The Layer Cake Model of the World and Non-Reductive Physicalism

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Abstract

In this paper I argue that non-reductive physicalism (NRP) continues to rely on the ontological aspect of the layer cake model of the world (LCM). NRP is a post-unity account of the relationship between phenomena in the world in the sense that it has been developed in response to the perceived failure of the unity of science thesis. The LCM constitutes a framework for the organisation of phenomena in the world. It articulates the idea that phenomena in the world are organised into levels. Specifically, that phenomena are layered into distinct, hierarchical levels of organisation. Historically, the unity of science thesis and the LCM have been intertwined; the LCM being the framework within which a unity of science might be possible. My argument will demonstrate that, despite a move away from unity of science positions, the LCM persists in post-unity accounts. In order to argue for this thesis, I present a close analysis of Oppenheim & Putnam's classic presentation of the LCM; picking out *the principle of hierarchic compositionality* which, I argue, captures the ontological aspect of the LCM. I then demonstrate how NRP continues to rely upon the principle and, as a result, continues to support the ontological aspect of the LCM. This result is significant. It shows that whilst the rejection of the *reductionist* aspect of the thesis has served as the basis for post-unity positions these positions do not engage directly with the framework within which reduction might be facilitated – the LCM. Furthermore, it demonstrates that pluralist or disunity accounts of the relationship between phenomena in the world will also have to engage directly with the framework of the LCM in order to avoid being *merely* anti-reductionist.

Keywords: *physicalism, reductionism, the layer cake model*

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1 Introduction

In this paper I argue that non-reductive physicalism, a prominent post-unity position on the relationship between phenomena in the world, and the branches of science that study them, continues to rely on the layer cake model of the world. In order to argue for this conclusion I offer a novel analysis of the layer cake model by picking out a condition that captures the ontological aspect of the model – a principle I label *the principle of hierarchic compositionality*. I then use this principle as a tool of analysis to show that non-reductive physicalism continues to rely on the principle and, as a result, continues to hold the layer cake model of the world. I conclude briefly on the significance of engaging directly with the LCM and the utility of the principle of hierarchic compositionality as a tool of analysis for doing so.

The paper will proceed as follows. In 2 I briefly motivate the significance of arguing that the LCM and non-reductive physicalism are compatible before presenting of the layer cake model of the world through a careful analysis of Oppenheim & Putnam's classic presentation of the model. I pick out *the principle of hierarchic compositionality* from this analysis and argue that it captures the ontological aspect of the layer cake model. In 3 I introduce non-reductive physicalism as a *post-unity* position on the relationship between phenomena in the world and the branches of science that study them. In doing so I highlight the development of non-reductive physicalism as a response to the perceived failures of the unity of science thesis – specifically the requirement for theory reduction. Finally, in 4 I demonstrate how non-reductive physicalism continues to rely on the principle of hierarchic compositionality and, as a result, continues to hold the layer cake model of the world.

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2.1 Why analyse this relationship?

It might initially be supposed that an analysis of the relationship between the layer cake model (LCM) and non-reductive physicalism (NRP) is neither required nor a fruitful line of inquiry. What is the significance of their compatibility, and what would such a result show? Here I will briefly offer three reasons why attention needs to be drawn to the relationship between the LCM and NRP. The first is that whilst historically the unity of science and the LCM have been interwoven theses, theoretically they come apart. NRP is sometimes seen as a successor to (or

rejection of) the unity of science thesis.[1] Accordingly I label NRP as a post-unity position (see 3.2 for more detail). However, it is my contention to show that being a post-unity position does not entail being a post-LCM position – a rejection of unity is not, by itself, enough to reject the LCM. The reason that it is supposed that the two positions stand or fall together is their association with *theory reduction*. A standard view is that the LCM is an account of *theory of reduction*. Daniel Steel ([25, pp.60-61]) explicitly talks of the 'layer cake model of reduction' in reference to Oppenheim & Putnam's work.[2] Furthermore Harold Kincaid ([13, p.576]) even calls the LCM, "the standard account of reduction". Thus, a primary aim of this paper is to show that such characterisations of the LCM are incorrect. The LCM is *not* a model of reduction, it is an articulation of the layers of organisation concept that might *allow* for inter-theoretic reduction to take place. In other words, it is a framework *within which* inter-theoretic reduction might take place. The way this will be done is by showing that NRP is compatible with the LCM; if the LCM is compatible with a thesis that is explicitly *non-reductive* then it cannot itself be an account of reduction.

