Fundamental Reality

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I—Jonathan Schaffer

The Action of the Whole

I discuss an argument for the monistic idea that the cosmos is the one and only fundamental thing, drawing on the idea that the cosmos is the one and only thing that evolves by the fundamental laws.

> It is possible to say a great deal about the world as a whole. We can point to global structuring principles, universal processes of world evolution, general symmetries, a common ontological basis of reality, a single origin of the universe, and various universally conserved quantities … The world [has] a highly integrated and coherent structure.
>
> ——Ellis 2001, p. 249

What are the fundamental blocks from which reality is built? The pluralist views the cosmos as pieced together from many tiny parts, while the monist holds that the entire scene is painted onto one vast unbroken whole. I provide an argument for monism—*the argument from nomic integrity*—which draws on the idea that the fundamental laws of nature govern the temporal evolution of the cosmos as a whole, applying at most approximately and derivatively to any merely partial subsystem:

(1) *Leibnizian Substance*: Something is a substance if and only if it evolves by the fundamental laws.
(2) R*ussellian Laws*: The cosmos is the one and only thing that evolves by the fundamental laws.
(3) *Spinozan Monism*: The cosmos is the one and only substance (from 1 and 2).

To fix another image: the cosmos ticks like a single clockwork. To cast a slogan: reality acts as one.

Plan: In §§I–III I discuss claims (1)–(3) in turn. In §IV I consider a variant argument using weakened counterparts of (1) and (2), but adding an Aristotelian principle about the mereology of substances.

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I

Leibnizian Substance—premiss (1) of the argument from nomic integrity—connects the notions of substance and lawhood. By 'substance' I mean *a fundamental and integrated thing*, a block from which reality is built, a tile of the cosmic mosaic:

> *Substance* Something is a substance if and only if it is a fundamental and integrated thing.[1]

A thing is fundamental if and only if it depends on nothing further, and a thing is integrated if and only if it is not an arbitrary gerrymander but displays natural unity. Obviously there is much more to be said about these notions, but I trust they are clear enough to work with.

Leibnizian Substance connects this notion of substance—that of a fundamental and integrated thing—to the notion of a fundamental law. By 'fundamental law' I mean something familiar from physics: Newton's $F = ma$ and Schrödinger's equation are historical candidates. I trust that this is also a clear enough notion to work with.

The crucial component of *Leibnizian Substance* is the way it connects substance to lawhood. Consider a candidate fundamental law such as $F = ma$. This law does not say what systems it concerns, but only how certain properties evolve through time. Indeed, one can apply this equation to arbitrary systems—collections of particles or billiard balls or rocket ships—with varying degrees of accuracy. So how can one tell, given such a fundamental law, which things are fundamental? How can one tell how the cosmic mosaic is tiled? *Leibnizian Substance* provides an answer, which is essentially that something is fundamental if and only if this fundamental equation applies to it with full accuracy. More precisely, the answer is that a substance must *evolve* by the fundamental laws, by which I mean that a substance must be such that plugging its state at any given time into the fundamental laws correctly predicts its actual behav-

[1] This conception picks up on certain aspects of Aristotle's conception of substance. For Aristotle, substances are fundamental, and without them 'it would be impossible for any of the other things to exist' (1984a, p. 5; cf. Spinoza 1994, p. 85). Aristotle likewise views substances as integrated, being 'that which is compounded out of something so that the whole is one—not like a heap, but like a syllable …' (1984c, p. 1644). Though Aristotle's conception also incorporates connections to further notions such as predication, on which the present conception stays neutral.

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iour. The tile of the mosaic are the loci of the dynamics.[2]

It is probably impossible to say anything more precise about what it takes to evolve by the fundamental laws without substantive assumptions about time and laws. For simplicity and definiteness, I begin from a picture on which reality is built from fundamental concrete things *enduring* through time, with fundamental laws describing *deterministic* evolutions. The idea of evolving by the fundamental laws can then be unpacked, beginning from the notion of the *state* of a thing at a time:

> *State* The state of a thing at a time is its fundamental intrinsic character at the time.[3]

For instance, a given particle might have a certain mass, charge and velocity at a given time. The state needs to be fundamental, since it is going to serve as an input to the fundamental laws, and needs to be intrinsic (or at least neighbourhood local; Butterfield 2006), or else the connection would be trivialized.

From the notion of the state of a thing at a time, one can characterize the *prediction* for that state, which takes in the state and the fundamental laws as input, and outputs a temporal evolution, which is a trajectory through the space of states across times:

> *Prediction* The prediction for a state is the temporal evolution that the fundamental laws output on the basis of the state.

To illustrate, for a Newtonian one-body system at rest at t_0, the prediction is inertial 'eternal rest':

[2] This idea is inspired by Leibniz, who—in his mature metaphysics—connects the notion of substance to the idea of an internal lawful dynamics. Thus Leibniz opens his *Principles of Nature and Grace* by defining a substance as 'a being which is capable of action' (1998b, p. 258), and explains to Arnauld, 'Each of these substances contains in its nature a *law of the continuation of the series of its own operations* …' (1989, p. 360).

