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## BETWEEN SCIENTISM AND ABSTRACTIONISM IN THE METAPHYSICS OF EMERGENCE

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Both experience and the seeming structure of the sciences suggest that some special scientific phenomena (broadly construed to include artifacts and the like) are synchronically dependent on lower-level physical phenomena, and yet are also distinct from and distinctively efficacious as compared to the lower-level physical phenomena upon which they depend. This characteristic combination of dependence and autonomy serves to motivate the notion of *metaphysical emergence* as important to understanding natural reality. Indeed, and reflecting different specific interpretations of the dependence or autonomy at issue, there is at present a great diversity of contemporary accounts of metaphysical emergence. As I'll here argue, however, many of these accounts – thankfully, not all – fail to satisfy one or both of the following criteria of adequacy:

- 1 *The criterion of appropriate contrast:* Reflecting that metaphysically emergent phenomena are supposed to be distinct from the lower-level phenomena upon which they synchronically depend, an adequate account of metaphysical emergence must provide a clear (i.e., explicit) basis for ruling out that phenomena it deems emergent can be given an ontologically reductionist treatment – that is, it must provide a clear basis for ruling out that emergent phenomena are *identical* to dependence base phenomena. Relatedly, an adequate account of metaphysical emergence must provide a clear basis for establishing that the phenomena it deems emergent are not just epistemically or representationally emergent. For example, even supposing that seemingly metaphysically emergent phenomena are always surprising to those who first encounter them, then (since being surprising is in itself compatible with being identical to some lower-level phenomenon) an account of metaphysical emergence in terms of such a response would fail to satisfy the criterion of appropriate contrast.
- 2 *The criterion of illuminating contrast:* An adequate account of metaphysical emergence must not only provide a clear basis for contrasting such emergence with ontological reduction, but moreover do so in a way that provides an illuminating – that is, explanatorily relevant – basis for understanding how such failures of reduction might occur. Relatedly, an adequate account of metaphysical emergence must provide a clear basis for the in-principle resolution of disputes over whether some phenomenon is metaphysically emergent, in a way going beyond appeal to brute intuitions or irrelevant distinctions. For example, even supposing that an oracle exists who can infallibly report whether a given phenomenon is metaphysically emergent, an account pitched in terms of such oracular pronouncements would fail to

illuminate what it is to be metaphysically emergent and so would fail to satisfy the criterion of illuminating contrast. More plausibly, an account according to which metaphysically emergent phenomena are dependent on but ontologically irreducible to lower-level physical phenomena, but which did not provide any explanatory insight into how, exactly, some dependent goings-on might be so irreducible, would lead directly to stalemate between emergentists and reductionists (e.g., with regard to the status as emergent of certain mental states), and so would fail to satisfy the criterion of illuminating contrast.

There are, of course, other important criteria of adequacy on an account of metaphysical emergence. Foremost among these is to provide a basis for accommodating the distinctive efficacy of metaphysically emergent phenomena – and moreover, to do so in a way that is able to address concerns, notably raised by Kim (in, e.g., his 1989 and 1993), according to which certain varieties of metaphysical emergence give rise to problematic causal overdetermination. Treatment of this and other criteria of adequacy is beyond the scope of this chapter, though I believe such treatment would support the methodological morals I will later draw.<sup>1</sup>

I'll start with some preliminaries (§1). I'll then discuss certain representative accounts of metaphysical emergence falling into three broad categories, assessing their prospects for satisfying the earlier criteria; the ensuing dialectic will have a bit of the Goldilocks fable about it. At one end of the spectrum are what I call 'scientistic' accounts, which characterize metaphysical emergence by appeal to one or another specific feature commonly registered in scientific descriptions of seeming cases of emergence; such accounts, I'll argue, typically fail to provide a clear basis for ensuring incompatibility with ontological reduction, and thus fail to guarantee satisfaction of the criterion of appropriate contrast (§2). At the other end of the spectrum are what I call 'abstractionist' accounts, which characterize emergence in terms floating free of scientific notions; such accounts, I'll argue, typically fail to guarantee satisfaction of the criterion of illuminating contrast (§3). I'll then look at several accounts of metaphysical emergence that are what I call 'substantive', in appealing to familiar relations or posits which are properly metaphysical, while being intelligibly connected to scientific relations and posits. As we'll see, the resources of such accounts are up to the tasks of blocking ontological reduction and of enabling investigations into metaphysical emergence to proceed in an illuminating way (§4). I close with some methodological morals (§5).

## 1. Preliminaries

I start with five preliminaries.

First, the phenomena (or as I'll sometimes put it, the 'goings-on') at issue in discussions of metaphysical emergence might be of any ontological category, including objects, systems, events, processes, properties, and tropes, and might pertain either to types or tokens of such goings-on. That said, accounts of metaphysical emergence are commonly pitched in terms of properties, on the assumption that the emergence of goings-on of diverse categories ultimately comes down, one way or another, to the emergence of properties.

Second, the notion of synchronic dependence at issue in metaphysical emergence is 'broad', in allowing for temporally extended dependence of emergent phenomena on base phenomena (as in the case, e.g., of processes). Synchronic dependence in this sense is compatible with but broader than instantaneous dependence, and is intended to contrast with diachronic dependence of the sort associated, for example, with effects as temporally posterior to causes. The dependence at issue is also typically supposed to have certain modal implications: at a minimum, it is nomologically necessary for the occurrence of a given emergent phenomenon (in worlds with the relevant laws of nature) that some dependence base phenomenon occurs, and the occurrence of

the dependence base goings-on is nomologically sufficient (again, in worlds with the relevant laws of nature), in the circumstances, for the occurrence of the emergent goings-on.

Third, discussions of metaphysical emergence typically take as a starting point the supposition that the foundational, or more foundational, goings-on upon which the emergent goings-on synchronically depend are physical. In turn, the typically operative supposition is that the physical goings-on are those that are the target subject matter of physics, modulo the caveat that physical goings-on cannot be fundamentally mental (as, e.g., a panpsychist view would have it).<sup>2</sup> Most participants to the present debate have something like this account in mind, and though there is room for further debate, such a characterization of the physical will suffice for purposes of my discussion.

The common assumption that the dependence base goings-on are physical reflects presumably contingent facts of a broadly scientific variety: as it happens, we have good reason to believe that special science goings-on broadly synchronically depend on lower-level physical goings-on. But it's worth noting that for purposes of characterizing metaphysical emergence, nothing *really* turns on the status as 'physical' of the dependence base goings-on. We can, and should, aim to make sense of what it is, or could be, for some goings-on to metaphysically emerge from some others, irrespective of whether the dependence base goings-on are physical.