This leads neatly to the second reason why attention needs to be drawn to the relationship between the LCM and NRP. If, as contended here, the LCM and the unity of science thesis do not stand and fall together, then an analysis of the LCM *as a framework* (or as an articulation of the levels of organisation concept) becomes required, or at least presents itself as an investigation worth conducting. Recently, an interest in the levels of organisation concept has been increasing (for example, [4]; [21]; [26]); particularly the search for alternative conceptions of the levels of organisation concept. My own, larger project, is to advance a *pluralistic* conception of the levels of organisation concept. One way to begin such a project (and contribute to other, related projects on alternative conceptions of levels of organisation) is to present a fine-grained analysis of the LCM, in terms of its essential ontological and epistemic components. Finally, then, the third reason I propose an analysis of the relationship between the LCM and NRP is to begin this project. In this paper I present a principle called the principle of hierarchic compositionality; a principle that I contend captures the essential ontological commitments of the LCM. I will put this principle to use in the analysis that follows; using it as a tool of analysis to show why NRP remains compatible with the LCM. Going forward it is my hope that this principle can serve as part of the groundwork for a new pluralistic articulation of the levels of organisation concept. That hope will not be pursued in

this paper, but the work done within will constitute a small step in that process.[3]

2.2 An Introduction to the Layer Cake Model

The layer cake model (LCM) is a view about the way the world *is*. It is a model of the structure of the world in terms of the phenomena that comprise it, and the branches of science that study it. It is a thesis that has structured, and arguably continues to structure, debates in the philosophy of science generally and more specifically the philosophy of biology, mind, cognitive science, and the social sciences. In the philosophy of biology the LCM came to the fore in arguments concerning the relationship between Molecular biology and Mendelian genetics. The debate centred on whether explanations from the more 'fundamental' field of molecular biology had the potential to subsume all explanations from Mendelian genetics; including the proposed laws of transmission from Mendelian genetics ([10]). In the philosophy of mind the LCM provides the framework within which debates concerning the relationship between mental and physical properties; their respective causal efficacy as well as their dependence upon each other ([12]). The LCM has proved important in the philosophy of cognitive science, particularly the relationship between psychological and (evolutionary) biological explanations of human behaviour (Cosmides & Tooby, 1994), as well as for explanations from neuroscience [3]. Finally, the relationship between the so-called 'special sciences' (economics, social sciences etc.) and more traditional sciences (physics and chemistry etc.) has been informed by the LCM and its alternatives (Fodor, [6]). The LCM contributes to all these debates precisely because it proposes a *structure* to the world. More specifically, it organises phenomena, entities, theories, or even whole branches of inquiry into organised levels or layers. Furthermore it stipulates the relationship between the constituents of those levels.

In this first section I present the LCM primarily through the work of Oppenheim & Putnam [19] (O&P). By no means does O&P's presentation of the LCM constitute the only available introduction to the LCM, nor do they have a monopoly on the thesis itself.[4] However, not only does O&P's work provide a good starting point (as good as any at least), their conception of the LCM certainly became a prominent representation of the LCM in the debates surrounding levels of organisation that followed in the mainstream philosophical literature. Before detailing O&P's thesis, I begin with a brief gloss on the basic components of

the LCM.

The LCM imposes (or describes depending on your viewpoint) a *hierarchical* structure onto the world, a structure in which the phenomena in the world are ordered into *distinct levels* of organisation. The levels move from 'fundamental' or 'micro' entities/phenomena, *up to* 'complex' or 'macro' entities or phenomena. The 'branches' of science (biology, chemistry, physics, etc.) that are concerned with phenomena at a given level of the hierarchy are resultantly presumed to form their own distinct hierarchical organisation, with physics at the bottom moving up through chemistry and biology, and on up to psychology, sociology, and economics towards the top. In order to move beyond these basic components, I will now introduce O&P's exposition of the LCM.

2.3 The Oppenheim & Putnam Layer Cake Model

O&P's exposition of a universal and generalisable model for organising the layers of phenomena in the world begins with six desiderata. In this section I present and explicate these six conditions as well as the resulting model of the layers of organisation that O&P contended met the conditions. I will not offer a critique of the conditions here, rather, in line with the aims of this paper, I wish to describe and explain – clearly and precisely – the components of O&P's LCM. The six conditions are designed to capture how phenomena in the world, and consequently the branches of science studying those respective phenomena, are related to each other:

(1) There must be several levels

(2) The number of levels must be finite

(3) There must be a unique lowest level (i.e., a unique 'beginner' under the relation 'potential micro-reducer); this means that success at transforming all the *potential* micro-reductions connecting these branches into *actual* reductions must, *ipso facto*, mean reduction to a single branch

(4) Any thing of any level except the lowest must possess a decomposition into things belonging to the next lower level. In this sense each level will be the 'common denominator' for the level immediately above it

(5) Nothing on any level should have a part on any higher level

(6) The levels must be selected in a way which is 'natural' and justifiable from the point of view of present day science. In particular, the step from any one of our reductive levels to the next lower level must correspond to what is, scientifically speaking, a crucial step in the trend toward over-all physicalistic reduction ([19, p.9]).

