WEAK PHYSICALISM AND SPECIAL SCIENCE ONTOLOGY

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> "While still at school our children get taught that water *consists* of the gases [sic] hydrogen and oxygen, or sugar of carbon, hydrogen and oxygen. Anyone who doesn't understand is stupid. The most important questions are concealed." Ludwig Wittgenstein, *Culture and Value*, p.71
>
> "In science there is only physics; all the rest is stamp collecting." Ernest Rutherford

1 INTRODUCTION: THE CONFLICTING IMAGES OF COMMON SENSE, THE SPECIAL SCIENCES AND PHYSICS

Arthur Eddington (1928, pp.ix–x) famously cast the problem of the relationship between the manifest image and the scientific image in terms of the two tables of common sense and of science respectively. They have seemingly incompatible properties and so it is natural to wonder whether both really exist. Prima facie the two images conflict. There are two broad strategies that we can take in response.

(1) The images really are in conflict so we must abandon one of them:
eliminativism about the manifest image; or,
eliminativism about the scientific image.

(2) The images are not really in conflict so we can retain them both:
reductionism about the manifest image; or,
non-reductive physicalism according to which the scientific image is ontologically primary but the entities of the manifest image supervene on the entities of the scientific image.

Even if one was happy to abandon the manifest image because it is anthropomorphic and the product of the peculiarities of our perception, Eddington's problem generalizes because the special sciences each have their own distinctive ontologies:

Fundamental physics: particles, fields, spacetime, strings,…
Physics as a special science: phonons, forces, quasicrystals,…
Chemistry: molecules, ions, chemical bonds,…
Biochemistry: lipids, proteins, nucleic acids,…
Biology: cells, genes, species,…
Ecology: producers, consumers, decomposers,…
Psychology: minds, beliefs, desires,…
Sociology: groups, structures, classes,…
Economics: money, markets, economies,…
Geology: plates, faults, intrusions,…
Astronomy: planetary nebulae, main sequence stars, galactic clusters,…
Cosmology: the universe(s), M-branes, dark energy,…

Some metaphysicians dispute the reality of many of these entities. They think about objecthood in terms of the issue of which mereological sums of simples are bona fide wholes. There are three common positions.

Nihilism: there are only simples.
Unrestricted composition: all sums of simples are genuine objects.
Restricted composition: only some sums of simples are genuine objects.

All these are blind to the way science comes to posit new ontological commitments, and to scientific accounts of the how higher level ontology arises dynamically out of lower level stuff. Even if there are simples, it is clear that the way parts combine to form wholes is in general different for the entities of the different sciences. Stars do not combine to form galaxies in the same way that cells combine to form multicellular organisms. There is no reason to suppose that there is a single composition relation in the different sciences. The above are also all synchronic conceptions of composition. In science, it is the interaction of parts over time that forms higher level entities. Furthermore, in science there is in general no interesting cause versus constitution distinction, rather in most cases to say how the

parts causally interact is to say how the whole is constituted by them. Naturalists should take these facts at face value and reject the conception of object, part and whole in analytic metaphysics. Science should determine our ontology and philosophy should look outwards when considering the relationship between the objects of physics and those of the rest of science (and manifest objects).

Jonathan Lowe says:

> … [R]eality is one and truth indivisible. Each special science aims at truth, seeking to portray accurately some part of reality. But the various portrayals of different parts of reality must, if they are all to be true, fit together to make a portrait which can be true of reality as a whole. No special science can arrogate to itself the task of rendering mutually consistent the various partial portraits: that task can alone belong to an overarching science of being, that is to ontology. (2006, p.4)

If we naturalize this conception of the distinctive task of metaphysics then we get something close to what Wilfrid Sellars said the philosopher's aim should be, namely "knowing one's way around with respect to the subject matters of all the special [scientific] disciplines" and "building bridges" between them (1962, p.35).

2 Physicalism

But naturalized metaphysics still faces the problem of the apparent conflict between the images of the special sciences and physics. Physicalism is commonly a commitment of naturalists. Physicalism is the heir of materialism. However, ironically materialism was killed by science, in particular by physics. Materialism has positive and negative components. The former is the ontological commitment to matter, the latter is the denial of the existence of mental or spiritual substance. The latter is retained in physicalism. There are various kinds of Physicalism:

Ontological imperialism: everything is physical
Causal closure: the physical world is causally closed – all physical events are determined or have their chances determined by physical causes.
Causal exclusion: the only genuine causes are physical causes.[1]

Ontological Imperialism is expressed by Philip Pettit when he says the world "contains just what a true complete physics would say it contains" (1993, p.213). This kind of physicalism conflicts with naturalism (if current physics is supposed to be a reasonable guide to true complete physics). This claim is not warranted by taking science as a whole seriously.

