CAUSATION IN PHYSICS & IN PHYSICALISM

Abstract: It is widely thought that there is an important argument to be made that starts with premises taken from the science of physics and ends with the conclusion of physicalism. The standard view is that this argument takes the form of a causal argument for physicalism. Roughly: physics tells us that the physical realm is causally complete, and so minds (among other entities) must be physical if they are to interact with the world as we think they do. In what follows, I raise problems for this view. After an initial review of the causal argument, I begin my case by showing that the totality of physical truths do not deductively entail the causal completeness of the physical realm, using a double-prevention scenario and causation by omission to show that nonphysical causes of physical effects would not need to violate physical conservation laws. I then move on to raise problems for an inductive argument for causal completeness by drawing on the neo-Russellian view that there is no causation in fundamental physics, and so causation must itself be a realized or derived entity. I conclude by suggesting that the underlying problem is that the causal argument has fallen out of touch with the sophisticated understanding that philosophers have developed of the role of causation within physics.

It is widely thought that there is an important argument to be made that starts with premises taken from the science of physics and ends with the conclusion of physicalism. Maybe the argument isn't decisive, and maybe physics isn't univocal on the matter.[1] Still, surely there is some sort of physics-based argument to be made here. One leading view is that it should take the form of a *causal argument for physicalism*. In what follows, I raise problems for this view. It does not easily mesh with our best understanding of causation today, or of the role causation plays within physics.

I begin in §1 by reviewing the causal argument, focusing especially on its premise that the physical realm is causally complete. I then consider two different ways

[1] For the view that physics gives us good reason to reject physicalism, see for instance Wigner (1961), who takes the Von Neumann-Dirac collapse formulation of quantum mechanics to support mind-body dualism. Or see Barrett (2006), who contends that both collapse and no-collapse formulations support dualism.

physics might be taken to support such causal completeness. In §2, I consider the view that the laws of physics *deductively entail* causal completeness. I reject this suggestion on the basis of a *double prevention* scenario in which absences figure as causes. In §3, I consider the alternative strategy of making an *inductive argument* for causal completeness. I cannot claim to refute this suggestion, but I do raise problems for it that draw on the neo-Russellian view that there is no causation in fundamental physics. Finally, in §4 I wrap things up by suggesting that the underlying issue we are running up against may be that the causal argument has fallen out of touch with our best current understanding of causation.

1. The Causal Argument

The version of the causal argument that we will work with is taken from David Papineau. It goes as follows:

> (P1): All physical events have complete physical causes (in the sense that those causes are either sufficient for or fully determine the chances of those events).
> (P2): All mental events have physical effects.
> (P3): The physical effects of mental causes are not all causally overdetermined.
> (C): Mental events are identical with physical event.[2]

Brief commentary is in order. Here and throughout, I will understand "physical" in accordance with the so-called *theory-based conception* of the physical, according to which physical entities are those denoted by the theoretical terms of physics.[3] So for example,

[2] Taken from Papineau (2001: 9), but using Papineau's (1993) formulation of the (P1) premise. Other proponents of causal arguments for physicalism include Lewis (1966), Davidson (1970), Peacocke (1979), Tye (1995, 2009), Levine (2001), and Melnyk (2003), Kim (2005).

[3] This is in contrast with the *via negativa* conception that defines 'physical' as (roughly) the non-mental; see for example Montero (1999), Papineau (2001) and (2002), Levine (2001), and Tiehen (2016). One reason to

electrons, angular momentum, and mass-energy all qualify as physical entities. The conclusion (C) as stated concerns just mental events, but the argument generalizes to other domains, yielding the conclusions that chemical events are physical, biological events are physical, geological events are physical, and so on, until we arrive at the *token physicalist thesis* that all events are physical.[4] There is an important debate over how exactly physicalism should be formulated—in terms of supervenience? realization? grounding?[5]—but I will try to pass over this debate here as much as I can. I will mostly just assume that the token identity thesis suffices for physicalism however exactly we conceive it.

(P1) is a version of the thesis known as the "causal closure of the physical realm" or the "causal completeness of physics." I will call it **Completeness**. As formulated, **Completeness** allows indeterministic causation, but indeterminism plays no real role in what follows. For our purposes, **Completeness** is the key premise. Proponents of the causal argument characteristically hold that the way physics supports physicalism is by virtue of supporting **Completeness**. I will consider two different ways of developing this thought. The first says that physics *deductively entails* **Completeness**.

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prefer the theory-based conception in the present paper is that what we are interested in the way the science of physics in particular provides evidence for physicalism.