[3] In a quantum setting, at least under some interpretations, one might not even be able to assign (pure) quantum states to things short of the cosmos, given pervasive entanglements. Thus Everett—denying that the state of a local subsystem has any 'independent existence' (1957, p. 455)—maintains, 'Subsystems do not possess states that are independent of the states of the remainder of the system … It is meaningless to ask the absolute state of a subsystem—one can only ask the state relative to a given state of the remainder of the system' (1957, p. 143). Perhaps this provides a direct 'static' argument for monism in an entangled quantum universe (Schaffer 2010a, §2.1), without even considering the dynamics. But the argument in the main text is intended to be independent of any such considerations, and independent of any interpretative controversies over quantum mechanics. So in the main text I allow the pluralist that one can at least assign states to the local subsystems she would consider fundamental.

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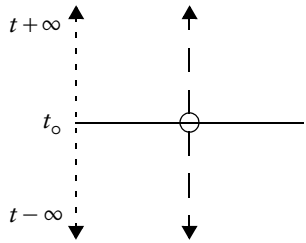


Prediction for a Newtonian one-body system at rest at t_o: eternal rest.

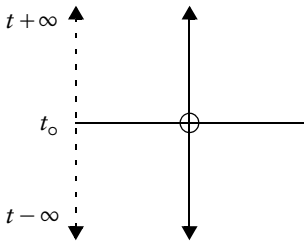
Finally, one can compare the prediction for the thing at the time to its *behaviour*, which is how it is over time, its actual temporal evolution:

Behaviour The behaviour of a thing is the temporal evolution it actually displays.

The relevant comparison is just whether the thing always behaves as predicted. Think of *Prediction* as a physics homework problem, and *Behaviour* as a lab observation checking the answer:

Evolving Something evolves by the fundamental laws if and only if, for any given time, its prediction at that time matches its behaviour.

After all, it is a minimal condition on something evolving by certain laws, that those laws *hold* for it.[4] A Newtonian one-body cosmos always behaves as predicted, and so the world/particle in that scenario satisfies *Evolving*:



Behaviour for a Newtonian one-body system at rest at t_o: eternal rest (as predicted).

[4] Match between prediction and behaviour is a minimal condition. In some scenarios (where there are multiple levels of match) one might want more, such as the requirement that the laws *generate* the behaviour. I return to this in §IV.

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Evolving is fitted to an endurantist-deterministic setting, but the idea readily generalizes. First, one can generalize away from evolutions in time to evolutions in space-time (as called for in a relativistic setting), simply by requiring that the thing always behaves as predicted *on any foliation*.[5] Indeed one can generalize to evolution in any 'arena' (Paul 2012): there is no requirement on the number of dimensions, the presence of metrical structure, etc. Secondly, one can work with perdurance instead of endurance, by replacing talk of the thing with talk of a *sequence of stages* united by temporal counterpart relations. The relevant claim would then be that cosmic-width stages are the one and only stages linked by the fundamental laws.[6] Thirdly, one can work with indeterminism (as called for under some interpretations of a quantum setting), by including *propensities* as an aspect of prediction and behaviour. The comparison of prediction to behaviour would then include a comparison of predicted to displayed propensities.[7] I leave open just how far *Evolving* can be generalized, and limit discussion to the endurantist-determinist setting.

So much for what *Leibnizian Substance* says. I consider it a plausible thing to say, for three main reasons. First, *Leibnizian Substance* draws on the idea of substances as *fundamental*, plausibly connecting fundamental things to fundamental laws (and thereby providing an empirical handle on the substances). Just as it is widely thought that the fundamental laws govern the fundamental properties (Lewis 1983, pp. 367–8), so it seems equally plausible to think that the fundamental laws govern the distribution of fundamental properties *over fundamental things*. More precisely: it is standard to regiment laws via the schema '$\forall x(Fx \rightarrow Gx)$'. The fundamental

[5] More precisely, in a relativistic setting, the state of a thing is to be understood as its fundamental intrinsic character along some time-like hypersurface. *Prediction* is then relativized to a full foliation of the space-time into time-like hypersurfaces. Given the invariance of the dynamics under different foliations, prediction at all times under any arbitrary foliation may be compared with behaviour within the manifold.

[6] *Complication*: In a perdurantist setting, there would remain cross-temporal questions about whether the stages are more or less fundamental than their fusions ('worms'). The argument from nomic integrity falls silent on this question, so given perdurantism it would leave open whether there are many vast fundamental things (each cosmic stage) or one (the whole serpent).