All forms of physicalism face Hempel's Dilemma: however physicalism is defined some content must be given to the term 'physical'; then physicalism will be either trivially true, if 'physical' is taken to refer to the content of idealized future physics, or false if 'physical' is taken to refer to the content of our best current physics.[2]

2.1 The Completeness of Fundamental Physics

Ladyman and Ross (2007) offer a new characterization of fundamental physics as the only science such that measurements at all scales and at all locations in spacetime are potential falsifications or confirmations of it. However, fundamental physics may not exist other than as a limiting ideal (if there is no fundamental level). (Many parts of physics are special sciences.) Fundamental physics aspires to a kind of completeness in so far as it is never permitted to invoke entities or processes from the special sciences in an explanation of the behaviour of the fundamentally physical. Physics is therefore analytically complete in so far as it is the only science that by its nature cannot be left incomplete. On the other hand, the incompleteness of the special sciences is a trivial fact about them. In all the special sciences it is acceptable to invoke entities and processes from more fundamental sciences in explanations. For example, the economy may be affected by the weather, living systems may be affected by radiation, chemical reactions may be affected by magnetic fields, and so on. Hence,

[1] In his paper Jerry Fodor characterized physicalism as the view that 'only matter has causal powers'.
[2] Brown and Ladyman (2009) offer a way out of Hempel's Dilemma and give references to the recent literature on characterizing physicalism.

there is a fundamental asymmetry between physics and the special sciences.

2.2 The Primacy of Physics Constraint (PPC)

Naturalists ought only to accept a form of physicalism that is motivated by reflection on the history of science and the nature and practice of contemporary science. Ladyman and Ross argue that this justifies nothing more than the PPC (a methodological form of physicalism):

> "Special science hypotheses that conflict with fundamental physics, or such consensus as there is in fundamental physics, should be rejected for that reason alone. Fundamental physical hypotheses are not symmetrically hostage to the conclusions of the special sciences." (2007, p.44)

This leaves it open to the naturalist to believe both that the entities posited by the special sciences exist, and that the causal relations posited by them are genuine.

2.3 Causation and Physics

The asymmetry in the PPC may be expressed by the claim that the physical world is causally closed, i.e. that all genuine causes of physical events are physical causes. But now, if special science entities are not reducible to physical entities, then this form of physicalism also conflicts with naturalism since the special sciences prima facie describe all manner of causal relations between special science entities and physical events. Furthermore, if one takes causal efficacy as a necessary condition for something to be counted as real (the Eleatic principle/Alexander's Dictum); then eliminativism about the ontologies of the special sciences follows.

3 THE CAUSAL EXCLUSION ARGUMENT

3.1 Causal Exclusion and Mental Causation

Jaegwon Kim's (1998, 2005) uses the following argument as a reductio of non-reductive physicalism about the mind:

> Mental states are not reducible to (identical with) physical states.
> Mental states are realised by physical states and supervene on them.
> Effects are not generally overdetermined by causes.
> The physical world is causally closed (there is some set of physical causes that are sufficient for any physical event (or at least sufficient to fix its objective chance).
> Mental states can cause other mental states and physical states.

The last premise contradicts the rest of the premises. Since Kim thinks that we must hold on to the reality of mental causation, and since the second premise is weaker than the first and the third and fourth premises are supposed to be independently plausible, Kim therefore concludes that we should deny the first premise and accept that mental states are reducible to physical states. It follows that mental causal relations are real just because they are reducible without residue to physical causal relations.

3.2 The Causal Exclusion Argument Generalised to Causes in the Special Sciences

Many critics (Baker 1993, Bontly 2002, Burge 1993, Fodor 1991) have argued that Kim's argument generalises to one with the conclusion there is no macrocausation at all. This is then regarded, for example by Block (2003), as showing that the original causal exclusion argument is unsound, if it is taken for granted that there is macrocausation and that interesting causal relations are described by the various special sciences. However, Kim agrees that there is mental and other forms of causation, he just thinks that reductionism must also be true. These critics do not diagnose where the argument goes wrong.

3.3 The Nature of Causation and the Causal Exclusion Problem

Kim thinks of causation as a physical phenomenon (2005, p.55, note 22). He defends a conception of causation as essentially connected with the spatial distribution of physical objects. It is not clear whether this notion of causation can survive the transition to a conception of the fundamental nature of the world that dispenses with spatiality as we know it and also with time as standardly construed as absolute. Many philosophers of science, following Russell (1913), deny that there is any causation in fundamental physics (c.f. Price and Corry (2007) and especially Norton (2007)). Whether or not they are right about this it is clear that causal exclusion is simply not an issue for a Humean view of causation. Whether causal relations are construed in terms of counterfactuals and then reduced to Humean facts about relations between possible worlds, whether concrete or abstract, or thought of as at best secondary qualities, there is no reason to think that underdetermination is problematic. Kim's arguments need only concern those who adopt a theory of generative or productive causation, or some kind of non-Humean approach.