[4] There are physicalists who reject this token identity thesis, holding that mental events are realized or constituted by physical events rather than identical with them—for discussion, see Yablo (1992). Perhaps they can embrace a modified version of the causal argument that makes room for their position, but this is not something I will explore.

[5] See Stoljar (2015) and Tiehen (2018) for discussion.

2. THE DEDUCTIVE CASE FOR **COMPLETENESS**

2.1 The Conservation of Energy (And Other Conservation Laws)

One frequently advanced deductive argument from physics to **Completeness** appeals to physical conservation laws, especially (but not only) the conservation of energy, which states that the total energy of any closed system remains constant over time. This is one of our very best-confirmed scientific laws and so any mind-body view that requires its rejection comes with a steep empirical cost.

To illustrate the supposed relevance of the conservation laws, imagine you want to move some physical body presently at rest. This will require the body to gain kinetic energy as it accelerates, a gain that must be offset elsewhere if total energy is to be conserved. A prospective physical cause could achieve this by losing energy that it transfers to the body to be moved, as when a cue ball comes to stop upon colliding with an eight ball that it sends off on its way. But consider a prospective nonphysical cause, like a Cartesian ego. It possesses no kinetic energy, since it has no mass or velocity; it possesses no gravitational or electric potential energy, since it has no mass or charge and stands in no spatial relations with other entities. If, by virtue of lacking physical properties like these, a Cartesian ego is precluded from possessing any energy at all, and so any energy it might transfer to the body to be moved, it follows that the only way the ego could move the body is by violating the conservation of energy principle. Assuming this point generalizes, so that the only way for any nonphysical cause to bring about a

physical effect would be by violating the conservation of energy principle (or some other conservation law), it would follow that the laws of physics entail **Completeness**.[6]

The thought that there is such an entailment has played an important historical role in arguments used against various antiphysicalist views. Famously, Leibniz rejected Descartes' interactionist dualism on these grounds.[7] He thought that although interactionist dualism was consistent with those laws posited by Descartes' physics, subsequent developments in physics known to Leibniz but not to Descartes involved the embrace of forms of conservation laws (including what we would today describe as the conservation of linear momentum) that ruled out interactionism and in effect entailed **Completeness**.[8] Now, in response to this point Leibniz opted for the doctrine of pre-established harmony rather than physicalism, and so in effect his take on the causal argument would be to reject its premise (P3) asserting mind-body interaction. But leave that aside. The key point is just that Leibniz took the physical conservation laws of his time to ensure the causal completeness of physics.

A second historical example worth highlighting is provided by Hermann von Helmholtz, whose 1847 pamphlet "On the Conservation of Force" did much to usher in the acceptance of the conservation of energy principle, and who was the first figure to

[6] Cornman (1978) argues that Broad's (1923) version of antiphysicalist interactionism is consistent with the conservation of energy but not with the law of the conservation of linear momentum. I mention this to highlight the need to bring in other conservation laws here.

[7] Leibniz (1998). Of course, many different critics objected to Descartes's interactionism, but I single out Leibniz because his objection is based specifically on physical conservation laws.

[8] For further discussion relating Leibniz's view to the case for **Completeness**, see Papineau (2001, 2002) and Montero (2006). Garber (1983) argues that Leibniz misrepresents Descartes' position, while McLaughlin (1993) responds that Leibniz got Descartes right.

formulate the principle mathematically in full generality.[9] An opponent of vitalist views positing the existence of a nonphysical "life force," Helmholtz as a student signed (in blood, according to legend) an oath asserting in part that, "No other forces than the common physical-chemical ones are active within the organism."[10] As Helmholtz saw it, the root problem with positing (nonphysical) vital forces is that they would allow for the possibility of a perpetual motion machine, in violation of the conservation of energy principle. The vitalist Hans Driesch recounted Helmholtz's reasoning as follows:

> If the Life-force could momentarily suspend the gravity of a body the latter could, without expenditure of physical energy, be raised at pleasure to any height, and then, when its gravity was restored, be rendered capable of accomplishing any amount of work desired. If the Life-force could momentarily abolish the chemical attraction of carbon to oxygen, then carbonic acid could be decomposed similarly without any consumption of energy, and the liberated carbon would be capable of new work.[11]

The idea that the conservation laws entail **Completeness** has thus been historically influential. It also has several prominent contemporary defenders; here I mention two. In *Consciousness Explained*, while making his case against interactionist dualism, Daniel Dennett writes,

> No physical energy or mass is associated with [nonphysical minds]. How, then, do they get to make a difference to what happens in the brain cells they must affect, if the mind is to have any influence over the body? A fundamental principle of physics is that any change in the trajectory of any physical entity is an acceleration requiring the expenditure of energy, and where is this energy to come from? It is this principle of the conservation of energy that accounts for the physical impossibility of 'perceptual motion machines,' and the same principle is apparently violated by dualism.[12]

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[9] The title of the pamphlet is standardly translated using "force," but Helmholtz retrospectively understood his argument to concern energy. For the development of his thinking on the point, see Elkana (1974).
[10] Hergenhahn and Henley (2013: 223).
[11] Driesch (2013: 145).
[12] Dennett (1991: 35).