Fourth, discussions of metaphysical emergence tend to suppose that the 'level' of physical goings-on includes not just the physical entities and features that are the explicit target of physics but also any and all massively complex pluralities (collections) or relational aggregates of physical goings-on. For example, suppose for the purposes of illustration that physics is atomistic, such that the basic physical entities are individual atoms and the basic physical relations are certain atomic relations holding between small numbers of atoms. The level of physical goings-on would be understood by most participants to the emergence debates to also include any and all pluralities of atoms, as well as any and all relational aggregates of atoms standing in atomic relations. Also standardly taken to be part of the lower-level physical base would be broadly logical combinations of individual atoms and groups of atoms (e.g., conjunctions or disjunctions of atomic aggregates) and linear combinations of the features of individual atoms (e.g., the mass of an aggregate of atoms would be included as among the lower-level physical properties as being just the sum of the individual masses).

Here again there is room to debate the details, not just about the extent of goings-on properly located at the physical level but more generally about how 'levels' of natural reality should be individuated. Again, not much will hinge on exactly how these questions are answered, so long as the level of physical goings-on is sufficiently inclusive that an ontologically reductionist view is not ruled out of court. Consider, for example, a middle-sized rock, and again assume an atomistic physics. If the lower level of physical goings-on fails to include complex aggregates of atoms, then there will be no substantive question of whether a reductive physicalist account of the rock makes sense: such an account will be immediately rendered false. Correspondingly, discussions of metaphysical emergence typically presuppose that we have an independent handle on what it would be for some complex entity or feature (a 'one') to exist and be properly deemed part of the lower-level physical dependence base, and the further question is: What would it come to for some special scientific entity or feature (another 'one') to depend on, yet be appropriately autonomous from, such a complex lower-level physical aggregate or feature?<sup>3</sup>

Fifth, against the operative backdrop assumption of the dependence base goings-on as physical, accounts of metaphysical emergence can be sorted into two broad categories: first, accounts on which the metaphysically emergent goings-on are physically acceptable, as per what is sometimes called 'weak metaphysical emergence'; second, accounts on which the metaphysically emergent goings are physically unacceptable, as per what is sometimes called 'strong metaphysical emergence'. In what follows I'll make clear whether a given account of emergence aims to

characterize the weak or rather the strong variety. Whether weak or strong, an account of the metaphysical emergence of some phenomenon should appropriately contrast with a reductive account of the phenomenon, on which the phenomenon is ontologically reducible to – that is, identical with – some (perhaps massively complex, etc.) lower-level physical goings-on.

## 2. Scientistic approaches to metaphysical emergence

As noted earlier, one of the primary motivations for there being metaphysical emergence comes from the sciences and the seeming combination of dependence and autonomy that frequently characterizes special scientific goings-on. As such, it is highly desirable that philosophers investigating emergence carefully attend to these data. ‘Scientistic’ accounts have the virtue of doing so, extracting features of emergence from close consideration of scientific case studies.

That said, many scientistic accounts are long on scientific detail and short on substantive metaphysical interpretation or illumination, with the ensuing accounts of emergence often doing little more than recapitulating features read off of scientific descriptions of the case studies in ways which fail to provide a principled basis for establishing the ontological irreducibility of the phenomenon at issue, and which correspondingly fail to shed illuminating light on the nature of metaphysical emergence.

### 2.1. *Unpredictability/algorithmic incompressibility*

Scientific descriptions of case studies of emergence often emphasize the ‘in-principle’ unpredictability (i.e., failure of deducibility) of the phenomena at issue, and an appeal to such unpredictability has been a frequent theme in accounts of emergence, including those aiming to characterize emergence as a metaphysical phenomenon. For example, the British Emergentist C. D. Broad offered the following account of emergence:

The emergent theory asserts that there are certain wholes, composed (say) of constituents  $A$ ,  $B$ , and  $C$  in a relation  $R$  to each other and that the characteristic properties of the whole  $R(A,B,C)$  cannot, even in theory, be deduced from the most complete knowledge of the properties of  $A$ ,  $B$ , and  $C$  in isolation or in other wholes which are not of the form  $R(A,B,C)$ .

*(Broad 1925, 64)*

Broad supposed that such in-principle failure of predictability would falsify ‘mechanism’, a variant of physicalism; hence he is appropriately seen as aiming to provide an account of strong emergence.

Now, unpredictability is an epistemological, not a metaphysical, notion, so why characterize metaphysical emergence in terms of this notion? Broad’s reason for thinking that in-principle unpredictability tracked strong emergence wasn’t bad at the time. For one way in which a metaphysically emergent phenomenon might be seen as both dependent on yet ‘over and above’ lower-level physical goings-on would be if the emergent phenomenon involved the operation of a new fundamental force, interaction, or law, which became operative only at a comparatively high level of complexity. And when Broad wrote, our best science – a relativistic variation on Newtonian mechanics – seemed to presuppose that phenomena that didn’t involve any fundamentally novel goings-on could be predicted, in principle, by means of the usual additive force

composition laws. Accordingly, cases where some composite phenomena could *not* be so predicted were thought to be indicative of the presence of a new fundamental force or interaction.

As it happens, soon after Broad offered his account of strong emergence, scientists and others came to appreciate and explore the fact that the properties and behavior of some uncontroversially physical phenomena (e.g., gases, hurricanes, and turbulent fluids) evolve via nonlinear rather than linear laws involving their lower-level physical components. Some such systems – so-called ‘chaotic’ complex systems – are highly sensitive to initial conditions, in ways entailing that even with the resources of the entire universe in hand, one would not be able to use the nonlinear laws governing such systems to predict the evolution after some period. Yet in spite of such ‘in-principle’ unpredictability, such systems are uncontroversially physically acceptable. And so an ‘in-principle failure of predictability’ account of strong emergence turned out not to be viable.

But – and here we turn to more recent accounts that are properly deemed ‘scientific’ – the advent of complex nonlinear systems did not spell the end of accounts of metaphysical emergence appealing to unpredictability. Rather, this feature became the mainstay of many accounts of emergence of the physically acceptable – that is, weak – variety.<sup>4</sup> Characteristic here is Bedau’s (1997) account, on which weak emergence is characterized as involving the absence of antecedent predictability, or ‘derivability, but only via simulation’. Bedau starts by flagging that his approach is motivated by scientific accounts of chaotic and nonchaotic nonlinear systems, as seeming cases in point of physically acceptable emergence:

An innocent form of emergence – what I call ‘weak emergence’ – is now a commonplace in a thriving interdisciplinary nexus of scientific activity [. . .] that includes connectionist modeling, non-linear dynamics (popularly known as ‘chaos’ theory), and artificial life.

(375)

As Bedau observes, such systems typically fail to admit analytic or ‘closed’ solutions. The absence of any such means of predicting the evolution of such systems means that the only way to find out what this behavior will be is by ‘going through the motions’: set up the system, let it roll, and see what happens. This refined version of unpredictability serves as the basis for Bedau’s account of weak emergence:

Where system  $S$  is composed of micro-level entities having associated micro-states, and where microdynamic  $D$  governs the time evolution of  $S$ ’s microstates: Macrostate  $P$  of  $S$  with microdynamic  $D$  is weakly emergent iff  $P$  can be derived from  $D$  and  $S$ ’s external conditions but only by simulation.