The following levels of organisation are proposed by O&P to meet the above six conditions:

(L6) Social Groups

(L5) Multicellular living things

(L4) Cells

(L3) Molecules

(L2) Atoms

(L1) Elementary Particles (*loc. cit.*).

The first two conditions are important to getting any model of phenomena in the world off the ground that consists in *layers* of organisation. As for (1) it almost trivially follows from a commitment to *layers* of organisation that there must *be* levels in the model that captures them. Nothing particularly substantive follows from that claim; for example, about the constituents of each level, the relationship between the entities in each level, or the complexity of organisation at each level. In other words, (1) doesn't get O&P to anything like the model constituting (L1) to (L6), but it is necessary for introducing the bare-bones of the framework. A commitment to the mere existence of layers or levels of organisation was (and continues to be) wide-spread at this time. Even accounts of the structure of the phenomena in the world that contained substantially different elements still took the existence of levels or layers of organisation to be a given[5]. In stark contrast to O&P's 3rd condition, for example Joseph Feibleman ([5, p.63]) contended that, "it is impossible to reduce the higher level to the lower". Alex Novikoff ([18, p.210]) also affirmed this anti-reductionist position and furthermore – in contrast to condition (5) – recognised the vague and blurry nature of the levels themselves, arguing that certain phenomena may, in fact, have places on more than one level. Despite the contrast of the claims with O&P's conditions, both Novikoff and Feibleman endorsed the existence of levels and the structuring of phenomena into layers of organisation.

It is not immediately clear why these levels must be *finite*, as stipulated by (2), until, perhaps, we consider the third condition. Condition (3) stipulates that there is a fundamental level of reality; a starting point to which *all phenomena can be reduced*. This makes condition (2) a little clearer, for if there is to be a unique, fundamental lowest level of reality (or organisation), then it must be the case that the layers in the model are *finite* – if not, the reductions that O&P refer to could potentially never end and the unique lowest level would never be found.[6] In the model presented by O&P this unique level is (L1), elementary particles. The claim is, then, that take any entity from any of the levels *above* (L1) and, by some means or other, that entity will potentially be reducible to a level of reality containing only elementary particles, such as quarks or neutrinos. As for condition (3) itself, an explicit argument for this condition is not forthcoming. However, it seems reasonable to assume that condition (3) is motivated by the principle that the levels ought to be selected in a way that is 'natural' and 'justifiable' from a scientific point of view, i.e., condition (6). Whilst it is arguably *not* the case that a fundamental level of reality is 'natural' and 'justified' from the point of view of science ([23]), Jaegwon Kim ([11, p.337]) points out that this has been a commonly held assumption possibly tracing back to Newton, so it seems likely that Oppenheim and Putnam take condition (3) as a permissible assumption on the basis of what is justifiable from a scientific perspective.

Why would it be the case that something from (L5), a Giraffe for example, be 'reducible' to whirring electrons? Or spinning quarks? Condition (4) provides a reason for this: because everything at one level is completely composed of entities at the next lowest level, until the fundamental level is reached. So a giraffe (L5) is composed of Cells (L4), which in turn are composed of a variety of Molecules (L3). Molecules are composed of Atoms (L2), and Atoms are composed of sub-atomic, or elementary particles (L1) such as Fermions (quarks, neutrinos, for example) and Bosons (neutrons, for example). Condition (4) might thus be described as the decomposition condition and constitutes a substantial ontological commitment to what there is in the world, and what those things are composed of. Condition (5) makes the composition condition even stronger by claiming that there can be no 'cross-level' entities, so if it's decided that a Giraffe belongs to (L5), then we ought to find no Giraffes at any other level of reality. Condition (5) thus stipulates the *distinctness* of each level – whilst all entities at one level consist of nothing but entities at the next level below, the levels or layers remain firmly

distinct; impenetrable barriers that no entity can break through. The final condition, (6), affirms a commitment to scientific practice, which in O&P's view consists in a commitment to physicalism and reduction.

2.4 The Principle of Hierarchic Compositionality

In this section I introduce and explain the principle of hierarchic compositionality (PHC). It is important to note that the principle does not appear explicitly in O&P's work. However, if I am correct that it does capture the salient ontological aspect of the LCM, then O&P would have endorsed it as I state it here.