Along similar lines, David Lewis in "What Experience Teaches" writes,

> if something nonphysical sometimes makes a difference to the motion of physical particles, then physics as we know it is wrong. Not just silent, not just incomplete—wrong. Either the particles are caused to change their motion without the benefit of any force, or else there is some extra force that works very differently from the usual four.[13]

2.2 Double Prevention

Turning now to my objection, I deny that the conservation laws—or, for that matter, any set of physical truths—entail **Completeness**.[14] My argument for this claim depends on causation involving absences, and more specifically the phenomenon of *double prevention*.[15] In the stock example, Bomber is on a mission to destroy Target.[16] Enemy hopes to prevent Bomber from doing so, and would succeed in shooting Bomber down if left alone. But Fighter, the escort of Bomber, shoots Enemy down, preventing Enemy from preventing Bomber from destroying Target—a double prevention. With Enemy safely out of the way, Bomber goes on to destroy Target successfully.

I claim (along with other defenders of absence causation) that Fighter's shooting down Enemy is a cause of the destruction of Target. After all, there is counterfactual dependence: if Fighter had not shot down Enemy, Target would not have been

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[13] Lewis (1990: 590). Beyond Dennett and Lewis, other philosophers who seem to take the conservation laws to rule out violations of **Completeness** include Fodor (1981), Lycan (1996), and Crane (2001). Here I am indebted to Montero (2006).

[14] Other authors who deny such an entailment include McLaughlin (1992) and Papineau (2001, 2002). They argue on different grounds than I do here; also, they endorse the inductive argument for **Completeness** that I reject in §3. See also Montero (2006) for skepticism that physics entails **Completeness**.

[15] Regarding double prevention, see for instance Hall (2000, 2004), Lewis (2000, 2004), Schaffer (2000, 2004), Gibb (2013, 2015a, 2015b), and Paul and Hall (2013).

[16] This is taken from Hall (2004: 271).

destroyed, since in that case Enemy would have shot down Bomber. And yet Fighter causes the destruction of Target without firing on Target herself, without transferring energy (or any other conserved quantity) to Target. Double prevention thus demonstrates a gap between causation and the transference of energy. We can exploit this gap to construct a scenario involving violations of **Completeness** in which all physical conservation laws are obeyed

2.3 Ectoplasm and Prevectoplasm

In doing this, I will draw on the work of Sophie Gibbs, who in a series of papers has explored a dualist view that exploits double prevention to create space for a kind of nonphysical mental causation.[17] I also will be extending an argument that I developed in a previous paper, independently of Gibb's work, in which I used a double prevention scenario to show that various higher-level truths are not deductively entailed by the set of physical truths alone.[18] **Completeness** is an example of a truth that is not so entailed, I will now try to show.

To do this, we start by considering some purely physical causal interaction here in the actual world: a cue ball collides with an 8-ball, causing the latter to speed off into the corner pocket. Now consider a world *w* that resembles the actual world in many ways but differs in that it contains the nonphysical substance ectoplasm. Ectoplasm at *w* is causally potent, often interacting with physical events. At *w*, a counterpart billiard

[17] Gibb (2013, 2015a, 2015b).
[18] (Reference Omitted).

game takes place. When the cue ball at *w* collides with the 8-ball, the ectoplasm intervenes, stopping the 8-ball in its tracks and preventing it from reaching the corner pocket.

Thus, *w* differs from the actual world with respect to particular matters of physical fact: here the 8-ball falls into the corner pocket, there it does not. But also, we can suppose, *w* differs from the actual world with respect to physical law: when the ectoplasm decelerates the 8-ball at *w*, it reduces the overall energy of the physical realm there, in violation of the conservation of energy law that holds in our world. I take this sort of violation of (actual) physical laws to be a logical possibility.

Finally, consider a third world *w** that is completely physically indiscernible from the actual world but contains *two* nonphysical substances, ectoplasm and prevectoplasm. When the cue ball at *w** collides with the 8-ball there, the ectoplasm is about to intervene and prevent the 8-ball from reaching the corner pocket, just as happens at *w*. But the prevectoplasm at *w** prevents this from happening—a double prevention. Acting as an 8-ball "Escort," the prevectoplasm "shoots down" the ectoplasm before it can interfere.

