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The Web of Reality: 
Mechanisms of Complexity & 
The Metaphysics of Levels

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Abstract

This dissertation examines the potential relations between the objects and processes different sciences study. It examines the history, motivations, and analytical consequences of the thesis that individual sciences (such as physics, biology, and psychology) essentially pick out and describe different 'levels' of reality. It argues against the notion that there are different levels of reality that divide empirical domains of enquiry from one another. It proposes an alternate, more fluid, conception of scientific boundaries based upon patterns of causation and spatio-temporal contexts.
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The Web of Reality: 
The Metaphysics of Levels & Mechanisms of Complexity

Contents

Chapter 1: Levels of Reality .......................................................... 1
  1.0 Metaphysics, Levels, & Reality ............................................. 1
  1.1 Presuppositions & Aims: Clarifying the Debate ...................... 3
  1.2 Inferring Reality-Metaphysics & Methodology ...................... 5
  1.3 A Preliminary Case for Levels ............................................ 8
    1.3.1 Materialism .......................................................... 9
    1.3.2 Realism ............................................................. 13
    1.3.3 Emergence .......................................................... 16
      1.3.3.1 Property Emergence ........................................... 18
      1.3.3.2 Object Emergence ............................................. 20
    1.3.4 The World according to the Levels Hypothesis .................. 22
    1.4 Levels, Realism, & the Realist Dilemma ............................ 23
      1.4.1 The Problem of Inter-level Interactions ....................... 24
    1.5 The Road Ahead ....................................................... 26

Chapter 2: The Compositional Conception of Levels .................... 28
  2.0 Compositional Ontological Levels ...................................... 28
  2.1 Oppenheim & Putnam’s “The Unity of Science” ...................... 30
  2.2 The Logic of Part/Whole & Explaining Scientific Explanation .... 32
  2.3 In Defense of Compositional Levels .................................... 35
    2.3.1 The Argument from Compositional Realism ...................... 36
    2.3.2 The Argument from Micro-Origins ................................ 40
    2.3.3 The Argument from Arbitrary Objects .......................... 42
    2.3.4 The Argument from Causal Emergence ........................... 44
    2.3.5 The Argument from Natural Kind Essentialism ................. 46
    2.3.6 The argument from inter-level interaction ..................... 49
    2.3.7 The argument from ceteris paribus clauses ...................... 50
  2.4 Summarizing The Case For Compositional Levels ................... 51

Chapter 3: Composition and the CCL ......................................... 53
  3.0 The Essential Problem of the CCL .................................... 53
Chapter 4: Property Conceptions of Levels-The PCL

4.0 Property Conceptions of Levels (PCL) ........................................ 82
4.1 Arguing Over Properties-Preliminaries ........................................ 85
4.2 The Preliminary Case for the PCL ............................................. 86
4.2.1 The Argument from Materialism ........................................... 87
4.2.2 ‘Functionalist’ & Realism ....................................................... 88
4.2.3 Multiple-Realizability and Emergence .................................... 92
4.3.0 Populating PCL Levels ......................................................... 96
4.3.1 Davidson on Homonomic Laws .............................................. 98
4.3.2 The Software Analogy .......................................................... 99
4.3.3 Fodor, Disjunctive Laws, and Disjunctive Properties ............... 101
4.3.4 Disjunctive Properties vs. 2nd Order Properties ..................... 106
4.3.5 From Disjunctive Properties to Levels .................................. 107
4.4 Summarizing The Case for the PCL .......................................... 108

Chapter 5: Against the PCL .............................................................. 110

5.0 The Case Against The PCL ....................................................... 110
5.1 Heil against the PCL ............................................................... 112
5.1.1 Problems with Heil ............................................................ 113
5.2 Kind-splitting ................................................................. 117
5.2.1 Split Kinds, Disjunctive Laws, and Ontological Inflation ........ 120
5.3 PCL Responses ................................................................. 122
5.3.1 Lawful Property Disjunctions as Indicative of Mistake .......... 122
5.3.2 Open vs. Closed Disjunctions ............................................ 124
5.3.3 Metaphysical Openness ..................................................... 126
5.4 Ceteris Paribus Clauses & Homonomic Laws ............................ 127
5.5 The Case Against the PCL ...................................................... 130