4 Weak physicalism and Special Science Ontology

4.1 Weak Physicalism

If it cannot be assumed that there is causation in fundamental physics then physicalism cannot be defined in terms of the causal completeness of physics. Here is a characterization of a weak form of physicalism that makes no reference to causation:

- Global supervenience (asymmetric)
- The PPC
- Ideal physics is analytically complete in its own domain but no other special science is.
- Theoretical reductions may or may not exist in particular cases, but do not exist in general.
- In general, no collection of fundamental objects is identical with the objects of the special sciences (such as the futures market in oil or the taxa *Felis silvestris catus*).

Of course, philosophers who worry about what they call 'fundamental ontology' are inclined to deny the existence of taxa and markets, but then many of them deny the existence of tables too, or hold that tables only exist because every arbitrary sum of fundamental objects exists. According to the proposed weak physicalism high level entities are not even token identical with aggregates of lower-level ones pace mereological accounts of composition. (Hence, the problem of the many is a pseudo-problem.) This is explained in the next section.

Here is a hypothesis that adds a further defeasible and a posteriori methodological component to the weak analytic completeness of physics above and the PPC: no new entities or processes will ever be introduced into fundamental physics solely to account for mental phenomena, and fundamental physics will never posit entities that have mental, intentional or spiritual properties. The history of science to date, in particular the failure of research programmes that posited vital forces and spiritual fluids and substances, supports this hypothesis.

Note that weak physicalism is compatible with there being no fundamental level, and note also that Kim thinks that the causal exclusion argument only works if the level of genuine causation is closed and complete (1998). The causal exclusion argument begins to seem less compelling once the token identity of higher level objects with collections of fundamental physical ones is denied.

4.2 Fundamental Physics and Special Science Objects

Hawthorne (forthcoming) distinguishes between two views of the relationship between the objects of fundamental physics and those of the special sciences. A conservative one involves the identification of the macro or manifest objects with fundamental objects or aggregates of them, while a liberal one posits additional objects that 'float over the fundamental layer'. However, this is a false dichotomy. A third position asserts that the macro or manifest objects are patterns in the structure of the fundamental objects that are neither free floating nor identical with those objects (Wallace 2003). A fourth position adds that there is no fundamental layer at all, and that the allegedly fundamental objects are themselves patterns in the structure of some deeper level of reality (Ladyman and Ross, 2007). (A fifth position is agnostic about whether there is a fundamental level.)

Note that in science one is only interested in recovering the statistical properties of low-level entities when tracking high level ones: for example,

information about exact microstates is not relevant in thermodynamics. It is plausible to generalize and suppose that coarse-graining and approximation are necessary for all or almost all special science ontologies to emerge from fundamental physics. This explains why even token identities do not obtain between say a cat and its constituent atoms. A cat is coarse-grained with respect to atomic theory; it is not that there are many possible exact collections of atoms that might be identical with a given cat, it is rather that no exact collection of atoms could be identical with the cat because no such collection has the right properties, since all the properties are defined at the higher level and are themselves coarse-grained with respect to lower level properties. In the special sciences one is usually interested in 'universal' forms of behaviour, where 'universal' means independent of microphysical or lower level constitution. The identification of universality and the appropriate descriptive categories for tracking it is one of the principle tasks of the special sciences.

This leads to what Ladyman and Ross (2007) call 'the scale relativity of ontology', namely the thesis that the existence of special science (and everyday) objects is relative to particular time and length scales (and relatedly to energy scales in particle physics). Tables and cats do not exist at very short or very long time or length scales. This idea is similar to what Sokal and Bricmont call the 'renormalization group view of the world' (Sokal 2008): the renormalization group describes transformations that allow the number of degrees of freedom in the Hamiltonian of a system to be massively reduced while still recovering the critical behaviour of the system. On the other hand, fundamental physics alone aspires to a scale-free ontology but it may never get there.

The special sciences are possible because the world is to some extent algorithmically compressible. At certain levels of description it is possible to use much less information to predict the behaviour of systems described in an approximate and probabilistic way, than would be needed to describe their microstates; for example, Kepler's laws, the ideal gas laws, the Hardy-Weinberg law, and so on. In fact almost all laws in the special sciences are like this. The special sciences rely upon reduction in the degrees of freedom of the system. There are real patterns in the world that are only visible at the right scales of resolution and degrees of approximation. If you don't see them you are missing something about reality and that is good enough to allow us to say that the objects, properties and processes described by the special sciences are real.