(378)

The broadly equivalent conception in Bedau (2002) takes weak emergence to involve algorithmic or explanatory ‘incompressibility’, where there is no ‘short-cut’ means of predicting or explaining certain features of a composite system. In being derivable by simulation from a microphysical dynamic, weakly emergent phenomena are understood to be physically acceptable; as Bedau (1997) says, such systems indicate “that emergence is consistent with reasonable forms of materialism” (376). And as one concrete illustration of the targeted variety of emergence he offers the property of being a glider gun in Conway’s well-known Game of Life.

Now, for purposes of characterizing a form of metaphysical emergence, the problem with Bedau's account is that it is unclear why unpredictability in the sense at issue would rule out the ontological irreducibility of the unpredictable phenomena. Indeed, Bedau encourages such a reductive reading when he says that "weakly emergent phenomena are ontologically dependent on and reducible to microphenomena" (2002, 6), and later, that "the macro is ontologically and causally reducible to the micro in principle" (2008, 445). As such, an 'algorithmic incompressibility' account of weak emergence fails to satisfy the criterion of appropriate contrast.

Notwithstanding said compatibility with reductionism, Bedau maintains that emergence on his account is not just epistemological but is also metaphysical – a challenge that might be seen as tacitly aimed at denying that the criterion of appropriate contrast is appropriately applied. He offers two reasons for thinking that emergence on his account is properly metaphysical. The first is that the incompressibility of an algorithm or explanation is an objective fact:

The modal terms in this definition are metaphysical, not epistemological. For  $P$  to be weakly emergent, what matters is that there is a derivation of  $P$  from  $D$  and  $S$ 's external conditions and any such derivation is a simulation. [. . .] Underivability without simulation is a purely formal notion concerning the existence and nonexistence of certain kinds of derivations of macrostates from a system's underlying dynamic.

(1997, 379)

But such facts about the absence of incompressible derivations or explanations, though objective and hence in some broad sense 'metaphysical', are not suited to ground the metaphysical autonomy of emergent goings-on. It's not clear that anything answering to 'autonomy' is associated with algorithmic incompressibility; in any case, insofar as such compressibility is compatible with ontological reduction, any such autonomy would attach not to the phenomena at issue, but rather to what it would take to predict or explain the phenomena, with knowledge about future states being in some sense epistemically 'autonomous' from knowledge about present states. Again, these are epistemic notions, with no clear bearing on the nature of metaphysical emergence.

Bedau also suggests that emergence on his account is properly metaphysical since the non-linear phenomena at issue typically instantiate macro-patterns. But first, incompressibility isn't either necessary or sufficient for the occurrence of a macro-pattern, so even if the occurrence of a macro-pattern is in some sense a metaphysical fact, the connection to Bedau's official account of emergence is unclear. Second, and more importantly, the mere presence of a macro-pattern isn't enough to establish ontological and causal autonomy. For ontological reductionists are happy to allow that there are macro-patterns – they just insist that these are ontologically reducible to complex configurations of micro-phenomena. Sure, they will reasonably say, nonlinear complex systems seem to manifest macro-patterns – that's why they are candidates for being emergent. But why think that there is anything metaphysically as opposed to epistemologically real about the phenomenon of macro-patterns? Bedau never addresses or answers this question; hence, an appeal to macro-patterns doesn't clearly establish that his account of emergence is properly metaphysical, either by lights of blocking ontological reduction (as per the criterion of appropriate contrast) or by any other lights.

Relatedly, the presence of seemingly autonomous macro-patterns is the starting point of most investigations into metaphysical emergence. What is primarily at issue in debates over the status of some phenomena as genuinely metaphysically emergent is precisely whether the appearances of seeming macro-patterns can be taken at face value or whether, contrary to appearances, the



phenomena are ontologically reducible to some or other lower-level goings-on. Correspondingly, an account based in a bare appeal to the advent of macro-patterns fails to provide any substantive basis for resolving the dispute at issue, and so violates the criterion of illuminating contrast.

## **2.2. *Universality/stability under perturbation***

Another scientific approach to emergence adverts to certain other scientifically interesting features of nonlinear complex systems – notably, that such systems exhibit universality, reflected, for example, in the behavior of systems undergoing phase transitions being characterized by a small set of dimensionless ‘critical exponents’. As Batterman (1998) motivates the approach:

What is truly remarkable about these numbers is their universality [. . .] the critical behavior of systems whose components and interactions are radically different is virtually identical. Hence, such behavior must be largely independent of the details of the microstructures of the various systems. This is known in the literature as the ‘universality of critical phenomena’.

(198)

More generally, in a series of papers, Batterman (2011, 1998, 2000, 2011) has offered an account of emergence as involving universality of certain features, or stability of certain behaviors under perturbation (for short, ‘stability’). As Batterman notes, universality and stability are two sides of the same coin; “most broadly construed, universality concerns similarities in the behavior of diverse systems” (Batterman 2000, 120).

Now an account of emergence as involving universality/stability is naturally given a metaphysical interpretation, and some commentators have read Batterman this way (see, e.g., Menon and Callender 2013). On the other hand, Batterman himself disavows concern with questions of ontological reduction or nonreduction, focusing rather on what is required if the critical behaviors of systems exhibiting universality are to be explained, with his key insight being that, for such systems, neither theoretical derivations nor causal-mechanical considerations can do this explanatory work. Reflecting this focus, Morrison (2012, 143) reads Batterman as offering an ‘explanatory’ account of emergence.

That Batterman’s account of emergence is open to both metaphysical and epistemological interpretations is symptomatic of a tendency in scientific accounts to follow scientists and scientific descriptions of case studies in often failing to properly track epistemological and metaphysical distinctions. Be this conflation as it may, and independent of exegesis of Batterman’s work, in any case it is common for both scientists and philosophers of science to appeal to features such as universalizability and stability under perturbation as characteristic of emergence of a weak (physically acceptable) variety (see, e.g., Wimsatt 1996; Klee 1984).

Any such accounts are, however, open to the charge that they fail to provide a clear basis for blocking ontological reduction. The difficulty here can be brought out by observing that universality and stability are close cousins of multiple realizability, which notion has played a large role in the metaphysics of mind; and as debates in the metaphysics of mind concerning the import of multiple realizability reveal, a mere appeal to universal or stable features of seemingly emergent goings-on is in itself insufficient to establish the distinctness of such goings-on. In that debate, non-reductive physicalists initially aim to block type-reduction of mental to physical states by appealing to multiple realizability, with the idea being that if mental state types are multiply realizable, they cannot be identified with any single physical state type. But reductionists respond with various strategies for accommodating multiple realizability. Perhaps the most popular is to

grant that such multiple realizability shows that certain mental state types cannot be identified, one to one, with individual physical state types but to maintain that this much is compatible with every multiply realizable mental state type being identical to a disjunction of physical realizer state types. Nonreductionists have a number of responses, which include rejecting disjunctive properties, denying that disjunctive properties track genuine natural kinds, and the sort of response that I will discuss down the line. But in any case insofar as scientific accounts appealing to universalizability/stability fail to address or respond to reductionist strategies for accommodating these features, they fail to provide a clear basis for blocking ontological reduction, and so fail to satisfy the criterion of appropriate contrast.