Chapter 6: Over-determination & Levels ........................................ 132

6.0 Over-Determination ............................................................... 132

3.1 Level-eliminativism vs. Macro-eliminativism ................................ 54
3.2 The Vagueness of ‘Composition’ ............................................ 55
3.3 Why Formal Mereology Doesn’t Help ...................................... 56
3.4 Material Composition .......................................................... 61
3.5 Structural Composition ......................................................... 64
3.6 Structural Composition, Ordered Levels, & Intransitivity ............ 68
3.7 Intransitivity & The Natural World ......................................... 71
3.8 The Central Charges against the CCL ..................................... 73
3.9 Summarizing the Case Against CCL ...................................... 79
6.1 The Over-Determination Problem(s) ................................................................. 132
6.1.1 Over-Determination Along the Horizontal Axis ........................................... 135
6.1.2 The CCL and Over-determination along the vertical axis ............................. 144
6.2 Should We live with Over-determination? ...................................................... 147

Chapter 7- Mechanisms vs. Levels: Solving the Problem of Over-Determination .... 151

7.0 Beating the Ontological Competition ............................................................ 151
7.1 Learning From Levels’ Mistakes ..................................................................... 152
7.2 Mechanisms ..................................................................................................... 155
7.2.1 Mechanisms, Functions, & Science ............................................................. 157
7.2.2 Mechanisms & Laws ................................................................................. 161
7.2.3 Mechanisms & Science .............................................................................. 163
7.3 Mechanistic Interaction: Avoiding Overdetermination (Part 1) .................... 165
7.3.1 Mechanisms, Theories, & Horizontal-Glue ............................................... 167
7.4 Property Emergence and Mechanisms ............................................................ 174
7.4.1 Object Emergence and Mechanisms ......................................................... 177
7.4.2 Mechanisms of Emergence in the Natural World ....................................... 180
7.5 Mechanisms, Materialism, & The Vertical Axis of Reality .......................... 188
7.5.1 Micro-Supervenience is Not Empirically Given ....................................... 194
7.5.2 Further Arguments Against Micro-supervenience .................................... 197
7.6 Leaving Levels Behind .................................................................................... 205

Bibliography ............................................................................................................ 207
Chapter 1: Levels of Reality

1.0 Metaphysics, Levels, & Reality.

The philosopher Jaegwon Kim recently noted “talk of levels is encountered everywhere, it has thoroughly permeated the primary scientific literature...as well as philosophical writings about science” (1998, 16). Kim subsequently urged philosophers to start “taking the levels talk and its attendant metaphysics seriously, more or less at face value, and try to make sense of it—or as much sense as one can” (2002, 2). In what follows I take up Kim’s challenge.

This is an exercise in empirically oriented metaphysics. The aim is to explore the case for and against the existence of ‘levels’ of reality that roughly correspond to domains of contemporary science (i.e. physics, chemistry, biology, psychology, etc.). The verdict I return is largely negative. While levels talk may be a prominent feature of contemporary reality, ‘levels’ themselves likely are not. The prominence of levels-talk can be instructive, however; many components of what I call the ‘Levels of Reality’ hypothesis have ancient intellectual roots and they help explain important features of the world as naturalistically conceived. Exploring what’s right and what’s wrong about the levels of reality hypothesis can, I believe, help in the building of a better conception of the world as revealed by science.

The Nobel prize-winning physicist Philip Anderson (2001) recently complained that “what seems to be missing in the thought of many philosophers of science... (is the realization) modern scientific knowledge is not an evolutionary tree or a pyramid but a multiply-connected web” (488). Anderson makes a worthwhile point. While many scientists seem to miss the point as well, and while I believe Anderson’s emphasis on
knowledge (vs. reality) is misplaced, an alternate way to characterize the present project is as an attempt to locate the problems with the pyramid and to get clearer on the motivations for taking something like Anderson's 'multiply-connected web' as a metaphysically serious option.

Richard Rorty has quipped that 'interesting philosophy' usually is "a contest between an entrenched vocabulary which has become a nuisance and a half-formed new vocabulary which vaguely promises great things" (9, 1989). While I don't agree with Rorty about much, there may be some of that going on here. Levels-talk has become a nuisance. It distorts discussion of the ways different sciences, objects, and processes relate to one another.