> **The Principle of Hierarchic Compositionality:** Phenomena in the world are such that they are subject to a specific decomposition into their requisite parts. This decomposition is hierarchically structured from 'complex' or 'macro', to 'basic' or 'micro'. There is an ultimate, or lowest, level of phenomena to which all things can be decomposed.

The (PHC) is not merely a restatement of the LCM. It is one *aspect* of the LCM. The LCM is most likely a combination of ontological and *epistemic* commitments.[7] The LCM certainly suggests ways to investigate the world around us i.e., epistemological or explanatory principles, but the PHC does not express this. It is an ontological principle only - a principle about the way the world *is*. The primary purpose of isolating the PHC from the wider commitments of the LCM is to have a tool of analysis. A principle that can be used to analyse other ontological positions, or simply positions about phenomena in the world more generally, in order to assess their potential compatibility with the PHC and *ipso facto* the *ontological* commitments of the LCM. The relationship between the ontological and epistemological commitments of the LCM – and the LCM's relationship to other epistemological frameworks – is a separate issue entirely. Accordingly, in order to maintain focus in this paper, I jettison issues concerning epistemology and explanation, and focus solely only ontology, i.e., the PHC. Some hold that the ontological and epistemic aspects of a framework not only can, but *should* be kept separate (Sakar, 1992: 169). Whilst I am sceptical that any particular account of explanation can really be assessed without reference to the metaphysical commitments it, at least, implies, I will adhere to the distinction for present purposes.

Hopefully it is clear why (PHC) pertains to ontology. Ontology usually refers to what there is in the world, or at least one's own commit-

ments to what exists in the world. It is perhaps useful to think of an ontology as simply a list of what's in and what's out. Perhaps tables, chickens, and DNA molecules, are in (they exist) and ghosts, deities, and phlogiston are out (they don't). Furthermore a fully-furnished ontology will specify how those things *relate* to one another. The PHC provides a structure to the list, a way to understand how the things in one's ontology relate. Specifically the PHC, then, proposes that understanding what there is the world and how those things relate to one another can proceed by understanding the hierarchical *composition* of putative phenomena. It specifies how different phenomena can be related to one another – they can be composites of other phenomena (parts) and/or composed of other phenomena (wholes). The PHC begins to give order to the phenomena in the world and it does so specifically by creating the specific kinds of levels of organisation proposed by O&P.

At this point it will be useful to use a simple example in order to illustrate both how the PHC orders phenomena in the world and how the resultant order relates to O&P's criteria. Recall the layers of organisation introduced by O&P:

(L6) Social Groups

(L5) Multicellular living things

(L4) Cells

(L3) Molecules

(L2) Atoms

(L1) Elementary Particles.

Let's begin with phenomena from (L6). A bee colony is arguably a social group of some kind. According to the PHC it should be the case that a bee colony is *fully decomposable* into phenomena at (L5) – that is, into its requisite parts. That decomposition would consist of *multicellular living things* – in this case individual bees. The individual bees, by the PHC, are taken to be more 'basic' than the whole colony with each individual bee being *smaller* (or more 'micro') than the collective colony. Furthermore we can claim that the bee colony is composed of *nothing but* individual bees but there can be no sense in which an individual bee *is* a colony by itself. So far, then, it looks like the PHC meets conditions (1), (2), (4), (5), and probably (6). I say probably (6) because (6) is certainly the most vague of the conditions, presumably the decomposition of a bee

colony into individual bees is 'justifiable' and 'natural' from a scientific point of view. There are finite levels (two so far), the higher-level is composed of nothing but phenomena at the lower-level, and nothing from the lower-level should have any part on a higher level. To meet the final condition, (3), we need to continue with the decomposition. Whilst this two-level model has a 'lower-level' it does not provide a 'unique lowest level'; the level 'individual bee' is not a fundamental level to which all things can be decomposed.[8] Sticking to O&P's model, it should be the case that individual bees can be decomposed into cells (L4); those cells into molecules (L3); then to atoms (L2) and elementary particles (L1). Hopefully this example illustrates the *hierarchical* nature of the model. As one proceeds down the levels, decomposing as one goes, the entities found there are to be smaller and more basic than at the level above. They are smaller because parts are smaller than wholes. They are more basic because they are a part of a more fundamental level than the whole they constitute. Cells are smaller than bees, which in turn are smaller than bee colonies.[9] This hierarchy is often represented by a pyramid, with (L1) serving as the broad base and narrowing as the levels are ascended towards a peak.