[7] If one opts for a more reductive view of chances, then one must compare the actual behaviour to a predicted probability distribution over behaviours. This difficulty is compounded if the probability distribution allots some probability to all possible behaviours, and compounded further if the distribution allots the same measure zero probability to all possible behaviours. I do not know how to generalize *Evolving* to such a setting.

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things should then be the things quantified over in the fundamental laws. Or perhaps better, one should think of laws as regimented by differential equations describing 'how the physical state of a system or particle evolves through time' (Maudlin 2007, p. 11). The fundamental things should then be the things with fundamental evolutions.

Secondly, *Leibnizian Substance* draws on the idea of substances as *integrated*, and can be understood as providing a nomic test for natural unity. To evolve by the fundamental laws is to act in an integrated way, forming an internally comprehensible and self-contained system (this is what makes something count as a *tile* in the mosaic). The natural unity of a thing is displayed in its dynamics. In a slogan: *to be one is to act as one*.[8]

Thirdly, *Leibnizian Substance* provides a plausible explanation for why certain conceptions of substance seem inadequate, as seen in Leibniz's critique of Malebranche's occasionalism. Malebranche claims that created minds are substances, and also that created minds lack an internal capacity for action but act only via God.[9] Leibniz sees a tension: how can created minds be substances if they require the constant external support of a deity?[10] *Leibnizian Substance* earns credence by providing a plausible explanation for the

[8] These first two points about fundamentality and integration reveal how Leibniz's conception of substance represents a culmination of the classical Aristotelian conception, as Rutherford explains:

> Rather than simply fixing what is to be called 'substance', [Leibniz] is working from a complex, historically rooted conception of what it is to *be* a substantial being, and is subsequently arguing that these conditions can only be satisfied if substance is conceived as being by nature a principle of activity. We may see him as claiming that substance could not fulfil its prescribed metaphysical roles—as an ultimate explanatory principle, as a being that is dependent for its existence on no other created being, as a being that persists through change, and as a true unity—unless it is also conceived as a principle of activity: a source productive of changes in its states or modifications, which nevertheless persists as itself through those changes. (Rutherford 1993, p. 138)

[9] For Malebranche, it is not merely created minds that lack internal power, but bodies too, and indeed everything beside God: '[N]o power can convey it to where God does not convey it, nor fix nor stop it where God does not stop it, unless God accommodates the efficacy of His action to the inefficacious action of His creatures' (Malebranche 1997, pp. 115–16).

[10] Indeed, in *Nature Itself*, Leibniz warns that occasionalism leads to the Spinozan heresy:

> [T]he doctrine of occasional causes which some defend can lead to dangerous consequences … [T]his doctrine seems, with Spinoza, to make God into the very nature itself of things, and to reduce created things to mere modifications of a single divine substance. For that which does not act, which has no active force, which is robbed of any distinguishing characteristic, and finally of all reason and ground of permanence, can in no way be a substance. (Leibniz 1998a, p. 221)

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inadequacy of Malebranchian occasionalism.

Of course, one might reject *Leibnizian Substance* for various reasons,[11] but perhaps the most interesting response vis-à-vis the debate over monism is to allow for substances that are merely among a plurality that co-evolve by the fundamental laws:

> *Leibnizian Substance, Plural* Some things are substances if and only if they co-evolve by the fundamental laws.

Leibnizian Substance, Plural can claim to preserve a link between fundamental things and fundamental laws, while allowing for a plurality of things (such as particles) to be substances, so long as they co-evolve as predicted. This may be the pluralist's most natural move.

But *Leibnizian Substance, Plural* does not fit the idea of substances as integrated. From the fact that some things co-evolve by the fundamental laws, one can only infer that this plurality acts as one. One cannot infer that any individual in this plurality has the natural unity of a substance (a tile in the mosaic). Indeed, it seems to me that a plausible way to decide whether a given composite system is most fundamentally a single composite substance or a mere heap of various elements is to see whether the plurality acts as one. So if some things co-evolve by the fundamental laws, it seems to me that one ought to conclude, not that each of these things is an individual substance, but rather that their system is a composite substance, for that is what forms a natural unit with respect to the dynamics.

Relatedly, without any test for individual integrity, *Leibnizian Substance, Plural* would count arbitrary heaps as substances, as long as they collectively compose the cosmos. Thus consider the plurality whose two members are the sum of all left feet, and its mereological complement (the cosmos minus the sum of all left feet). They collectively evolve by the fundamental laws just because they together compose the cosmos. But obviously they are each mere heaps without natural unity.

And relatedly, *Leibnizian Substance, Plural* would ruin Leibniz's plausible critique of Malebranche. After all, Malebranche does think that the plurality whose members are the created minds and

[11] It may be worth noting that *Leibnizian Substance* is separable from Leibniz's theism with its pre-established harmony, and separable from Leibniz's monadology with its pluralist idealism. (Though the fact that Leibniz combined *Leibnizian Substance* with pluralism helps show that *Leibnizian Substance* does not presuppose monism.)