When one divides up the world into a discrete hierarchy of micro/macro or property (i.e. physical, chemical, biological, etc) relations, then a tacit assumption takes hold that these domains are (always, everywhere) related to one another in the same way. Thus there is now much debate regarding whether individual sciences are completely autonomous from one another (as authors such as John Dupre (1993) and Jerry Fodor (1997) have maintained) or whether they are all ultimately reducible to 'lower-level' micro-processes (as Jaegwon Kim (2003) and David Lewis (1999)) have maintained.

But debates like this exemplify a false dichotomy. The assumption that all psychological processes (for example) must collectively either be autonomous from, or wholly reducible to, neurobiological processes is ill motivated. Pre-theoretically, there is nothing to rule out the possibility that some psychological processes are wholly determined by neurological processes while some are not. But many philosophers fail to see anything but an 'all or nothing' position regarding inter-theoretic science and
relations. Much of the reason for this, I submit, is the conceptual blinders put in place by their (often tacit) acceptance of the levels of reality hypothesis.

1.1 Presuppositions & Aims: Clarifying the Debate

Many contemporary philosophical debates concerning reduction, emergence, realism, natural kinds, etc., touch upon issues I will be discussing below. At least one reason such debates have become prominent is, as Jerry Fodor put it, “this is one area where the metaphysics matters” (Fodor 160, 1997). It matters because the intuitions in question, such as those about whether ‘lower levels’ (i.e. those dealing with microparticles and processes) are in some sense more fundamental than higher ones, help determine where scarce research dollars get spent.

While it’s nice to matter, the aims of many contemporary philosophical discussions of these issues are orthogonal to mine. The issues can be framed in very different ways. Some authors see the crucial questions as concerning the structure of theorizing, practice, or language, rather than the structure of reality. One reason for this is that many strands of contemporary philosophical thought have positivist/anti-realist roots. Anti-realists tend to see metaphysical debate as something of a doomed attempt to ‘eff’ the ineffable’, as metaphysical posits (just like all theoretical posits) are bound to be under-determined by the available evidence. There will always be alternate ontological schemes, the anti-realist will point out, that could produce the evidence such debates rely on. As such, anti-realists tend to see the proper focus of philosophers in regards to science as being on its process--whether and how it is rational and progressive--rather than its product (i.e. what it can tell us about the nature and structure of reality).
Given that there are those who conceptualize these issues very differently, to stave off misunderstanding I want to make my assumptions and aims explicit here at the start. I will simply note in passing—as Michael Redhead recently put it—"to anti-realists, or social constructivists, this realist discussion looks patently absurd. There is no way that the world is" (1999, 70).

In what follows I am just going to assume that there is such a thing as reality and that science aims at (and sometimes succeeds in) accurately mapping it. Metaphysics and ontology, as I see them, play an essential role in helping to delineate the 'furniture of the universe'. They serve as a necessary complement to empirical enquiry. While controlled experiment and observation may provide our most credible sources of evidence, they do not take place in a metaphysical vacuum. By necessity, scientists (as well as everybody else) make substantive assumptions about the way the world works that go beyond the point where experience and experiment can speak definitively. Getting those assumptions out in the open while placing them under the analytical microscope is the proper aim of ontological enquiry on the current view.

I am a realist about science. I believe the proper explanation for why our representations of reality work—i.e. allow us to successfully navigate and control bits of the world around us—is that these representations reflect the way the world really is. Scientific Realism has different forms. In what follows I will largely follow Richard Boyd (2002) in his recent definition of 'scientific realism' as the view that "the characteristic product of successful scientific research is knowledge of largely theory-independent phenomena and that such knowledge is possible (indeed actual) even in those cases in which the relevant phenomena are not ... observable" (1).
My aim in what follows is to analyze the thesis “that the world, it seems, runs in parallel at many levels” (Fodor 162, 1997); that there is a “hierarchy of levels of nature, each level marked by a nexus of nomic generalizations and supervenient on all those levels below it” (Lycan, 1993, 49); that “levels are not arbitrary but arise naturally, they are ‘cutting the world at its joints’” (Rohrlich 186); that “levels are a deep, non-arbitrary, and extremely important feature of the ontological architecture of the natural world” (Wimsatt 1994, 225).