Holding the PHC does not generate a commitment to O&P's proposed model of the actual token levels of organisation. The world, it might be suggested, seems to be an infinitely more complicated one than can be organised into the six suggested levels. This seems right, however the PHC itself only prescribes the decomposition of phenomena into smaller parts, and insists on a lowest level. One could still hold the PHC with an extremely expanded list of actual token levels. For example there are known to be, at least, *more* elementary particles than O&P would have been working with (for example, the Higgs boson's existence now having believed to be confirmed), and it's possibly the case that O&P wouldn't have even been considering elementary particles of this sort.[10] However, the PHC allows for such readjustment; tinkering with the levels. Despite this one of the most important aspects of the PHC (and O&P's model) is that it is supposed to be universal and generalisable. However many levels are postulated, it is supposed to be the case that one model (one system of levels) can capture *all* phenomena and that any given phenomenon has a proper place on the model; *one* level and *no more* than one.

3

3.1 The Unity of Science & The Layer Cake Model

The LCM provided the framework for the unity of science movement. In fact O&P presented their six conditions as *necessary* conditions to meet in order for the unity of science thesis to progress, or more specifically to establish the unity of science as a working hypothesis. But what is the unity of science thesis? The contemporary historical roots of the Unity of Science thesis can be found in the work of the Vienna Circle (*Wiener Kreis*) and early 20th Century Logical Empiricists (sometimes referred to as logical positivists[11]). For present purposes the most salient aspect of the Vienna Circle was their work on a Unity of Science or Unified Science (*Einheitwissenschaft*) beginning with the organising of several International Congresses for the Unity of Science,[12] and the subsequent publication of *The International Encyclopedia of Unified Science* (1938). The scholarship on the unity of science movement is vast, partly due to the nuanced differences between the positions of the members of the Vienna Circle, as well as those who followed them.[13] In order to maintain focus in this paper, it will be helpful to take a general overview from Ian Hacking ([8]) on the concept of 'unity', as advanced by the Circle.

'Unity' can refer to a plethora of categories but is most often taken to refer to three central themes. Unity of scientific language can refer to the desire for a single language for scientific discourse [1, p.32], or at least the potential translatability of different scientific languages to aid co-operation ([17, p.15]). Unity of scientific reasoning or methodology often manifested in the debates surrounding the demarcation of science from non or puesdo-science (Popper, 1959). Finally, metaphysical unity of science concerns the relationship between phenomena in the world and the branches of science that study those phenomena ([9]; [15, pp.336ff]).[14] It is only in the last of these three categories of unity in which one can see something like the LCM as integral. Hacking ([8, p.40]) subdivides metaphysical unity into three further categories:

A 'Interconnectedness' – all kinds of phenomena must be related to one another

B 'Structural' – there is a unique, fundamental structure to the truths in the world

C 'Taxonomic' – there is one fundamental, ultimate way of system classifying everything: nature breaks down into natural kinds.

The LCM can be seen as a way of fleshing out the categories A, B, and C. For example, B claims that there is a unique structure to the truths in the world – but it does not, by itself, specify *what* that unique structure looks like. The LCM does precisely that, by adding that the structure will be hierarchical, will consist in the decomposition of wholes into requisite parts, and will end with an ultimate lowest level of phenomena.

The main point I wish to stress here is that whilst it is the case that *historically* and *theoretically* the unity of science thesis and the LCM *can* be closely tied together – they need not be. By themselves Hacking's categories amount to a kind of monism about science – they stress that there is *one* fundamental structure to the world; *one* way of classifying phenomena. They do not, by themselves, entail *the* unity of science thesis associated with the Vienna Circle. Instead the unity of science thesis is reached by understanding A, B, and C as *reductive* principles. Phenomena in the world are connected via reductive relations from higher-level phenomena to lower-level phenomena (or more accurately, reductive relations between higher and lower-level *theories*). The unique, fundamental structure to the truths in the world is that ultimately all knowledge should be derivable from a set of fundamental laws, principles, and theories (presumably from physics). Rejecting aspects of the unity of science movement – specifically the *reductionist* understanding of unity – does not speak to rejecting the principles of the LCM. Due to this heavy focus on rejecting reductionism, the LCM remains prevalent in many post-unity accounts of the relationship between branches of science and the phenomena they study.