Relatedly, insofar as reductionists and emergentists can agree that seemingly higher-level goings-on are multiply realizable/universal/stable under perturbation, compatible with their contrasting views, accounts of metaphysical emergence in terms of these features fail to provide an illuminating basis for resolving debate over the emergent status of a given phenomenon, and so also fail to satisfy the criterion of illuminating contrast.

### 3. Abstractionist approaches to emergence

At the other end of the spectrum from scientific approaches are abstractionist approaches, on which metaphysical emergence is characterized in abstract modal or primitivist terms. As I'll now argue, these approaches also fail to guarantee satisfaction of one or both of the operative criteria.

#### 3.1. Modal accounts of strong emergence

As noted earlier, core to the notion of metaphysical emergence is that emergent goings-on broadly synchronically depend on base goings-on, in that, at a minimum, the occurrence of the emergent goings-on nomologically requires the occurrence of some dependence base goings-on, and the dependence base goings-on are nomologically sufficient, in the circumstances, for the occurrence of the emergent goings-on. This minimal characterization is pitched in modal correlational terms; in the lingo of supervenience, emergent goings-on supervene with at least nomological necessity on base-level goings-on. Modal accounts of emergence take a page from this sort of minimal specification, aiming to characterize strong emergence in terms of a difference in the strength of modal correlations holding between goings-on that are or are not strongly emergent on lower-level physical goings-on.

More specifically, on modal accounts, strongly emergent goings-on are taken to supervene with nomological, but not metaphysical, necessity on base goings-on. For example, van Cleve (1990) characterizes emergence of the sort intended to contrast with physicalism as follows:

If  $P$  is a property of  $w$ , then  $P$  is emergent iff  $P$  supervenes with nomological necessity, but not with logical necessity, on the properties of the parts of  $w$ .

(222)

Similarly, Chalmers (2006) characterizes the strong emergence of consciousness as involving nomological, but not metaphysical, supervenience:

[C]onsciousness still supervenes on the physical domain. But importantly, this supervenience holds only with the strength of laws of nature (in the philosophical jargon, it is natural or nomological supervenience).

(247)



Similar positions are endorsed by Witmer (2001), Noordhof (2010), and others.

A modal account of strong emergence is problematic, however. Consider Lewis's (1966) position, according to which mental states are functionally specified states that are identical to the normal lower-level occupiers of those states. Now, according to Lewis, the powers of lower-level states are contingent, varying with laws of nature. Hence, it might be that in worlds with laws of nature similar to ours, every instance of mental state *M* is identical to an instance of lower-level physical state *P*, but that in worlds with different laws of nature, physical state *P* has different powers not suitable unto occupying the functional role associated with *M*. In other words, on Lewis's view, *M* might supervene with nomological, but not metaphysical, necessity on lower-level physical goings-on. Nonetheless, as per Lewis's calling his view an 'identity theory', this view is ontologically reductive. Hence, a modal account of strong emergence fails to satisfy the criterion of appropriate contrast.

A modal account also fails to satisfy the criterion of illuminating contrast, not just because mere nomological supervenience is compatible with ontological reduction but also because metaphysical supervenience is compatible with emergence of an 'over and above' (i.e., strong) variety. This last would be the case if, for example, a consistent Malbranchean God brings about certain higher-level features upon the occasion of certain lower-level features in every possible world; or if features are essentially constituted by (all) the laws of nature into which they directly or indirectly enter; or if some strongly emergent features are grounded in nonphysical fundamental interactions and all the fundamental interactions are unified.<sup>5</sup> Correspondingly, disputants might agree on whether some goings-on satisfy the modal conditions, yet disagree about whether the goings-on are strongly emergent. In all such cases, a modal account fails to shed illuminating light on the phenomenon of metaphysical emergence.

The deeper diagnosis of these problems lies in the attempt to use modal correlations as a 'stand-in' for a properly metaphysical distinction. The underlying motivation for a modal account of strong emergence lies in the natural thought that strongly emergent phenomena involve some relation associated with laws of nature, by way of contrast with more intimate relations such as identity or the determinable–determinate relation, whose holding is not thought to hinge on laws of nature. But even if one's independent commitments (e.g., to the contingency of laws of nature) do ensure that there is a modal difference between relations that do, and relations that don't, hinge on laws of nature, it is the substantive distinction between relations, not the distinction between modal correlations, which is doing the work of illuminating the phenomenon of emergence.

### **3.2. Primitivist approaches to emergence**

A second abstractionist approach appeals, one way or another, to a primitive conception of metaphysical dependence, as per the notion of 'Grounding' recently advanced by Fine (2001), Schaffer (2009), and Rosen (2010), among others, understood as holding either between worldly items (Schaffer) or facts/propositions (Fine, Rosen).

#### *3.2.1. A Grounding-based approach to weak emergence*

Proponents of Grounding typically stipulate, first, that Grounding is operative in any and all contexts where the idioms of metaphysical dependence (e.g., 'in virtue of', 'nothing over and above') are operative, and second, that Grounding has the formal features of a partial order: Grounding relations are irreflexive, asymmetric, and transitive. These features together might be thought to motivate a Grounding-based account of weak emergence, according to which any broadly

synchronic case of Grounding is one involving weak emergence. Such an account of metaphysical emergence is inadequate, however, in failing to satisfy either of our two operative criteria.

To start, notwithstanding the stipulation that Grounding is a partial order, the account does not clearly block ontological reduction; for as noted earlier, it is also stipulated that Grounding is operative in any and all contexts where the idioms of metaphysical dependence ('nothing over and above') are operative; and in these contexts, one of the most common understandings of nothing-over-and-aboveness is in terms of *identity*, as per reductive physicalism. If Grounding is indeed operative in 'any and all' such contexts, then it is compatible with ontological reduction, in which case a Grounding-based account of weak emergence fails to satisfy the criterion of appropriate contrast.

The proponent of Grounding might respond by revising their ostensive characterization of Grounding to apply only to *nonreductive* contexts where the idioms of dependence are operative. But as the debate between reductive and nonreductive physicalists shows, there is no agreement about which contexts are reductive and which aren't. Hence, there's no ostensive route to a primitive posit of nonreductive Grounding, nor to a Grounding-based account of weak emergence.

The upshot is that a Grounding-based account of weak emergence will satisfy the criterion of appropriate contrast only at the expense of failing to satisfy the criterion of illuminating contrast; for in the absence of any independent handle on Grounding *qua* primitive nonreductive metaphysical dependence relation, a Grounding-based account will foreseeably lead to immediate stalemate between those weak emergentists and their ontologically reductive opponents.

### 3.2.2. *Grounding-based approaches to strong emergence*

Might primitive Grounding do better as a basis for characterizing strong emergence? There are a couple of strategies by which one might aim to develop such an account, but as I'll now argue, none succeeds.