If it helps make the scenario more gripping, you can add or tweak details in various ways. You can think of the prevectoplasm as a nonphysical mind that wants the 8-ball to reach the corner pocket, while the ectoplasm is a distinct nonphysical mind that wants to stop this—the scenario is a battle of wills. Or you can think of ectoplasm and prevectoplasm not as distinct substances but as distinct nonphysical mental modes (property instances) within a single substance—a nonphysical mind with conflicting

desires about what it wants to happen. You can also swap out the billiard balls for physical particles moving around the pineal gland, or for other physical processes taking place elsewhere in the brain. None of this would change the key features of the scenario, although it might make for a more realistic account of mental causation.[19]

Again, *w** is *physically indiscernible* from the actual world. First, it is indiscernible with respect to all particular matters of physical fact. The 8-ball reaches the corner pocket there just as it does here. Second, we can also suppose that it is indiscernible with respect to all physical laws. To illustrate, take the conservation of energy principle. The principle is not violated at *w**, as it is at *w*, since the 8-ball at *w** is never decelerated—the prevectoplasm prevents this from happening. Now, that the principle is not violated does not by itself ensure that it qualifies as a law at *w**, since many principles or universally quantified generalizations are true while falling short of lawhood. However, if we suppose that the interaction between ectoplasm and prevectoplasm was itself governed by (nonphysical) law, so that prevectoplasm always prevents ectoplasm from interfering, then it will follow that the conservation of energy principle is not merely true at *w** but also nomologically necessary there. On this basis, I claim that the principle is a law at *w** just as it is in the actual world. Taking this result to generalize, the actual world and *w** are indiscernible with respect to which physical laws hold at them.

[19] This is essentially the view of mental causation envisioned by Gibb (2013, 2015a, 2015b), with the caveat that she denies that absences can be causes—a position we will consider in §2.4—and so frames her view as giving the mental a kind of causal relevance to the physical without causing physical effects. In effect, Gibb frames her account as a way to reconcile a kind of dualist mental causation with **Completeness**, while I have framed my argument here as showing that **Completeness** can be false even if all actual physical truths hold.

And yet, despite this complete physical indiscernibility with the actual world, the prevectoplasm is a (non-overdetermining) cause of the 8-ball falling into the corner pocket at *w**. For, if the prevectoplasm had not intervened by "shooting down" the ectoplasm, the 8-ball would not have reached the corner pocket.[20] But if the prevectoplasm is a (non-overdetermining) cause of the physical event that is the 8-ball reaching the corner pocket, then **Completeness** is false at *w**. Now, as we have seen, the totality of physical truths that obtain here in the actual world also obtain in *w**. But if all actual physical truths obtain at *w**, while **Completeness** is false there, it follows that the totality of actual physical truths do not deductively entail **Completeness**.

We can connect this result to a point familiar from discussions of what physicalism requires. Physicalism cannot require that the totality of physical truths *by themselves* entail all truths, so that any possible world that is a physical duplicate of the actual world is a duplicate simpliciter. For the physical truths are by themselves silent on whether various nonphysical entities exist, entities like ectoplasm and prevectoplasm. Instead, what physicalism plausibly requires is that all truths are entailed by the physical truths *taken together with* something like the set of negative truths, or perhaps a kind of "that's-all truth" stating that the world contains nothing

[20] *Objection*: If (as we are assuming) the conservation of energy law holds at *w**, then the 8-ball reaching the corner pocket does not counterfactually depend on the prevectoplasm intervening, since the law would have obtained even if the prevectoplasm had not intervened. *Reply*: By assumption, the conservation of energy principle holds as a law at *w** at least partly *because* there is a nonphysical law ensuring that prevectoplasm prevents ectoplasm from interfering with physical processes. Once we counterfactually suppose this nonphysical law away (by supposing the prevectoplasm had not intervened in this case), we cannot assume the conservation of energy principle would continue to hold as a matter of law.

more than what it must contain for those physical truths to obtain.[21] Indeed, perhaps the very thesis of physicalism can be equated with this entailment claim.[22]

Now, I concede that the totality of actual physical truths, taken together with a that's-all truth, deductively entail that our world does not contain ectoplasm or prevectoplasm, and in connection deductively entail **Completeness**. However, this is not the interesting, philosophically controversial result that *physics* deductively entails **Completeness**. It is the uninteresting, philosophically uncontroversial result that *physicalism* deductively entails **Completeness**, something antiphysicalists generally concede. The upshot is that attempts to run any kind of deductive argument from physics to **Completeness** are doomed.