3.2 Non-reductive Physicalism as a Post-Unity Position

I label a position as *post-unity* if it has been developed in response to specific criticisms concerning the unity of science thesis. Non-reductive physicalism (NRP) is a paradigm example of a post-unity position as it has been developed in response to the perceived failure of the *theory* reduction required by the unity of science thesis ([15]). NRP is the view that ultimately everything in the world is physical (or describable in physical terms) but it is not the case that all theories (or laws, or predicates) in science are reducible to physical theories (or laws, or predicates). Another way to put this is that whilst any predicate from any branch of science is (or could be) token-identifiable with a physical predicate (a predicate from physics), it is not the case that any predicate from any branch of science must be type-identifiable with a physical

predicate. NRP is heavily employed in philosophy of mind, particularly when discussing the relationship between mental and physical properties ([12]). More generally, NRP has been used to attempt to accommodate properties that are said to be 'physically multiply-realisable'. For example, 'money' is a concept that is physically multiply-realisable – many 'physical' things can be used as (or satisfy the predicate) 'money' (paper, plastic, metals, sheep even). So whilst everything that can be used as a token of money is a physical thing, the predicate 'money' is not type-identifiable with any one physical type.

The example of money is not an arbitrary choice here. In a seminal paper in the development of NRP Jerry Fodor ([6]) focused on the multiple-realisability of economic predicates to reject Oppenheim & Putnam's claim that the unity of science ought to be pursued as a working hypothesis, as well as Nagel's specific account of theory reduction. Fodor argued that the multiple-realisability of economic predicates (like 'money') shows that reducing theories or laws to one another (and ultimately to physics) is impossible, or at least it seems extremely unlikely that such reductions could ever take place. This is because under Nagel's ([15, p.354]) account of theory reduction we would need to posit 'bridge-laws' to stand in the derivation of 'higher-level' theories from 'lower-level' theories. Such bridge-laws would need to contain a predicate from both the 'higher-level' and 'lower-level' theory (i.e., the reduced and the reducing theory, respectively). However, because the predicates of the 'higher-level' theory will almost certainly be multiply-realisable by predicates of the 'lower-level' theory, it is hard to see how one could postulate anything like a 'law' that contained both kinds of predicate. At best, such a law would have to contain a massively (possibly infinite) disjunctive predicate to reflect the multiply-realisable nature of the 'higher-level' predicate. Fodor further argued that massively disjunctive predicates are just not the sort of thing that figures in a law, by any ordinary undertaking of a scientific law.

Fodor's critique (along with others such as [20]; [14]) proved fairly convincing to many philosophers and contributed to the general demise of the unity of science thesis, at least in its classic form. As noted above the concept of multiple-realisability was a driving force in the critique, but it was also the basis for claims within NRP about the relationship between properties in the world (or more generally phenomena in the world). This relation is the *supervenience* relation. Supervenience can be a complicated piece of philosophical jargon with a plethora of uses across the field. It can be understood as a dependence relation.[15] It can

also be helpful to think of supervenience as a consistency or coherence constraint.[16]

The literature on supervenience is vast and it can be formulated in many ways.[17] In the present context the supervenience relation is designed to capture the idea the two properties can be *distinct* yet one property remains *wholly* dependent on (or 'fixed by') the other. The property, x, is wholly dependent on the other, y, in the sense that there can be no difference in x without a difference in y. To see this let's consider an example. Alexander Rosenberg has argued that, "the concept of fitness is *supervenient* on the manifest behavioural properties of organisms, their anatomical, physiological, behavioural, and environmentally relative properties" ([22, p.372], original emphasis). Let's call the properties that Rosenberg claims are the supervenience base for the concept of fitness that organism's set of P-Properties. The claim is, then, that there cannot be a difference in an organism's level of 'fitness' without a difference in their set of P-Properties; otherwise put, the 'fitness' of an organism is wholly dependent on their set of P-Properties.

Multiple-realisablity is also reflected in this example. Whilst it is correct to say that for *any given* organism its fitness of supervenes on its set of P-Properties (token-identity) it is *not* the case that for all organisms, 'fitness' supervenes on a *particular* set of P-Properties (type-identity). Thus whilst it is the case that once the P-Properties are fixed, the level of fitness too will be fixed; the same level of fitness can be realised in many different sets of P-Properties. In summary, NRP can be seen as a conjunction of accepting a supervenience relation for multiply-realisable properties (or, for that matter, events) and the move from asking for type-identity for such properties (reductionism) to accepting token-identity between them (non-reductive physicalism).

4 Non-reductive Physicalism & the Layer Cake Model

NRP is a post-unity position that has tried to accommodate seemingly physically multiply-realisable properties by citing a supervenience relation. But what bearing does this have on the LCM? Does NRP reject the LCM, modify the LCM, or endorse it? It is my contention that NRP continues to rely upon the PHC. To start with, then, does NRP reject the claim that all phenomena are subject to specific decomposition into their requisite parts? It doesn't seem so. Remember that whilst NRP rejects type-identity between 'higher-level' and 'lower-level' properties, it maintains token-identity. Accepting token-identity is primarily used

to retain the physicalist component of the theory (all things are ultimately physical, or describable in the language of physics). However, it also seems to allow for the decomposition claim. If we once again return to the concept of money, it would seem to hold that whilst not everything that is 'money' is decomposable into the *same* (physical) parts it is decomposable into its *physical* constituents.