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the deity co-evolves by the fundamental laws (the volitions of the created minds help inform the actions of the deity). What is missing is the means to see that the minds themselves lack any internal capacity for action. To see that, one must consider each mind individually and see how *it* can act.

II

Whereas *Leibnizian Substance* connects the notions of substance and lawhood, *Russellian Laws*—premiss (2) of the argument from nomic integrity—makes an empirical claim about laws, bringing in the cosmos. By 'the cosmos' I mean the whole material universe, the total system, the sum of all concrete things:

Cosmos The cosmos is the whole material universe.

The existence of such a thing claims intuitive and empirical support. Intuitively, the cosmos is hardly a strange fusion undreamt of by the folk, but is an entity for which natural language supplies a singular term.[12] Empirically, the cosmos is an entity posited in physics, and indeed the subject of cosmology, which Hawley and Holcombe characterize as 'the study of the formation, structure, and evolution of the universe as a whole' (2005, p. 5). Only the most radical views of mereological composition, contravening both intuition and science, could refuse the cosmos.

(I continue to work with an 'endurantist' picture on which things can exhibit numerical identity across time and through change. So I am treating the cosmos as a single enduring thing exhibiting numerical identity across each moment of time and through all changes.)

Russellian Laws claims that the cosmos has a unique relation to the fundamental laws, being the one and only thing that evolves by them. Plugging in *Evolving*, the claim is that the cosmos is the one and only thing that always behaves as predicted. As Maudlin writes, '[T]he fundamental laws of nature appear to be laws of *temporal evolution*: they specify how the state of the universe will, or might, evolve from a given initial state' (2007, p. 172). The fundamental laws govern the temporal evolution of the whole system, and apply

[12] 'Cosmos' derives from the Greek '*κόσμος*' for order, and served as the title of a 1980s public television series featuring Carl Sagan.

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at most approximately and derivatively to any merely partial subsystem.[13]

The content of *Russellian Laws* can be further elucidated by considering 'monadistic' scenarios with local subsystems—windowless bubbles—that behave as predicted. In such scenarios, the temporal evolution of the world state may be understood piecemeal, via the independent evolutions of its monads. The core content of *Russellian Laws* is that our world is not like this. One cannot correctly specify independent evolutions of distinct subsystems first, and then patch together the dynamics of the whole. We can only specify evolutions in the context of the whole system. The evolutions of subsystems are thus to be understood as derivative abstractions from the fundamental evolution of the whole system.

So much for what *Russellian Laws* says. I consider it a plausible thing to say, for three main reasons. First, local subsystems are always liable to outside disruption. For instance, if someone strikes a match, whether and how the match will light depends on external factors like the wind. The cosmos—being the one system for which nothing is 'outside'—is the one system immune to disruption. This means that the cosmos is the one and only thing that evolves by strict laws. Local subsystems at best have a *ceteris paribus* (more precisely, *ceteris absentibus*) evolution. Given that the fundamental laws are strict rather than *ceteris paribus*, *Russellian Laws* follows.

[13] This idea is inspired by Russell, who—rejecting the crude 'philosopher's view' that there are fundamental laws linking one little event to another (e.g. linking the striking of the match to its lighting)—writes:

> The case where one event A is said to 'cause' another event B, which philosophers take as fundamental, is really only the most simplified instance of a practically isolated system. It may happen that, as a result of general scientific laws, whenever A occurs throughout a certain period, it is followed by B; in that case, A and B form a system which is practically isolated throughout that period. It is, however, to be regarded as a piece of good fortune if this occurs; it will always be due to special circumstances, and would not have been true if the rest of the universe had been different … (Russell 1992, p. 204)

And so Russell concludes that the fundamental laws—being exceptionless principles which do not merely hold 'as a piece of good fortune'—cannot link local states. The 'rest of the universe' must be included. And, moreover, these fundamental laws will not divide global states into 'A' versus 'the rest,' they will simply characterize the temporal evolution of the system as a whole. As Loewer explains:

> Russell (1913) observed that the fundamental laws—he was thinking of the differential equations of classical mechanics, but the same holds for quantum mechanics—specify how the whole state of an isolated system evolves (or the chances of possible evolutions) but don't specify which parts of the state at one time are causally connected to which parts of the state at other times. (Loewer 2007, p. 296; cf. Maudlin 2007, p. 178)

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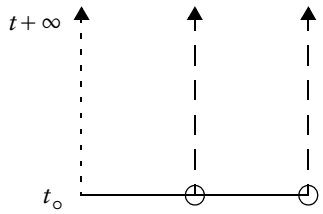
A second reason for finding *Russellian Laws* plausible is that local subsystems are in fact constantly disrupted. There are no closed systems in nature short of the whole cosmos. So any lawful prediction of the behaviour of any local subsystem is not just potentially falsifiable, but in fact false.[14] Open systems generally deviate from their internally predicted course as they are buffeted about by external forces (save for the miraculous circumstance in which the impinging forces perfectly counterbalance). For instance, in a Newtonian setting—ignoring mathematical curiosities like objects entering asymptotically 'from infinity' (Earman 1986)—the state of the cosmos at any given time determines its state at all other times. But this is not true for any local subsystem, due to external forces, including the instantaneous gravitational 'tug' of every massive body throughout the cosmos.[15]