4.3 Serious Metaphysics?

Many philosophers will think that the above may all be taken as an account of the epistemological short-cuts that are necessary in describing the world, but that only the fundamental ontology is real and that all the higher level stuff is just necessary for pragmatic reasons. Of course, if there is no fundamental level then on such a view nothing is real except perhaps the whole universe. Either way, such a view leaves unanswered all the interesting questions about the relationship between the ontologies of fundamental physics and the special sciences. Supposing there is a fundamental level that will one day be described by fundamental physics, it remains to be decided whether epistemological irreducibility and indispensability is sufficient for genuine ontological commitment. The best answer to this question is to ask how else we are to mark the distinction between spurious ontological commitments of special sciences and genuine ones other than by assenting to the existence of the latter and not the former. This will not persuade those who think there is a special metaphysical sense of 'exists'.

It can also be questioned whether high-level properties are determined by low-level ones. It is not obvious that global supervenience entails this. Consider Laplace's demon: it is usually said that the demon would know everything about the future but is this correct? Of course the demon would know everything about the positions of all the particles but does it follow that it would know what you had for breakfast? Not if there is no type-type identity. What if high level objects and properties are only apparent if one makes exactly the right approximations and coarse-grainings?

Metaphysicians often operate with what Ladyman and Ross (2007) call 'domesticated physics' and deploy in their metaphysical theorizing what Lakoff and Johnson (1980), 'the containment metaphor': The world is supposed to be 'made of' myriad 'little things' in roughly the way that (some) walls are made of bricks. Unlike bricks in walls, however, the little things are in motion, and the paradigm of causation is the little things hitting each other. Hence, the causal structure of the world imagined by the domesticating metaphysicians is a network of 'microbangings'. The preoccupation with the search for 'genuine causal oomph' or 'biff' to settle the competition between different levels of reality derives from this conception of causation and microbanging. This is profoundly unscientific and does not fit with contemporary physics.

Note however, that if there are no causal powers in fundamental physics this does not imply that there are none in the special sciences. Har-

old Kincaid (2004) describes how the special sciences seek laws and theories of causal processes particular to their domains. Russell presupposes a conception of causation as "invariable uniformities of sequence" (1913, p.178), and he is right that causation in this sense is not a feature of the scientific image of the world. However, the distinction between Humeanism and a notion of productive or generative causation that is based on an outdated model of the physical world is not exhaustive.

4.4 Functionalism about all Ontology

The above discussion motivates consideration of an information theoretic approach to ontology according to which 'to be is to be a real pattern' in the sense of a compressible set of data according to the relevant level of description (c.f. Dennett (1991)). This is a deflationary approach to ontology and a form of ontic structural realism (Ladyman (1998)).

4.5 Causation in the Special Sciences

Robin Hendry and Paul Needham argue that "[i]f molecules are ontologically reducible to their physical bases, then they ought to have no causal powers other than those conferred by those physical bases." (assuming causal completeness of physics) (2007, p.342). The argue that the acidic behaviour of HCl is due to its asymmetric shape and this shape is not conferred by its physical basis. However, we must ask what 'conferred by' means here. The shape of the molecule is surely supervenient on the physical because one cannot countenance two molecules with different shapes without there being a difference in the state of underlying physical entities. On the other hand, it is true that the shape is causally important and that the shape is not attributable to anything other than the whole molecule. There is an analogy with plural reference. Consider the sentence: 'the army surrounded the castle'; it is not possible to reduce this sentence to a claim about individual soldiers. Each one is only doing what they do because the others are there too. Similarly with a baseball breaking a window. This is not the aggregate of causal relations between minimal parts of the ball and minimal parts of the window. None of the minimal parts in each case is causally necessary for the effect. Each could be doing something slightly different and it wouldn't matter.

Causation in the special sciences is a relation between entities that are coarse-grained with respect to fundamental physics. Only probabilistic/

statistical facts about the underlying realms must be correctly described at the higher level. Difference making only obtains with respect to individual properties and objects at the coarse-grained level. After all, there are many changes to microproperties in the backwards lightcone of an event as described by a special science, for example, the erosion of a river valley, that make no difference to whether or not it occurs.

The general point made by Hendry and Needham is well taken: since there is (probably) no causation in fundamental physics and there is causation in the special sciences then all causal powers are likely to be emergent. This is even more clear when we are talking about population level causal claims in biology. However, since the fundamental physical level (if it exists) is either causally closed or nomologically complete, any instance of downwards causation is an instance of overdetermination and therefore harmless to physicalism.

5 Conclusion

The problem of emergent objects and properties and higher level causation is based on two misconceptions:

- There is a fundamental physical level of substantial objects with intrinsic properties.
- There is causal power at this level.

Rather the situation is this: ontology as pattern obtains all the way down and there is probably no causation at or below the level of current fundamental physics. There may be no fundamental level at all, and even if there is it will not consist of a set of simples. Hence, the causal relations tracked by the special sciences and common sense, and the ontologies that they relate are fully ontologically respectable. Sometimes at least: 'philosophy leaves everything as it is'.

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