2.4 Difference-Making vs. Production

One potential response to the preceding objection is to deny that absences are causes, and by extension to deny that double prevention is a genuine form of causation. There are, after all, competing accounts of causation. One family of theories thinks of causation in terms of *difference-making*, where this might be spelled out in terms of probability-raising, interventionist approaches based on causal modeling, counterfactual dependence, or something else.[23] Such theories differ in details but are broadly alike in

[21] This was the focus of my (omitted).
[22] See Jackson (1998), Chalmers (1996, 2012), and (omitted). Or perhaps, as Jackson and Chalmers maintain, physicalism allows that the entailment base will include indexical truths in addition to physical truths and a that's-all truth. I will ignore this complication here.
[23] On probability-raising theories, see for instance Suppes (1970) and Eells (1991); for interventionist approaches, Woodward (2003, 2009) and Hitchcock (2009); for counterfactual theories, Lewis (1973, 2000).

various ways, including that they tend to be friendly to absence causation. If prevectoplasm had not intervened, the 8-ball would not have reached the corner pocket. Here I invoke counterfactual dependence to suggest prevectoplasm makes a difference to—and thus causes—the given physical effect.

But another family of theories thinks of causation in terms of *production*, where a leading way to spell this out is in terms of *physical processes* like those involving the exchange of conserved physical quantities—the focus of Phil Dowe's account.[24] Dowe denies that absences are causes and effects on the grounds that they don't exchange such quantities, and so he denies that double prevention is a genuine causal relation.[25] On this sort of view, the prevectoplasm in my scenario does not qualify as a genuine cause of the 8-ball reaching the corner pocket, and so the scenario involves no violation of **Completeness**. In that case, my argument fails.

In response, I am willing to endorse the difference-making conception of causation and treat it as a premise of my argument.[26] The difference-making approach is, for better or worse, presently the leading way of understanding causation, with many philosophers persuaded that it is especially needed to make sense of special science

[24] Dowe (1992, 2000, 2001, 2004). Other defenders of broadly similar physical theories of causation include Aronson (1971), Fair (1979), Salmon (1984), Hall (2004), Kim (2007), and Ney (2009). I note that Fair develops his account in a way that allows for absence causation.

[25] Instead, he says double prevention is a form of 'causation*' (Dowe: 2000), or 'quasi-causation' (Dowe: 2001).

[26] Strictly speaking, my argument does not require the difference-making conception—it is for instance compatible with Fair's (1979) non-standard physical theory that allows for absence causation. But because the most familiar way to defend absence causation is in connection with difference-making views, and because I find such views plausible anyway, I am willing to make them my focus here and treat them as a premise of my argument.

causation generally, including mental causation.[27] If difference-making causation is out, perhaps mental causation is out too—even for physicalists![28]

Now, physicalism *itself* is perfectly compatible with the difference-making approach to causation. But in that case, physicalists in general should prefer that the *argument* in favor of physicalism should be neutral as well. If it turns out that the causal argument requires the rejection of the difference-making approach, this would be a very serious cost of embracing the argument, it should lead physicalists to look for some less costly alternative—something compatible with the difference-making approach.[29]

3. The Inductive Case for Completeness

3.1 Setting out the Inductive Case

A second option available to proponents of the causal argument is to hold that physics supports physicalism by virtue of supporting an *inductive* case for **Closure**. Andrew Melnyk endorses such a case in the following passage:

> [it is not true] that in order to be persuaded of the causal closure of the physical one must already be persuaded of physicalism. To see this, it is necessary only to

[27] Influential difference-making approaches to mental causation have been defended by Lepore & Loewer (1987), Yablo (1992), Loewer (2007), Woodward (2015), among others.

[28] See Schaffer (2000, 2004) for arguments that many of the causal claims advanced in the special sciences invoke absences. Loewer (2007) argues that difference-making mental causation is as much as physicalists can hope for, and that they should be content. Russo (2016) makes the empirical case that the physiological mechanisms underlying human action involve double prevention, in which case philosophers who deny that double prevention is causation will be forced to hold that mental events do not cause human actions.

[29] An anonymous referee notes that Kim (2007) acknowledges that it is the productive conception of causation rather than the difference-making one that is operative in his causal exclusion argument, which is broadly similar to the causal argument for physicalism. In that case, my argument would fail to saddle Kim with any burden he does not already willingly take on. However, there are other proponents of the causal argument for physicalism who operate with the difference-making conception, including as a paradigmatic example David Lewis—for his defense of the causal argument, see Lewis (1966), and for his counterfactual theory of causation, see Lewis (1973). In that case, my argument in this section exerts leverage on at least some proponents of the causal argument.