To see this point in action, again consider a Newtonian two-particle system, with an initial state t_o at which both particles are at rest. First consider each particle individually at t_o. Since each particle is at rest, the lawfully predicted behaviour for any one particle, if only considered alone, is just what is predicted for a one-body system, namely, eternal rest:



Behaviour for each particle in a two-body Newtonian system at rest at t_o: eternal rest.

Such a prediction obviously will not match the actual behaviour of the system. Assuming that both particles have non-zero mass, and considering only gravity, there will be mutual attraction:

[14] In a partially related vein, Cartwright (1983) argues that the laws of physics 'lie,' and are at best idealizations. *Russellian Laws* can be understood as the claim that Cartwright is *almost* completely right. There is just one system, namely the cosmos, about which the laws speak truly.

[15] In a relativistic setting these influence are limited to hypersurfaces of back light-cones, but—even in inflationary 'multiverse' models—there are still no completely closed subsystems in nature.

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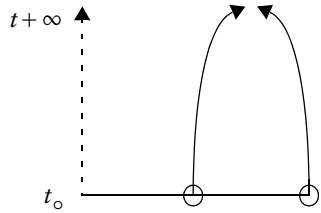

Behaviour for each particle in a two-body Newtonian system at rest at t_o: mutual attraction.

It is only the lawfully predicted behaviour *for the whole system*—in this case the two-body system—which matches actual behaviour. Only the whole system acts as one.

A third reason supporting *Russellian Laws* comes from conservation laws, which only apply to the whole. No subsystem need be conservative so long as the remainder 'compensates'. (Alternatively, one might think of conservation laws as only applying to closed systems; then the point is again that there are no closed systems in nature short of the whole cosmos.) Indeed, by Noether's theorem, conservation laws can be understood as space-time symmetries, where a symmetry is an invariance under certain global transformations. Such laws are global by construction. In this vein, Bigelow, Ellis and Lierse conclude:

> [T]he most fundamental laws of nature, e.g. the conservation laws, the principles of relativity, and the symmetry principles, … neither ascribe properties to things within the world, nor describe correlations between things in the world. It is natural to construe them, rather, as characterizing … the world *as a whole* … (Bigelow, Ellis and Lierse 1992, p. 384)

Of course one might challenge *Russellian Laws* for various reasons. For instance, one might maintain that the world in fact contains all sorts of practically isolated subsystems, and that this suffices for *Evolving* (or some emended version thereof). It is true that the world in fact contains all sorts of practically isolated systems, but false that this suffices for *Evolving* (or any plausible emendation thereof). Practically isolated systems remain systems for which prediction does not match behaviour. Thus they remain systems that do not exhibit the right connections with the fundamental laws to be fundamental, and do not act in a sufficiently unified way to be integrated. What does it matter how many decimal points deep the mismatch lies?

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What is relevant is whether there is a mismatch, not its magnitude.[16]

Secondly, one might challenge *Russellian Laws* on grounds that local subsystems do possess an internal capacity for action. For instance, one might think that local subsystems—unlike Malebranchian minds—at least have a *counterfactual capacity for action*, since they would evolve by the fundamental laws if alone. But substances need to be actual unities, and the fact that something might potentially act as one if alone does not entail that it actually acts as one when accompanied. Moreover, Malebranchian minds may well possess such a counterfactual capacity for action. For the Malebranchian, individual minds without a deity are impossible, and so the associated counterfactuals may be vacuously true. So Leibniz's plausible critique of Malebranche would fall.

Or instead, one might think that local subsystems—unlike occasionalist minds—at least generate *component forces* which match components of the behaviour exhibited (they merely fail to match the overall resultant behaviour due to further component forces). But—granting *arguendo* the existence of component forces—there is clearly no matching component behaviour. As Cartwright aptly notes, 'When a body has moved along a path due north-east, it has travelled neither due north nor due east' (1983, p. 60). Moreover, occasionalist minds are essential (though non-vectorial) 'components' of a mind-deity system in which the mind freely chooses a course of action, and only then is the deity guided to impart a behaviour to the body. So again, Leibniz's plausible critique of Malebranche would fall.

What emerges is that local subsystems are like Malebranchian minds in a relevant sense, namely that both lack an internal lawful evolution, instead requiring external support. With Malebranchian minds, the external support required is the grace of the deity. In the case of local subsystems, the external support required is the context of the cosmos. Thus neither sort of thing exhibits the right connection to the fundamental laws to be fundamental. And neither sort of thing can count as integrated, for neither sort of thing acts as one.