If NRP does endorse decomposition then from the above talk of 'higher' and 'lower' level properties, non-reductive NRP maintains the *hierarchical* nature of the decomposition. This might seem odd given the stress on the impossibility (or at least improbability) of *reducing* these properties to one another. Nevertheless the concept of *levels* or *layers* hierarchically structured is certainly maintained by token-identity. Whenever talk of token-identity is afoot, proponents of NRP still referring to identifying 'macro' or 'higher level' properties with 'micro' or lower-level' properties. Take the debate in philosophy of mind as an example. The debate concerns the relationship between mental and physical properties and is also couched under the long-established 'mind-body problem'. Interestingly, it is not straightforward to slot 'mental' and 'physical' properties in to O&P's six levels. Mental properties are taken to belong to what is referred to as 'folk psychology' and pertain to (amongst other things) propositional attitudes such as believing, wanting, and hoping. These predicates are taken to belong to theories in psychology as well as capturing the way we commonly use them (hence the 'folk' label). When philosophers talk of 'physical' properties in this debate they are referring to what is going on in the brain. They are referring to theories from neurobiology. So perhaps when philosophers talk of 'physical' properties within this debate they are referring to phenomena at (L3) and with 'mental' properties a new, higher level: (L7). Thus ultimately, however the phenomena are categorised, even within a non-reductive physicalist setting the debate is still about the relationship between theories at different *levels* of organisation.

There is still one important difference between referring to levels of organisation and holding the PHC, which is found in the claim that there is an ultimate, or lowest, level of phenomena to which all things can be decomposed and that it is always and only the next lower level. Surely, if one is a *non-reductive* physicalist, one can avoid this claim. This, I contend, is misguided. The PHC talks of *decomposition* and not *reduction*. Reduction is about theories, predicates, laws, and so on. It is about the project of neatly logically deriving all theories and explanations about the world from a set of fundamental principles. In other words, it is

about the classic unity of science project. Decomposition, on the other hand, is not about abstract reconstructions of theories and their logical relation to other theories. Decomposition is largely concerned with *mereology* – the constitutive relationship between parts and wholes, and the organisation and activities of those parts. In-line with the acceptance of a supervenience relation between higher and lower-level properties, it seems consistent to claim that NRP is compatible with what has been called mereological supervenience ([21, p.123]). Mereological supervenience would claim that wholes supervene on their parts. Nothing too controversial there. But if the hierarchical structure of decomposition is maintained it follows that eventually, once the supervenience relations of parts and wholes have been established, there will be a lowest level of decomposition – a part that supervenes on nothing but itself. To reinforce this point consider again the levels of organisation introduced by Oppenheim & Putnam:

(L6) Social Groups

(L5) Multicellular living things

(L4) Cells

(L3) Molecules

(L2) Atoms

(L1) Elementary Particles

Whilst it is no longer the case, under non-reductive physicalism, that theories from (L6) can be *reduced* to a set of theories at (L1), it will still be the case that wholes at (L6) will supervene on nothing but their parts on (L5), and wholes on (L5) supervening on nothing but their parts on (L4), and so on. In fact, the transitivity of supervenience ensures that – given the hierarchical structure of the model – wholes from (L6) will supervene, ultimately, on parts from (L1). This maintains the claim from the PHC that there is an ultimate, or lowest, level of phenomena to which all things can be decomposed.

To summarise, whilst NRP has focused on rejecting the unity of science thesis – specifically the grand reductionist aspect of it – the token-identity and mereological supervenience theses used to replace reductionism are fully compatible with the PHC. Not only is the concept of hierarchical levels maintained by non-reductive physicalism, but so too is the idea that there is ultimately a lowest level of reality, a level

upon which everything else depends. In establishing this conclusion I hope to have shown that characterisations of the LCM as a model of reduction are incorrect, due to its compatibility with an explicitly non-reductive thesis. This argument should have demonstrated the need for the clarification of the LCM as a *framework* (or articulation of the levels of organisation concept), the unity of science thesis as an account of *reduction*, and NRP as a *post-unity* but not *post-LCM* account. As suggested in 2.1 this work will now constitute a small step in the direction of a fuller engagement with the LCM; it's relationship to other theses about the organisation of phenomena in the world; and hopefully the emergence of a truly pluralistic articulation of the levels of organisation concept.