One strategy would be to characterize strong emergence as involving a failure of Grounding. But a failure of Grounding is – at least going by what its original proponents have said – compatible with either an antirealist eliminativist stance concerning the non-Grounded goings-on or with a realist strong emergentist stance with regard to the non-Grounded goings-on. Before one can settle on a metaphysical interpretation, one must look to the specific reasons for the supposed failure of Grounding, but *qua* thinly described primitive, Grounding is silent on these reasons. Hence, such an account will fail to guarantee satisfaction of the criterion of appropriate contrast (see Wilson 2014 for further discussion).

Yet more problematically, if Grounding corresponds to metaphysical dependence, then a failure of Grounding corresponds to a failure of metaphysical dependence. But it is a live position with regard to strongly emergent phenomena that these are, while over and above lower-level physical phenomena, nonetheless *partially*, though not completely, metaphysically dependent on lower-level physical phenomena (see Wilson 2002). In response, the proponent of a Grounding-based characterization of strong emergence might introduce a notion of partial Grounding and move to an account of strong emergence as involving a failure of full *or partial* Grounding. But it is unclear how to add partial Grounding to the mix without introducing additional primitives, thus rendering the account incapable of satisfying the criterion of illuminating contrast.

To see this, first note that one cannot define full Grounding in terms of primitive partial Grounding, by analogy with accounts taking proper parthood as primitive and defining improper parthood in terms of identity (such that  $P$  is a part of  $Q$  iff  $P$  is a proper part of  $Q$  or  $P$  is identical with  $Q$ ); for fully Grounded goings-on may be distinct from Grounding goings-on.<sup>6</sup>

Nor (as noted by Leuenberger, 2015) can a proponent of Grounding define partial Grounding in terms of primitive full Grounding, with  $X$  being a partial Ground of  $Z$  iff there is some  $Y$  such that

X and Y fully Ground Z. For this move problematically imports a conjunctive or weak supplementation structure to dependence. As Fine (2012) notes, “a partial ground need not always be part of a full ground” (53). More specifically: perhaps truth is an unsupplementable component of knowledge (Williamson 1995); the soul is an unsupplementable constituent of a person (Brentano 1874), open interiors are unsupplementable proper parts of closed regions (Whitehead 1929), determinables are unsupplementable constituents of determinates (see Wilson 2017 for discussion), and physical goings-on are unsupplementable dependence bases for strongly emergent features (see Wilson 2016a).

The upshot is that the ‘partial dependence strategy’ for accommodating strong emergence on a Grounding-based view will require a second ‘partial Grounding’ primitive – and likely a third, corresponding to the unexplained relation between full and partial Grounding. Such a plethora of primitives is ontologically costly. More importantly for present purposes, a conception of metaphysical emergence in terms of multiple primitives is incapable of shedding any light on or providing a basis for resolving disputes over metaphysical emergence, and hence fails to satisfy the criterion of illuminating contrast.

### 3.2.3. *Primitive fundamentality and primitive dependence*

One last abstractionist approach is worth considering – namely, Barnes’s (2012) ‘meta-ontological’ account of emergence, according to which emergent goings-on are those which are both fundamental and dependent, and where the notions of fundamentality and dependence are each primitive. Barnes does not distinguish between strong and weak forms of metaphysical emergence in her discussion, but in appealing to fundamentality her account plausibly aims to characterize emergence of the strong, ‘over and above’ variety. In characterizing strongly emergent goings-on as fundamental, this account is a step in the right direction. In particular, such a characterization, if it makes sense, clearly blocks ontological reduction, thus satisfying the criterion of appropriate contrast: if some goings-on are fundamentally novel vis-à-vis the goings-on upon which they depend, then the former are clearly not identical to the latter.

The problem is that such an abstract characterization doesn’t clearly make sense of strong emergence. An initial concern is that such a characterization is at odds with a common understanding of independence as core to our understanding of fundamentality:

[I]ndependence is a – the – central aspect of our notion of fundamentality. Things that are [fundamental] do not depend on anything else.

*(Bennett 2017)*

Even if one denies, as I do, that independence is core to our understanding of fundamentality on grounds that there are cases of fundamental structure on which the fundamental goings-on are self-dependent or mutually dependent (see, e.g., Wilson 2014; Bliss 2014; Tahko forthcoming),<sup>7</sup> these cases don’t involve positing fundamentality both at low levels and at higher levels of compositional complexity. Hence it is that an understanding of strong emergence as combining dependence with fundamentality is the traditional starting point of discussions of strong emergence (to be discussed in more detail shortly), with the bulk of effort devoted to filling in the operative notions of dependence and fundamentality so as to illuminate how these characteristics could be jointly instantiated.<sup>8</sup>

An account of strong emergence on which the operative notions of dependence and fundamentality are each taken to be primitive goes no distance towards illuminating how this could be. Even if what makes it the case that some goings-on are fundamental at a given world is a primitive matter

(in that, following Wilson 2014, the fundamental goings-on are analogous to metaphysical axioms or postulates), in combination with a primitivist account of dependence, the resulting conception of strong emergence is simply too abstract to provide a clear basis for establishing that such emergence is metaphysically coherent (a necessary condition of satisfying the criterion of appropriate contrast), much less for illuminating the nature of metaphysical emergence or for allowing debate to proceed in substantive fashion (as per the criterion of illuminating contrast).<sup>9</sup>

#### 4. Substantive accounts of metaphysical emergence

I turn now to considering several cases in point of what I call ‘substantive’ accounts of metaphysical emergence. As I’ll argue in what follows, in each of these accounts there is sufficient substance in the operative characterizations of emergence to provide a clear basis for satisfaction of the criteria of appropriate and illuminating contrast.

##### 4.1. Substantive accounts of weak emergence

Substantive accounts of weak emergence are frequently pitched as accounts of ‘realization’ of one form or another and are typically advanced in service of establishing the viability of ontologically nonreductive physicalism, either as a general thesis or with regard to a specific phenomenon. In what follows, I’ll use ‘nonreductive realization’ and ‘weak emergence’ as synonyms.

###### 4.1.1. Functional realization accounts

The original account of nonreductive realization was one according to which higher-level features are associated with certain functional roles, which roles are played or implemented on any given occasion by some lower-level physical feature, and where a functional role consists in a characteristic syndrome, so to speak, of typical causes and effects. Higher-level features, so understood, are functionally realized by lower-level features.

An early version of the view was proposed in Putnam (1967):

We shall discuss ‘Is pain a brain state?’ [. . .] I shall, in short, argue that pain is not a brain state, in the sense of a physical-chemical state of the brain (or even the whole nervous system), but another *kind* of state entirely. I propose the hypothesis that pain, or the state of being in pain, is a functional state of a whole organism.