[16] Practically isolated local subsystems are crucial to the *epistemology* of science, allowing global laws to be subjected to approximate local tests. Thus Chew explains the possibility of scientific knowledge: 'All phenomena ultimately are interconnected, so an attempt to understand only a part necessarily leads to some error, but the error is often sufficiently small for the partial approach to be meaningful' (1968, p. 763).

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III

From *Leibnizian Substance* and *Russellian Laws*, *Spinozan Monism*—the conclusion of the argument from nomic integrity—follows. (The historically informed reader might note the irony of combining ideas from Leibniz and Russell—two of the greatest opponents of monism—to reach the Spinozan view.) The cosmos ticks like a single clockwork. It displays the connection with the fundamental laws that befits a fundamental thing, and an internal dynamics that befits an integrated unity. Nothing short of the cosmos—no mere cog of the whole clockwork, no arbitrary fragment of the continuous mosaic—displays this connection with the fundamental laws, or such an internal dynamics.[17]

The inference from global structure to the unity of the whole is indeed drawn explicitly by Ellis, albeit without connection to the classical monism debate. Thus Ellis speaks of the world as a 'a highly integrated and coherent structure' (2001, p. 249), and adds:

> [T]he fact that these global properties and this structure exist at all implies that the world is a unified whole. If the world consisted of unrelated kinds of things that were just thrown together somehow, these properties and this structure would be inexplicable. (Ellis 2001, p. 251)

The argument from nomic integrity merely connects this orthodox claim in the philosophy of physics, to a classical but neglected viewpoint in metaphysics.

Of course, one might take the conclusion of *Spinozan Monism* to suggest a *reductio* of one of the premisses of the argument. I would only ask why *Spinozan Monism* should be rejected (especially if it

[17] This idea is inspired by Spinoza, for whom 'in Nature there is only one substance …' (1994, pp. 93–4), and who invokes something like nomic integrity in a letter to Oldenburg:

> [A]ll bodies are surrounded by others, and are determined by one another to existing and producing an effect in a certain and determinate way, the same ratio of motion to rest always being preserved in all of them at once, that is, in the whole universe. From this it follows that every body, in so far as it exists modified in a certain way, must be considered as a part of the whole universe, must agree with the whole to which it belongs, and must cohere with the remaining bodies. (Spinoza 1994, pp. 83–4)

Indeed (as I have learned from Katja Vogt) this sort of argument may be traced back to the Stoics. As Alexander reports:

> [The Stoics] say that since the world is a unity which includes all existing things in itself and is governed by a living, rational, intelligent nature, the government of existing things which it possesses is an everlasting one proceeding in sequence and ordering … In this way all things are bound together. (Long and Sedley 1987, p. 337)

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follows from plausible premisses). Monism may have been scorned in the twentieth century, but for the preceding millennia it was considered a profound idea, worthy of the allegiance of many of our greatest philosophers. Perhaps the monistic vision was scorned for good reason. I only ask to hear it.

The closest I can find to an argument against *Spinozan Monism* comes from the idea that it conflicts with Moore's platitudes such as 'Here is one hand, and here is another' (Moore 1993, p. 166), and with Russell's 'common-sense belief that there are many separate things' (Russell 1985, p. 36). But there is no conflict. *Spinozan Monism* does not say that exactly one entity exists, and it does not even say that exactly one thing exists. It only says that exactly one *substance*—one fundamental and integrated thing—exists. It is thus compatible with the existence of any number of *dependent things*, which is surely what Moore's hands are, and what Russell's common-sense belief concerns. To speak of the cosmos as a single clockwork is not to deny that it has parts, but rather to characterize the parts as dependent cogs. To say that *the whole is prior to its parts*—as per the classic monistic dictum—is to *presuppose* that the whole has parts, and to assert a claim about the dependencies between these things.[18]

Of course, if one operates with a background schedule of categories on which all entities are either substances or modes, then *Spinozan Monism* would entail that Moore's hands can at most be modes.[19] But the problem here is not *Spinozan Monism*, but the background schedule of categories, which leaves no space for dependent things like hands. The pluralist—were she to operate with this schedule—would face the same problem. For such a pluralist,

[18] Thus Proclus writes, '[S]ince the monad is everywhere prior to the plurality, all beings must be attached to their particular monads. In the case of bodies, the whole that precedes the parts is the whole that embraces all separate beings in the cosmos' (Proclus 1979, p. 79). Likewise Joachim speaks of the part as 'a fragment torn from its context, in which alone it has its being and significance', explaining that the part 'owes its *nature* to its place in the whole system of bodies which together constitute the corporal universe' (Joachim 1901, p. 23). See Schaffer (2010a, 2010b) for further discussion of this view, labelled *priority monism*. *Spinozan Monism* is also compatible with the more radical *existence monism*, which denies existence to anything other than the whole (Horgan and Potr 2008). My point is just that *Spinozan Monism* is compatible with priority monism.