> review how the closure principle is evidenced. First we become persuaded, on the basis of observational evidence and ordinary canons of scientific reasoning, that various physical effects have sufficient physical causes, since the best available explanations of those effects posit physical and only physical causes; surely no assumption of physicalism is needed to take this first step. Then, employing enumerative induction, we treat these well-supported explanations as evidence that *all* physical effects have sufficient physical causes[.][30]

I will now set out two interrelated problems for this sort of inductive case for **Completeness**. Unlike with the deductive case, the inductive argument for **Completeness** does not admit of definitive refutation, and so I want to be clear in advance that I mean to allow that there may be solutions to the problems I pose. But I claim that the problems are serious and in need of a solution, and I will regard my argument as successful if I can convince the reader of that.

3.2 The Lack of Causation in Fundamental Physics

In setting out these problems, my argument appeals to the so-called *neo-Russellian* view of causation.[31] According to the neo-Russellian view, causation is not a fundamental feature of physical reality, it plays no role in fundamental physics. There are a few different lines of argument taken to support this conclusion; here I will focus on two. First, causation involves temporal asymmetry (causes at least normally precede their effects) while fundamental physical dynamical laws are time-symmetric (e.g., Newton's second law, the Schrödinger equation). Second, causation is generally taken to involve local events (e.g., striking the match caused it to light) while the fundamental

[30] Melnyk (2003: 289-290).
[31] For discussion see Russell (1913), Field (2003), Norton (2003), the essays contained Price and Corry (2007), Kutach (2013), Papineau (2013), Frisch (2014), Ney (2016), Loew (2017), and Haug (2019).

physical dynamical laws relate entire swathes of spacetime regions, like cross-sections of light cones (so, nothing fundamental distinguishes the striking of the match from anything else in the past light cone of its lighting).

Put these two points together and you get the result that from the standpoint of fundamental physics, almost any localized event in either the past or future light cone of a given effect has as much claim to "causing" that effect as any other such event does. Oswald's firing a rifle from the Texas School Book Depository has no greater claim to causing Kennedy's death in 1963 than does that 1951 publication of "Two Dogmas of Empiricism," or than does the 1993 World Series, when each of these events is described in fundamental physical terms. This result is so at odds with our intuitive conception of causation that it seems better to say there simply is no causation in fundamental physics.

Bertrand Russell notoriously took considerations like these to give us reason to reject the notion of causation altogether: "the law of causality… like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm."[32] But *neo*-Russellians today do not follow him on this. Instead, they acknowledge that causation plays a crucial role in various sciences other than fundamental physics, and so instead of eliminating it from our ontology altogether they seek to explain how causation can be "nothing over and above" fundamental physics, a derivative feature of reality in much the way physicalists in the philosophy of mind view consciousness.[33] Unfortunately, as with consciousness,

[32] Russell (1913: 1).
[33] See for instance Albert (2000) and several of the essays contained in Price and Corry (2007).

there is presently no widely accepted account of just how causation is realized by/grounded in/etc. fundamental physics. Hartry Field describes this as "probably the central problem in the metaphysics of causation."[34]

Suppose that the neo-Russellian view is right. This sets up the first problem I want to pose for the inductive case for **Completeness**. Namely, if there is no causation in fundamental physics, this significantly shrinks the base of potential evidence that might otherwise have been used to support the inductive argument. Melnyk might have hoped that fundamental physics would provide numerous positive instances of **Completeness**, and that these positive instances would support **Completeness** in the familiar way that enumerative induction works. However, if the neo-Russellian view is right, there are no such positive instances to be found in fundamental physics, for **Completeness** is a claim about causation, while causation does not figure in fundamental physics. This weakens the inductive case for **Completeness** by tossing out much of its potential evidence.

In saying this is a "problem," I want to allow that proponents of the inductive case for **Completeness** might be able to overcome it. Sometimes problems have solutions. Maybe such proponents can appeal to positive instances of **Completeness** found in domains of *non-fundamental* physics, like thermodynamics.[35] Or maybe they can appeal to positive instances of it in domains involving entities that are independently known to be physically realized/grounded/etc.—maybe this is true of parts of chemistry. At any rate, it is a serious problem that needs to be addressed somehow. In the next step

[34] Field (2003: 443).
[35] Papineau (2013) pursues this line of thought.

of my argument I set out a second problem for the inductive case, a problem that at least some attempts to solve the first problem figure to confront.

