxford: Basil Blackwell.
- Coleman, W. (1977). *Biology in the Nineteenth Century*. Cambridge: Cambridge University Press.
- Crane, Tim, and Mellor, Hugh (1990). "There is no Question of Physicalism," *Mind* 99, pp. 185–206.
- Daly, Chris (1998). "What are Physical Properties?" *Pacific Philosophical Quarterly* 79, pp. 196–217.
- Donald Davidson (1970). "Mental Events," in L. Foster and J. Swanson (eds.) *Experience and Theory*. Amherst, Mass.: University of Massachusetts, pp. 291–303.
- Eccles, J. (1980). *The Human Psyche: The Gifford Lectures, University of Edinburgh, 1978–1979*. New York: Springer.
- Feigl, Herbert (1958). "The 'Mental' and the 'Physical'," in Feigl, H., Scriven, M. and Maxwell, G. (eds.) *Concepts, Theories, and the Mind-Body Problem: Minnesota Studies in the Philosophy of Science, Volume II*. Minneapolis: University of Minnesota Press, pp. 370–497.
- Hall, A. R. (1962). *The Scientific Revolution, 1500–1800: The Formation of the Modern Scientific Attitude*. Boston: Beacon.
- Hellman, G. P. and Thomson, F. W. (1975). "Physicalism: Ontology, Determination, and Reduction," *Journal of Philosophy* 72, pp. 551–64.
- Hellman, Geoffrey (1985). "Determination and Logical Truth," *Journal of Philosophy* 82, pp. 607–18.
- Kim, J. (1998). *Mind in a Physical World*. Cambridge Mass.: MIT Press.
- Kripke, Saul (1972). "Naming and Necessity," in Gilbert Harman and Donald Davidson (eds.) *Semantics of Natural Language*. Dordrecht: D. Reidel, pp. 253–355.
- Kripke, Saul. (1980). *Naming and Necessity*. Oxford: Basil Blackwell.
- Lewis, D. K. (1983). "New Work for a Theory of Universals," *Australasian Journal of Philosophy* 61, pp. 343–77.
- Meehl, P. and Sellars, W. (1956). "The Concept of Emergence," in Feigl, H. and Scriven, M. (eds.) *Minnesota Studies in the Philosophy of Science Volume I: The Foundations of Science and the Concepts of Psychology and Psychoanalysis*. Minneapolis: University of Minnesota Press, pp. 239–52.
- Oppenheim, P. and Putnam, H. (1958). "Unity of Science as a Working Hypothesis," in Feigl, H., Scriven, M. and Maxwell, G. (eds.) *Concepts, Theories, and the Mind-Body Problem: Minnesota Studies in the Philosophy of Science, Volume II*. Minneapolis: University of Minnesota Press, pp. 3–36
- Papineau, David (1993). *Philosophical Naturalism*. Oxford: Basil Blackwell.
- Peper, S. (1926). "Emergence," *Journal of Philosophy* 23, pp. 241–5.
- Poland, Jeffrey (1994). *Physicalism: The Philosophical Foundations*. Oxford: Clarendon.
- Putnam, H. (1975). *Mind, Language and Reality: Philosophical Papers, Volume 2*. Cambridge: Cambridge University Press.

- Quine, W. V. O. (1979). "Facts of the Matter," *Southwestern Journal of Philosophy* 9, pp. 155–69.
- Schlick (1953). "Philosophy of Organic Life," in H. Feigl and M. Brodbeck (eds.) *Readings in the Philosophy of Science*. New York: Appleton-Century-Crofts, Inc., pp. 523–36.
- Smart, J. J. C. (1978). "The Content of Physicalism," *Philosophical Quarterly* 28, pp. 339–41.
- Smart, J. J. C. (1989). *Our Place in the Universe: A Metaphysical Discussion*. Oxford: Basil Blackwell.
- Snowdon, Paul (1989). "On Formulating Materialism and Dualism," in John Heil (ed.) *Cause, Mind and Reality: Essays in Honour of C. B. Martin*. Dordrecht: Kluwer Press, pp. 137–58.
- Spurrett, David and Papineau, David (1999). "A Note on the Completeness of 'Physics'," *Analysis* 59/1, pp. 25–9.
- Stroud, Barry (1987). "The Physical World," *Proceedings of the Aristotelean Society* 87, pp. 263–77.