5 Conclusion

In this paper I argue that non-reductive physicalism, a post-unity account of the relationship between phenomena in the world and the branches of science that study them, continues to rely on the layer cake model of the world. In 2 I introduce the layer cake model through a careful analysis of Oppenheim and Putnam's classic presentation of the model. I then introduced *the principle of hierarchic compositionality* and argued that it captures the ontological aspect of the layer cake model. In 3 I introduced non-reductive physicalism as a post-unity account; showing its relationship to the classic unity of science thesis. Finally in 4 I demonstrated how non-reductive physicalism continues to rely on the principle of hierarchical compositionality and thus that non-reductive physicalism continues to rely on the layer cake model of the world.

Notes

1 For example, Jerry Fodor's ([6]) seminal paper 'Special Sciences', which is perhaps an *exemplar* text for the beginnings of non-reductive physicalism, is directly targeted at the unity of science thesis, specifically Ernest Nagel's [15] 'condition of connectability', or 'bridge-laws.

2 "The classic presentation of the layer-cake model *of reduction* is found in Paul Oppenheim and Hilary Putnam's [19] essay 'The Unity of Science as a Working Hypothesis'" ([25, p.60]; my emphasis). Steel ([25, pp.61–62]) goes on to emphasise the difference between the LCM account of reduction and Ernest Nagel's model of reduction. My contention here, however, is not that there is a *difference* between the two accounts of theory reduction; but in fact only Nagel's is

an *account* of theory reduction – Oppenheim & Putnam's LCM is a framework within which reduction might take place.

3 Of course, a further reason to see the compatibility as a significant result is that the proponent of NRP might be worried about its compatibility with the LCM. The LCM is, at the very least, a problematic account of levels of organisation; perhaps an account that one might want to rule out compatibility with. However, in this paper I will not be arguing the LCM is false and, accordingly, I will not be stressing that NRP's compatibility with the LCM is problematic, in that sense.

4 For example, Joseph K. Feibleman ([5]) discussed hierarchical and integrative levels of organisation before the publication of O&P's paper.

5 Perhaps the work of the 'organicists', who took a more holistic approach to the organism might have been an exception here, see for example Joseph Needham ([16]).

6 Or at least the levels must be finite towards the *bottom-end* of layers. Nothing about condition (3) precludes there being infinite levels *above* the unique lowest level. Perhaps condition (6) may at least constrain the positing of infinite levels, in the sense that putative levels must at least correspond to a scientifically justifiable classification of phenomena.

7 It may be more, or less, than this. For example, the LCM may just be a heuristic device to structure research programmes. I do not think there can be as fruitful a discussion about the LCM as a heuristic device as there can be about its more substantive ontological and epistemic commitments.

8 This is also perhaps why condition (6) is not yet met. Perhaps the 'natural' and 'justifiable' thing to do from a scientific point of view is to continue to decomposition analysis until it reaches this 'unique fundamental lowest level'.

9 It also seems implicit in the model that not only are the entities smaller at each level, but they are also more numerous e.g., one bee has *many* cells. However, it is not immediately clear that this is specified by O&P's conditions.

10 There was little to no evidence for quarks, for example, until 1968 with the current understanding being supported by experiments at Firmilab only in 1995 (Carithers & Grannis, 1995: 4-16).

11 Though this does not seem to be how they referred to themselves. Neurath ([17, p.1]), for example uses the labels 'logical empiricism' and 'empirical rationalism' but does not mention 'logical positivism' in his opening paper of the *International Encyclopedia of Unified Science*.

12 The first being held at the Sorbonne, Paris in 1935 ([17, p.26]).

13 For a comprehensive overview of both the Circle and its key members see Friedrich Stadler ([24]) *The Vienna Circle. Studies in the Origins, Development and Influence of logical Empiricism.*

14 Ironic, perhaps, that Hacking chooses the label 'metaphysical unity' to capture, at least some, aspects of unity worked on by the logical empiricists; famous for their rejection of metaphysics. The concerns of the Vienna Circle are probably best associated with unity of scientific language; however, the specific label doesn't matter much for present purposes, it nevertheless captures a salient project of the unity of science thesis.

15 In fact not much is lost, at least for a basic understanding of supervenience, by just reading 'supervenes on' as 'is dependent on'.

16 In the case of normative judgments, for example, it would be incoherent to hold that two events with identical non-normative content be given *different* respective normative judgments – illustrating how the normative *supervenes on* the non-normative.

17 Arguably the most detailed work on supervenience is due to Jaegwon Kim ([11]).

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