[19] Spinoza himself works with the categories *substance* and *mode*, though Spinoza's official definition of a mode is simply that of 'the affections of the substance, *or* that which is in another through which it is also conceived' (1994, p. 85), which might be thought to cover dependent things. If so, then my complaint is rather that his *mode* conflates dependent property-bearers like hands with the properties they bear, when a categorical distinction is called for.

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Moore's hands would equally count as neither substances (not fundamental) nor modes (not properties). A decent schedule of categories needs to leave room for dependent things which are neither substances nor modes, and any schedule that achieves this will allow the friend of *Spinozan Monism* to hold on to Moore's hands.[20]

Indeed I think that a decent schedule of categories should forgo *substance* altogether. I take it that entities fall under their categories essentially (or perhaps better: no contexts permit cross-categorical counterparts). But fundamentality seems inessential. The monist can grant that her cosmic substance may be embedded in a larger whole, and then it would no longer be a substance. Likewise, the pluralist who treats, say, a given electron as a substance can grant that it may be divisible into smaller constituents, and then it would no longer (by her lights) be a substance. And all sides can agree that a given mind is a dependent entity at a physicalist world, but that it may be a substance at a dualist world. So, given that things are substances only contingently, *substance* cannot be a category.

There is a natural amendment to hand, which is to replace *substance* with *thing*, where a thing is a bearer rather than a property, surface rather than paint. A substance is a thing that just happens to have some special features, namely fundamentality and integration. Replacing *substance* with *thing* makes room for dependent things, and fits the observation that fundamentality seems contingent. The categorical divide that nothing can cross is between bearer and property, not between fundamental and dependent.[21]

But—whatever schedule of categories one ultimately prefers— the underlying point is that all sides need to allow for dependent things, if they would sustain Moorean platitudes. Moore's hands offer no support for pluralism. If there is anything wrong with *Spinozan Monism*,

[20] What is the category of Moore's hands on an Aristotelian schedule? For Aristotle, a hand is not a substance, since it depends on its host organism (indeed a hand is not even possibly a substance, since it would not survive separation from its organism). But a hand is surely not a quality or relation or member of any other Aristotelian category either.

[21] There is also the option of rejecting the divide between bearer and property, and operating with a one-category ontology instead. In this vein Paul (2012) defends a property-only ontology. Though on her approach there remains the question of whether the fundamental properties are global or local, and nomic integrity could be used to argue that the most fundamental bundle is a bundle of global properties. Relatedly, Campbell—who advocates a one-category trope ontology—claims, 'All basic tropes are space-filling fields, each one of them distributes some quantity, perhaps in varying intensities, across all of space-time' (1990, p. 146), and thereby defends 'Spinoza's conclusion, that there is just one genuine substance, the cosmos itself …' (1990, p. 154).

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it is at least not what Russell and Moore said was wrong. Given that *Spinozan Monism* follows from two seemingly plausible premisses, I ask: why not follow the argument where it leads?

IV

The argument from nomic integrity is not the only route from the global character of the fundamental laws to a monistic conclusion. A variant argument—*the argument from cosmic substantiality*—is available, using weakened versions of both *Leibnizian Substance* and *Russellian Laws* plus an Aristotelian principle about the mereology of substances, to reach a restricted version of *Spinozan Monism*:

(4) *Leibnizian Substance, Sufficiency*: If something evolves by the fundamental laws, then it is a substance.
(5) *Russellian Laws, Positive*: The cosmos evolves by the fundamental laws.
(6) *Cosmic Substantiality*: The cosmos is a substance (from 4 and 5).
(7) *Aristotelian Principle*: No proper part of a substance is a substance.
(8) *Spinozan Monism, Restricted*: Among the cosmos and its proper parts, the cosmos is the one and only substance (from 6 and 7).

Leibnizian Substance, Sufficiency allows that there may be other sorts of substances that lack the right connection with the fundamental laws for nomic integrity—it merely posits that such a connection suffices for substantiality. And *Russellian Laws, Positive* allows that there may be other systems that evolve by the fundamental laws—it merely says that the cosmos does. So even someone who would reject *Leibnizian Substance* and/or *Russellian Laws* might still accept these weakened counterparts. Together they entail that the cosmos is a substance, as per *Cosmic Substantiality*.[22]

[22] *Cosmic Substantiality* fits Aristotle's claim in *On the Heavens* that 'the whole or totality'—by which he means 'all body included within the extreme circumference'—forms a substance (1984b, p. 462). This is the individual which, in hylomorphic terms, has the sum of all matter as its matter and wholeness as its form. Thus, as Matthen observes, for Aristotle, 'the corporeal cosmos is a single substance with a motion proprietary to itself …' (Matthen 2001, p. 171).