(53–54)

Putnam suggested that the functional role of pain was along the following lines:

[T]he functional state we have in mind is the state of receiving sensory inputs which play a certain role in the Functional Organization of the organism. This role is characterized, at least partially, by the fact that the sense organs responsible for the inputs in question are organs whose function is to detect damage to the body, or dangerous extremes of temperature, pressure, etc., and by the fact that the ‘inputs’ themselves, whatever their physical realization, represent a condition that the organism assigns a high disvalue to. [. . .] [T]his does not mean that the Machine will always *avoid* being in the condition in question (‘pain’); it only means that the condition will be avoided unless not avoiding it is necessary to the attainment of some more highly valued goal.

(57)

Putnam's talk of 'the Machine' reflects the analogy motivating a functionalist treatment, of a software program which can be run or implemented on any number of hardware systems. Relevantly similar accounts of functional realization have been advanced by Fodor (1974), Papineau (1993), Antony and Levine (1997), Melnyk (2003), among many others.

In picking up on, developing, and applying the idea that multiple hardware systems may implement the instructions associated with a given piece of software, there is a sense in which functional realization accounts appeal to the same phenomenon underlying scientific appeals to universality and stability under perturbation – that is, multiple realizability. However, in highlighting that the basis for the universality/stability/multiple realizability reflects the association of the higher-level feature with a specific functional role, functional realization accounts introduce certain metaphysically substantive posits which, in turn, provide a principled basis for blocking ontologically reductive strategies for accommodating multiple realizability.

Here's how. To start, if a feature (e.g., pain) is associated with a functional role, then it is associated with certain powers – in particular, powers to give rise to certain effects (e.g., grimacing) when in certain circumstances.<sup>10</sup> Philosophers disagree on how best to understand powers; they disagree, for example, about whether properties and powers are associated with nomological or rather metaphysical necessity. But as we will see, nothing in the weak emergentist strategy to come hinges on this or other controversial issues in the metaphysics of properties.

So, a higher-level functionally realized feature  $F$  will be associated with a distinctive set of powers, reflecting the 'forward-facing' aspects of its functional role. Now on the assumption that  $F$  is physically acceptable (as the weak emergentist assumes), every such power of  $F$  on any given occasion of  $F$ 's instantiation will be numerically identical with a token power of whatever lower-level physical feature  $P$  realizes  $F$  on that occasion. But importantly,  $F$  will not inherit *all* of  $P$ 's powers. Again, recall the motivating software/hardware analogy. Here the realizing systems are similar in each having whatever powers are needed to implement the software, but are different in having other powers associated with their distinctive hardware bases. More generally, in cases where a type of functionally characterized higher-level feature is multiply realized, it is plausible that each of its realizing types will have all of the powers associated with its functional role, and more besides. Correspondingly, a proper subset relation will hold between the powers of the realized type and those of any of its realizing types (for discussion, see Wilson 1999).

Also importantly, this subset relation between powers will hold not just between higher-level and lower-level types but will also hold on any occasion of realization involving tokens of the types (see Wilson 2015). Again, attention to the powers of the features involved lights the way. To start, a type of functionally realized feature has a distinctive set of powers – namely, those tracking the effects characteristic of its functional role; and as just argued, any lower-level realizer of such a functionally realized feature will have these powers, and more. Now if a token of this functionally realized type were to be identical with a token of its realizing type on a given occasion, then the token of the functionally realized type would have token powers not associated with its type. But that would be a reason for denying that the token was an instance of the functionally realized type! Correspondingly, an account of weak emergence in terms of functional realization blocks ontological reduction at both the level of types and the level of tokens of the features involved, and hence satisfies the criterion of appropriate contrast.

A functional realization account of weak emergence also illuminates the nature of (this form of) weak emergence in a way that allows debate to proceed in conformity to the criterion of illuminating contrast. Is a given seemingly emergent feature associated with a distinctive functional role? Relatedly, can a functional role capture all the distinctive characteristics of the seemingly emergent feature? If so, can the role be implemented by multiple lower-level physical systems in

such a way as to support taking a proper subset relation between powers to be in place? Even if the higher-level feature is not multiply realizable, are there other ways (e.g., by appealing to distinct systems of laws) to establish that a proper subset relation between powers is in place? Here it is worth noting that in answering these questions, a functional realization account can appeal to special science laws in ways reflecting that, notwithstanding that functional realization is a properly metaphysical relation in being generally applicable to a wide range of phenomena (including broadly mathematical phenomena of the sort associated with software programs and the like), this relation is nonetheless intelligibly connected to the more specific causal roles encoded in special science laws. An account of weak metaphysical emergence as based in functional realization thus does not float free of, but rather encodes and generalizes, the special scientific considerations that motivate attention to metaphysical emergence in the first place.

#### 4.1.2. *Determinable-based accounts*

Next, consider accounts of nonreductive realization appealing to the determinable–determinate relation, the relation of increased specificity paradigmatically holding between properties such as *being red* (as determinable) and *being scarlet* (as determinate) or *being shaped* (as determinable) and *being rectangular* (as determinate).<sup>11</sup> On determinable-based accounts of the sort advanced by MacDonald and MacDonald 1986, Yablo 1992, and Wilson 1999, the suggestion is that higher-level features are nonreductively realized by lower-level features specifically in being determinables of lower-level physical determinates. Here again the appeal to a substantive metaphysical posit provides the basis for satisfaction of the criteria of appropriate and illuminating contrast.

To start, as with functionally realized features, there is a case to be made that the causal powers associated with determinable features are a proper subset of those of their realizing determinate features at both the type and token levels (see Wilson 1999). Like other broadly scientific features, determinable features are plausibly taken to be associated with a distinctive set of powers. For example, if a patch is red, it has the power to get a pigeon, Sophie, who is trained to peck at any red patch, to peck at it. Now, determinable properties, like functionally realized properties, can be multiply ‘determined’: a red patch might be scarlet, or burgundy, or crimson. Each of the distinct determinates of a determinable will share the powers of the determinable – a scarlet patch has the power to get Sophie to peck at it, as does a crimson patch, and so on. But these determinate features will have powers associated with their more determinate nature that the determinable feature does not have. For example, a scarlet patch has the power to get Alice, a pigeon trained to peck only at scarlet patches, to peck at it, whereas a red patch does not have this power (since a red patch might be crimson, not scarlet). So, determinable features plausibly have a proper subset of the powers of their associated determinates. And here again, this proper subset relation will be preserved when determinable and determinate are instantiated, on pain of undercutting the supposition that the determinable is instantiated. Consequently, an account of weak emergence as involving the determinable–determinate relation satisfies the criterion of appropriate contrast.

A determinable-based account also satisfies the criterion of illuminating contrast in characterizing weak emergence in terms of a metaphysical relation with which we are experientially and theoretically familiar. This is not to say, of course, that a determinable-based account is correct. Indeed, debate over the status of determinable-based realization has been vigorous and substantive, proceeding largely via attention to the question of whether, given the characteristic features of the determinable–determinate relation, it really makes sense to see mental or other higher-level features as determinables of lower-level physical determinates (see, e.g., Ehring 1996; Walter 2006; Worley 1997; Funkhouser 2006; see Wilson 2009 for replies). The jury is still out, but what is crucial for present purposes is that such debate



has been able to proceed precisely because we do have an independent and substantive handle on the relation between determinables and determinates.