3.3 The Causal Argument Regarding Causation

If there is no causation in fundamental physics, there is then a real question of how exactly causation fits within the physical world, one analogous to that of how consciousness fits in. It would not be incoherent—even if implausible—to think that it does not fit in at all, and that causal relations have to be regarded as nonphysical additions to the world, in something like the way dualists think of consciousness. Indeed, Field attributes such a view to Nancy Cartwright, describing her position as one on which "there is some sort of causal fluid that is not taken account of in the equations of physics."[36] He dismisses such a view out of hand without explaining in detail the case against it. But physicalists need a worked-out case against it.

Now, however that case might go exactly, *it cannot take the form of a causal argument*. For, consider. There is a coherent and perhaps even compelling worry that if consciousness were nonphysical, we would be forced into the conclusion that it exists but is epiphenomenal. And there is a coherent worry that this dynamic generalizes to various other domains, so that if chemical or biological phenomena were nonphysical, we would similarly be forced into the conclusion that they exist but are epiphenomenal. However, there is no analogous coherent worry that if causation were nonphysical, we

[36] Field (2003: 443), describing Cartwright (1979).

could be forced to say that causal relations exist but are epiphenomenal. For causal relations *by their very nature* are causal, and so the worry about being forced into an unpalatable epiphenomenalism gets no grip here. Any scenario in which causation turns out to be nonphysical is a scenario in which causal relations exist outside the physical domain, not one in which causal relations exist but are not causal.

Here is one way to develop this thought further, a way I find attractive but don't take to be strictly mandatory for the sake of my argument. Take the version of the causal argument presented back in §1 and then, in order to see how the argument might even potentially be directed at causation, replace all occurrences of 'mental events' with 'causal relation tokens.' Here is the result:

> (P1): All physical events have complete physical causes (in the sense that those causes are either sufficient for or fully determine the chances of those events).
> (P2): All causal relation tokens cause physical effects
> (P3): The physical effects of causal relation tokens are not all overdetermined.
> (C): Causal relation tokens are identical with physical tokens

When faced with this version of the argument, there is reason to deny that causal relations themselves cause physical effects, and so deny (P2). The idea is that causal relations do not themselves cause effects of any sort, but rather are the glue (the "cement of the universe") by which *other* events cause effects. Suppose that striking a match causes it to light, and call the causal relation token that obtains in the case 'R.' Then R is not itself a *partial cause* of the lighting, something that helps the striking generate the lighting in the way that one friend might help another carry a couch. And R is not an *overdetermining cause* of the lighting, operating alongside the striking in the way that multiple gunshots from a firing squad might causally overdetermine a prisoner's death.

Rather, R is no cause of the lighting at all. Instead, R is what obtains because the striking (an entity distinct from R) causes the lighting.

This rejection of (P2) seems to fit especially naturally with the difference-making approach to causation that I endorsed in §2. If causal relations are to be analyzed in terms of patterns of counterfactual dependence, for instance, then it seems right to hold that such patterns of counterfactual dependence do not themselves enter into patterns of counterfactual dependence. However, there are other views of causation on which it is more natural to hold that causal relations can themselves cause effects,[37] which is why I don't want to treat the present point as strictly mandatory for my broader argument: you can agree that causal relations are not at risk of turning out to be epiphenomenal even if you accept (P2).

If this is right, there are two consequences for the causal argument for physicalism that are of note. First, it follows that the causal argument is in an important sense *incomplete*. The causal argument cannot take us all the way to physicalism *simpliciter*, all the way to physicalism for all entities, but instead must be supplemented with some separate physicalist argument that applies to causation. That is to say, the causal argument needs to be combined with some sort of *non-causal argument* for physicalism.

Second, once this non-causal argument is in place, there is a threat that it will render otiose the inductive case for **Completeness**. To illustrate the worry, consider

[37] Thanks to an anonymous referee for suggesting this point, giving as an example Anscombe's (1971) view according to which we can perceive causal relations.

what is perhaps the best known non-causal argument used to support physicalism: the argument from *simplicity*. The rough idea is that physicalists hold that nothing exists over and above the physical realm, while various antiphysicalist positions hold that this same physical realm exists while in addition so too does some nonphysical realm. But then physicalism is the simpler view and this gives us reason to favor physicalism, according to the simplicity argument.[38]

Suppose then that we respond to the fact that we cannot use a causal argument to establish physicalism about causation by instead developing a simplicity argument to establish physicalism about causation. It then seems plausible that we should be committed to endorsing simplicity arguments for physicalism across the board—not just for causation but also for consciousness, chemical phenomena, biological phenomena, geological phenomena, and so on. After all, if simplicity considerations really do give us good reason to embrace physicalism for causation, it seems like these reasons should generalize and give us good reason to embrace physicalism in these other domains as well. This seems especially plausible since simplicity arguments for physicalism are typically formulated with these other domains most in mind—they are advanced by philosophers focusing on consciousness, not causation. It is of course possible that consciousness and causation differ somehow so that simplicity arguments for physicalism succeed in the causation case but not in the consciousness case, but this would be a surprising result.