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The argument from cosmic substantiality then proceeds through *Aristotelian Principle*, which prohibits proper parthood relations between substances.[23] This principle seems plausible for three reasons. First, it befits the guiding claim that substances are not mere aggregates but real unities. A substance is *one*. Something that has a substance as a proper part will not itself be one but must be more (a 'one-plus'). So Aristotle says, 'a substance cannot consist of substances present in it actually' since anything consisting of two substances must be 'actually two' and so 'never actually one' (1984c, p. 1640).

A second reason to support *Aristotelian Principle* is that it befits the guiding claim that substances are fundamental entities, given the further plausible thought that fundamental entities are open to free recombination (Schaffer 2010b). When entities are related as whole to part, they are not open to free recombination, since these entities—assuming that they retain their mereological relation—constrain each other. To illustrate, the semicircles cannot be green if the circle is red.

A third reason to support *Aristotelian Principle* is that it befits the Leibnizian conception of substances as the sites of fundamental powers. Principles of action for both whole and part would yield an implausible overdetermination of fundamental powers, yielding at best redundancy (if the fundamental powers attributed to wholes and parts happen to cohere), and at worst incoherence. To illustrate, the semicircles cannot turn left if the circle turns right.

Of course, one might reject *Aristotelian Principle* for various reasons, but perhaps the most pressing concern is that it seemingly conflicts with *Leibnizian Substance* (and equally with *Leibnizian Substance, Sufficiency*). For what if both whole and proper part evolve by the fundamental laws? What about a cosmos that contains closed subsystems? For instance, consider a 'two-monad' world of two non-interacting windowless bubbles, with purely inertial laws: the whole system evolves by the fundamental laws, but so does each monad. *Leibnizian Substance* would then rule that both whole and proper part are substances, contradicting *Aristotelian Principle*.

But the conflict is only apparent. *Leibnizian Substance* and *Aristotelian Principle* are not modalized, and so say nothing about other worlds (like the two-monad world). Of course *Leibnizian Substance* and *Aristotelian Principle* are metaphysical claims, and so I think

[23] *Aristotelian Principle* follows from my stronger *tiling constraint* on fundamental things (Schaffer 2010a, pp. 38–42): the tiles that make the mosaic should cover the cosmos without overlap.

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they ought to follow from metaphysically necessary principles. But that does not mean that the backing principles must be *Leibnizian Substance* prefixed with a box plus *Aristotelian Principle* prefixed with a box.

Indeed, there is a natural alternative metaphysical principle behind *Leibnizian Substance*. *Leibnizian Substance* encodes the minimal condition of *match* between prediction and behaviour. This minimal condition is sufficiently discriminating for worlds like ours in which prediction and behaviour match at exactly one mereological level, but needs strengthening in worlds like the two-monad world in which prediction and behaviour match at multiple mereological levels, to discriminate the level of match reflecting the workings ('governance') of the fundamental laws from the level resulting as a by-product:

> *Leibnizian Substance, Modalized* It is metaphysically necessary that something is a substance if and only if it has an evolution *governed* by the fundamental laws.

Provided that governing is always restricted to a single mereological level (to avoid overdetermination of fundamental powers), *Leibnizian Substance, Modalized* would not conflict with *Aristotelian Principle*.[24]

There is also a natural alternative metaphysical basis for *Aristotelian Principle*. For overdetermination of fundamental powers—so long as they cohere—yields a redundancy that seems not metaphysically impossible but merely methodologically dispreferred:

> *Aristotelian Principle, Modalized* It is metaphysically necessary that if there is no redundancy then no proper part of a substance is a substance.

Aristotelian Principle, Modalized entails *Aristotelian Principle* at worlds like ours that are (presumably) without redundancy, but would not conflict with *Leibnizian Substance*.

In any case, whatever modal generalizations one ultimately prefers, *Leibnizian Substance* and *Aristotelian Principle* can and should stand together at our world. Both remain plausible claims for our

[24] *Leibnizian Substance, Modalized* does not yet say which mereological level reflects the workings of the fundamental laws in a two-monads world. That is a substantive matter. Still the monist might argue that, given that the fundamental laws work at the level of the whole in worlds like ours, it is plausible to extend this pattern.

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world, and both can be seen as reflections of various compatible metaphysical principles.

Cosmic Substantiality and *Aristotelian Principle* together entail *Spinozan Monism, Restricted*, which is a restricted but still powerful monism, ruling in the substantiality of the cosmos and ruling out the substantiality of particles, organisms, and other major candidates for the office. Indeed, as long as one gets to *Cosmic Substantiality*—whether via *Leibnizian Substance, Sufficiency* plus *Russellian Laws, Positive*, or in some other way—one can apply *Aristotelian Principle* to infer *Spinozan Monism, Restricted*. The argument from cosmic substantiality thus takes on a life of its own. The image of the cosmos as an integrated nomic system—one vast clockwork—merely provides one reason to view the cosmos as a substance.[25]

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