## **4.2. Substantive accounts of strong emergence**

### **4.2.1. Fundamental powers, forces, interactions, and laws**

Though, as previously, the British Emergentists sometimes characterized strong emergence in terms of ‘in-principle unpredictability’, they did so not because they thought emergence was at bottom an epistemological phenomenon, but because they thought that in-principle epistemic gaps were a reliable criterion of fundamental novelty at the level of the emergent goings-on. Though their epistemological criterion turned out to be unsuited for this purpose, still intact is the conception of British Emergentism as “the doctrine that there are fundamental powers to influence motion associated with types of structures of particles that compose certain chemical, biological, and psychological kinds” (McLaughlin 1992, 52), where the powers at issue might be thought to “generate fundamental forces” (71), or more generally, fundamental interactions. A related concept is one according to which emergent features are governed by fundamental laws (tracking or otherwise associated with having new powers to produce fundamental forces, etc.), as in Broad’s (1925) remarks:

[T]he law connecting the properties of silver–chloride with those of silver and of chlorine and with the structure of the compound is, so far as we know, an unique and ultimate law.

(64–65)

Several contemporary accounts of strong emergence similarly appeal to fundamentally new powers, forces, or laws. So, for example, Silberstein and McGeever (1999) understand emergent features as having irreducible causal capacities (that is, fundamentally new powers) of the sort that would undermine physicalism:

Ontologically emergent features are neither reducible to nor determined by more basic features. Ontologically emergent features are features of systems or wholes that possess causal capacities not reducible to any of the intrinsic causal capacities of the parts nor to any of the (reducible) relations between the parts.

(186)

And O’Connor and Wong (2005) characterize strongly emergent features as conferring fundamentally novel powers:

[A]s a fundamentally new kind of feature, [an emergent feature] will confer causal capacities on the object that go beyond the summation of capacities directly conferred by the object’s microstructure.

(665)

Finally, Wilson (2002) suggests that strong emergence involves the coming into play of a new fundamental interaction.

As with substantive accounts of weak emergence, substantive accounts of strong emergence introduce resources that provide a basis for satisfying the criteria of appropriate and illuminating

contrast by explicating how it can or could be that some goings-on are both fundamental and dependent.

First, in many and indeed perhaps all of these accounts, the explanatory basis at issue will plausibly ultimately advert to the notion of a power, comparatively neutrally understood (as noted earlier). We have previously seen that both functionalist and determinable-based accounts of weak emergence block reduction by taking the higher-level features at issue to have a proper subset of the powers of their realizers on any given occasion. In being associated with only a proper subset of powers of their realizers, weakly emergent features are nonfundamentally novel. By way of contrast, substantive accounts of strong emergence take such emergence to involve posits that plausibly entail that the higher-level features at issue have novel powers – powers that their lower-level physical realizers do not have – which in turn provide a basis for the usual supposition (again, tracing back at least to the British Emergentists) that strongly emergent features are fundamentally novel. For example, insofar as laws of nature pertaining to some goings-on register what these goings-on do when in certain circumstances, such laws are plausibly seen as registering what powers are associated with those goings-on; hence, the supposition that strong emergence involves fundamentally novel laws is appropriately seen as entailing that strongly emergent features have new powers – powers that their lower-level physical goings-on do not have. Similarly for views on which strong emergence involves fundamentally novel features, with powers to produce new forces, and the like.

To be sure, there has been debate over whether it really makes sense to attribute novel powers to dependent goings-on, with the charge being that any such powers will ‘collapse’, one way or another, so as to be possessed by the dependence base goings-on (see, e.g., van Cleve 1990; Howell 2009; Taylor 2015). However, here again there is sufficient metaphysical content to the operative account(s) of emergence for debate to proceed, and as discussed in Baysan and Wilson (2017), there are several available means of responding to the collapse objection (one of which is to relativize strong metaphysical emergence to sets of interactions and powers associated with these interactions, as I will later discuss).

Moreover, this feature – the having of at least one new power – is compatible with strongly emergent features’ being dependent on lower-level physical features, whether this dependence is cashed in terms of minimal nomological necessitation or in some stronger terms (e.g., a view on which strongly emergent goings-on share some of the token powers of their physical dependence bases). Such a powers-based explication, it seems to me, provides a reasonable basis for taking strong emergence as coupling dependence with fundamentality to make sense, and moreover to do so in a way that clearly blocks ontological reduction. Thus, a ‘new power’ conception of strong emergence plausibly satisfies the criterion of appropriate contrast. Moreover, since we have in hand working means of exploring whether fundamentally novel laws or features and associated novel powers are in place, substantive debate can proceed, as it in fact has (as in, e.g., O’Connor 2002; Chalmers 2003), over whether a given phenomenon is strongly emergent.

Second, an approach to strong emergence as involving a novel fundamental interaction (as per Wilson 2002) provides a yet clearer means of explicating the joint compatibility of fundamentality and broadly synchronic dependence. Consider, by way of illustration, the weak nuclear interaction. This interaction was originally posited as a novel fundamental interaction whose operation broadly synchronically depends on certain other phenomena (i.e., certain complex nuclear arrangements and associated fundamental interactions). Correspondingly, the weak nuclear interaction is, or in any case clearly could have been, an actual case of a fundamental feature of natural reality that broadly synchronically depends on other fundamental goings-on. The advent of this sort of novel fundamental interaction provides a clear sense in which fundamental novelty can make an appearance only in comparatively complex situations; moreover, the case of the weak nuclear interaction also makes sense of how such higher-level fundamental goings-on

might also be broadly synchronically dependent on lower-level goings-on – since the operation of the weak nuclear interaction in nuclear circumstances clearly synchronically depends on other fundamental interactions (e.g., the strong nuclear interaction) being in operation. Now, such an instance of strong emergence would not be such as to falsify physicalism, for reasons having to do with the usual ways of characterizing the physical goings-on (see Wilson 2006 for discussion). But the more general point remains that this scientific case study provides support for the coherence of an interaction-based account of strong emergence, and moreover illuminates the nature of such emergence in ways that (since we have some working handle on the criterion for positing a novel fundamental interaction; see Wilson 2002 for details) provide an in-principle basis for resolving debates over the status of a given phenomenon as metaphysically emergent.

## **5. Methodological morals**

I close with some methodological morals concerning the metaphysics of metaphysical emergence.