[38] Proponents of simplicity-based arguments for physicalism include Smart (1959), Brandt and Kim (1967), Churchland (1987), Hill (1991), Hill and McLaughlin (1999), McLaughlin (2007), Block and Stalnaker (1999).

But if in advancing a simplicity argument for physicalism about causation we are committing ourselves (by parity of reasoning) to endorsing simplicity arguments for physicalism across all domains, what remaining work is there for the causal argument for physicalism to do? It is as if in order to make the causal argument work, it needs to be paired up with some other argument, and this other argument is so good that it establishes the truth of physicalism all by itself without help from the causal argument.

Of course, physicalists are allowed to endorse two separate arguments for their view, one causal and one not. But in the case as we are imagining it, the non-causal argument takes a kind of epistemic priority. This is because the inductive evidence for **Completeness**, which is needed to support the causal argument, is supposed to take the form of one physical event causing another, but one physical event causing another qualifies as evidence in favor of physicalism only if causation itself is physicalistically acceptable. If it is not physicalistically acceptable—because causation itself is something nonphysical—then instances of one physical event causing another are evidence *against* physicalism, evidence *refuting* physicalism. "Here is how we refuted physicalism: we observed one physical event causing another, and noted that this causal relation was some sort of causal fluid that is not taken account of in the equations of physics" we might say, mimicking how Field describes Cartwright's view.

We can rule out this sort of antiphysicalist understanding of what is involved in one physical event causing another by establishing that causation is itself something physical via the simplicity argument. But then the causal argument taken in conjunction with the inductive case for **Completeness** turns out to depend on the simplicity

argument for physicalism in a way that the simplicity argument does not similarly depend on the causal argument combined with the inductive case. You can endorse a non-causal argument like the simplicity argument for physicalism while remaining agnostic on or even rejecting the causal argument for physicalism taken in conjunction with the inductive argument for **Completeness**, but not vice versa.

Again, it may be that proponents of the inductive argument for **Completeness** will be able to solve the problem I am setting out in this section. But it genuinely is a problem that needs a solution. In summary: How is their argument meant to apply to causation itself? If the idea is to handle causation as a special case and use some sort of non-causal argument targeting it, then why not just use that non-causal argument across the board, dropping the causal argument taken in conjunction with the inductive case for **Completeness**? These are the questions they need to answer.[39]

4. Conclusion

Papineau, in his presentation of the causal argument, emphasizes how physicalism really came into prominence in the 1950s and 1960s.[40] He suggests that this

[39] Two authors who have explored conclusions similar to mine—but not arguments similar to mine—are Ney (2016) and Haug (2019). Ney argues that there is a tension between the causal argument for physicalism and causal anti-fundamentalism. She then suggests that this gives us reason to reject anti-fundamentalism. In effect, Ney and I agree on what the decision points are in this debate, we just disagree on which decisions should be made at those points. Haug acknowledges there is a tension between the causal argument and causal anti-fundamentalism, and proposes to meet that challenge by developing two distinct but complementary arguments for physicalism: one argument that is causal and draws on evidence from various sciences, and one that is non-causal and focuses on fundamental physics. The overall view is at odds with mine, but there is at least this much agreement: I too say that the causal argument alone cannot get us all the way to physicalism, and at best can work by being supplemented with a non-causal argument.

[40] Papineau (2001, 2002).

timing reflected a growing appreciation among philosophers of the empirical evidence that was then coming in, supporting the physicalist case. This may be right, but I want to conclude by making a different point about historical timing.

Philosophical (and empirical) work on causation has made tremendous advances in recent years, including but not limited to advances in our understanding of the connections between causation and physics. This includes a new understanding of how absences show that causation can come apart from underlying physical processes, so that you can have causal relations that are not backed by the transference of energy (or other conserved physical quantities). Even in the best case scenario for the causal argument, this point is bound to complicate attempts to establish **Completeness** by appealing to conservation laws; in the worst case scenario, the point threatens to doom such attempts. The advances also include a new appreciation that there is a puzzle about how causation fits within fundamental physics, with many suspecting that at least in some sense it does not fit in at all. Again, even in the best case scenario for the causal argument, this raises serious questions about our basis for embracing physicalism about causation itself; in the worst case scenario, the answer to this question is we should drop the causal argument in favor of some noncausal alternative, like the simplicity argument. Given the leaps that have been made in our recent understanding of causation, my view is that the causal argument for physicalism no longer has the force it once seemed to have.

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