First, regarding scientific accounts. As philosophers interested in the metaphysics of emergence, we should of course attend to scientific case studies of the sort inspiring attention to metaphysical emergence in the first place. But these case studies should constitute input into our theorizing as opposed to the theorizing itself. This is not to say, of course, that features discussed in scientific descriptions of scientific case studies might not serve as an apt basis for an adequate account of metaphysical emergence – indeed, my own work has often taken advantage, for metaphysical purposes, of certain previously underexplored scientific notions, including the notion of a fundamental interaction (as fruitfully entering into an adequate account of strong emergence; see Wilson 2002) and the notion of a degree of freedom (as fruitfully entering into an adequate account of weak emergence; see Wilson 2010). Still, philosophers appealing to such features need to do more than simply highlight the fact that certain scientists have taken these features to be characteristic of emergence. This is especially true since, as illustrated earlier, the features making an appearance in scientific case studies of emergence are often either explicitly epistemological, in ways not having any clear or relevant metaphysical import, or else are – at least for all proponents of scientific accounts of emergence established – subject to ontologically reductive interpretation, contra the criterion of appropriate contrast.

Second, regarding abstractionist accounts. Though abstractionist accounts of emergence appeal to posits (modal correlations, primitive Grounding, and the like) that are properly metaphysical, the overly abstract characterizations of these posits renders them too devoid of content to do any useful theoretical work. As with attempts to characterize emergence in epistemological terms, modal patterns are, at best, a sign of emergence or its absence; they do not constitute emergence. And accounts in terms of primitive Grounding, as well as other accounts characterizing emergence in primitive terms, provide no illuminating or working handle via which debate with regard to the status of some phenomenon as metaphysically emergent might proceed. If these primitivist gestures were the best we could do, then metaphysical emergence, weak or strong, would have turned out to be simply beyond our ken.

Third, luckily, there are ways of theorizing about metaphysical emergence that lie between the extremes of scientific reportage and abstractionist gestures. The substantive accounts of weak and strong metaphysical emergence discussed earlier, while sensitive to the proffered features of scientific case studies of seeming emergence, bring to the theoretical table a range of substantive metaphysical resources for theorizing about emergence, which provide a clear basis for ensuring the contrast between emergent and ontologically reducible phenomena, and for illuminating the nature of metaphysical emergence in a way that allows substantive debate to proceed.<sup>12</sup>

This comparative result is a specific case in point of the virtues of what I have called (in Wilson 2016b) the ‘embedded’ conception of metaphysics. On this conception, the posits and claims of

metaphysics do not float free of other disciplines treating its target subject matter, as abstractionist accounts are prone to do; nor does metaphysics simply take on board the posits and claims of these other disciplines, as scientific accounts are prone to do. Rather, on this conception, metaphysical posits and claims are embedded in the posits and claims of other disciplines; though typically both more abstract and more metaphysically substantive, the components of metaphysical accounts grow from, rather than float free of, these other notions in ways that are, dare I say, just right.

## Notes

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- 1 See Wilson (forthcoming) for expanded discussion.
- 2 See Wilson (2006) for motivation and defense of a ‘no fundamental mentality’ account of the physical.
- 3 That said, one might also consider an account of emergence as a ‘many-one’, broadly compositional phenomenon, taking individual physical goings-on (e.g., atoms and atomic features and relations) as input and composed aggregates with distinctive features as output (see, e.g., Gillett 2002). Here the further question is: What would it be for an entity or feature (the ‘one’) to emerge from a complex plurality of entities or features (the ‘many’)? As I’ve discussed elsewhere (in, e.g., Wilson 2015), the ‘many-one’ and ‘one-one’ approaches to emergence need not be seen as competitors. Rather, phenomena that are output of many-one accounts are in many cases plausibly seen as the dependence base goings-on input into one-one accounts.
- 4 For detailed discussion of nonlinearity and its historical and contemporary bearing on accounts of emergence, see Wilson (2013).
- 5 See Wilson (2005) for discussion.
- 6 Indeed, as previously noted, proponents typically stipulate that Grounded and Grounding goings-on are distinct.
- 7 Cases involve, among others, a self-sustaining God, a world of mutually dependent objects (as per a certain read on Leibnizian monads or Huayan buddhism), and mutually constituting quarks.
- 8 Problematically, Barnes does not cite or engage with any of these historical precursors.
- 9 Barnes does offer a ‘criterion’ for dependence of the sort at issue in her account of emergence:

*Ontological Dependence* (OD): An entity  $x$  is dependent iff for all possible worlds  $w$  and times  $t$  at which a duplicate of  $x$  exists, that duplicate is accompanied by other concrete, contingent entities in  $w$  at  $t$ .

But this criterion is subject to immediate fatal counterexamples. Suppose that a form of nonreductive physicalism (weak emergence) is true about mental states and that according to this account some presumed fundamental lower-level physical state  $P$  metaphysically necessitates some mental state  $M$ , distinct from  $P$ , in any world where  $P$  exists and where both  $P$  and  $M$  are contingent – that is, do not exist at some worlds. Then physical state  $P$  turns out to be dependent (on  $M$ , in particular) by lights of *OD*, since for all possible worlds  $w$  and times  $t$  at which a duplicate of  $P$  exists, that duplicate will be accompanied by a distinct contingent entity (namely,  $M$ ). That’s wrong: by assumption,  $M$  depends on  $P$ , not vice versa. Moreover, since the physicalist takes  $P$  to be fundamental, then given *OD*,  $P$  turns out to be strongly emergent. That’s wrong. More generally, when coupled with *OD*, Barnes’s account of strong emergence renders all fundamental physical goings-on strongly emergent from any contingent goings-on that completely metaphysically depend upon them. For example, according to Barnes’s account any fundamental lower-level physical determinate feature (say, being a specific charge) will be strongly emergent from any (e.g., special scientific) determinate of that determinate. See Pearson (2018) for a number of other reasons to think that Barnes’s account of emergence is either unilluminating (if appealing to primitive notions of dependence and fundamentality) or extensionally incorrect (if the notion of dependence is filled in via *OD*).

- 10 The feature might also be thought to be associated with what Shoemaker (1980) calls ‘backwards-facing’ powers. Such talk is misleading, however. Strictly speaking, features do not have ‘powers’ to be caused in this or that way – they simply are caused to be instantiated, one way or another. Once instantiated, features can then contribute to the causing of certain effects – that is, be associated with powers.
- 11 See Wilson (2017) for further discussion.
- 12 It will not be lost on the reader that the strategies via which the substantive accounts of weak and strong emergence noted earlier manage to satisfy the operative criteria proceed by attention to one or another relation between the powers associated with emergent and dependence base features, respectively. In

particular, substantive accounts of weak emergence provide resources for accommodating the criteria by appealing to metaphysical relations (functional realization, the determinable-determinate relation) which plausibly entail that weakly emergent features have a proper subset of the powers of their dependence base features, whereas substantive accounts of strong emergence provide resources for accommodating the criteria by appealing to metaphysical posits (fundamental features, forces/interactions, laws) that ensure that strongly emergent features have one or more powers that their dependence base features don't have. Such patterns are suggestive; and indeed, in previous and forthcoming work (see especially Wilson 2015, forthcoming), I argue in detail that existing substantive accounts of metaphysical emergence, of both weak and strong varieties, are plausibly and profitably seen as instantiating one or another pattern, or schema, for emergence.

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