And as the introductory quote from Kim noted, this appears to be a thesis scientists are as likely to hold as philosophers. Note the prominent biologist, E.O. Wilson, recently characterized the primary aim of science as the attempt “to fold the laws and principles of each level of organization into those at more general, and hence more fundamental levels” (Wilson 55).

1.2 Inferring Reality-Metaphysics & Methodology

Some see metaphysical inquiry as essentially involving the employment of deductive reasoning in the pursuit of certain knowledge of eternal truths proceeding from unquestionably true premises (Van Inwagen’s (1990) embodies something close to this stylistic caricature). In contrast, I see metaphysics closer to science in methodology and aim. Both seek substantive truths about the nature and structure of reality (be it in terms of ‘Superstrings’ or ‘immanent universals’). Both truck in the supposition of unobservable theoretical entities (‘cause’, ‘gene’, ‘mental module’). And both can employ inference to the best explanation (also ‘abduction’ or ‘ampliative inference’) as a primary guide (see Swoyer’s (1999)). Inference-to-the-best-explanation is the style of reasoning that led to the acceptance of the atomic hypothesis as the best explanation of
Brownian motion. It similarly led to the positing of Neptune to explain irregularities in Uranus' orbit. In both of these cases, unobserved (and at the time unobservable) entities were assumed to exist because the causal/determinative powers attributed to them could explain parts of the observed world.

According to an inference-to-the-best-explanation strategy, one should attempt to pile up as many arguments as possible for and against a particular hypothetical posit and then assess how much and how well its existence would explain in combination with other widely accepted explanatory frameworks. For example, the atomic explanation of Brownian motion was deeply resisted by Ernst Mach and other physicists (see Lindley) for over a century until Einstein's 1905 paper vindicating Boltzmann's statistical approach to classical thermodynamics. Similarly, it wasn't until heliocentrism and Newtonian gravitation had been accepted that the supposition of the planet Neptune would have made sense. This second component of the strategy--assessing fit with other accepted explanatory models--provides the primary constraint on potential abductive inferences. It provides some insurance against accepting the existence of fanciful entities (i.e. ethereal quantum elves) in the face of genuine mysteries. While the application of such a constraint in a metaphysical context is complicated by the fact that there is less general metaphysical consensus currently on offer than, for example, heliocentrism and the Newtonian account of gravity had at the time of the acceptance of Neptune's existence, in the next section I will provide some additional constraints to guide our discussion regarding whether the Levels-of-reality hypothesis is ultimately to be accepted.
Not everyone accepts abductive arguments as valid primary tools of metaphysical inquiry. However, in the face of anti-realist objections to my methodology, I will again simply admit and pass over the fact that there is no guarantee that inference-to-the-best-explanation will lead to ontological truth; there is admittedly room for slack between best explanations and true ones. Something can be the best of a bad lot. Even so, the attempt to obtain better ontological frameworks (rather than true ones) can still be motivated as part of an attempt to open up unexplored avenues of theoretical and empirical inquiry. Additionally, the ontological strategy adopted herein can be justified in the current context in part on the prior assumption of scientific realism. After all, inference-to-the-best-explanation is widely employed within science itself and justified by its past successes. If we assume (as I have) that it can lead to truth in the empirical realm, objections to it in a metaphysical setting appear simply question-begging. Finally, the metaphysical strategy adopted herein can also be justified on grounds of skepticism regarding other methods of metaphysical assessment. Until the invention of the ontoloscope, ‘inference to the best explanation’ is likely the only metaphysical game in town as concerns the attempt to lay bear the underpinnings of the ever-evolving world as revealed by science.

Now given that this style of analysis crucially entails assessing how well levels-of-reality can serve explanatory roles, a crucial preliminary to any critique is to get a handle on what they may be able to explain. As such, the next section turns to that question.
1.3 A Preliminary Case for Levels

Why have so many come to accept talk of levels of reality, as Kim put it, ‘at face value’? Analyzing the case for levels is complicated by the fact that there is no explicit set of ‘canonical’ arguments in favor of their existence. The present work constitutes the most elaborate defense, as well as critique, of which I am aware. While the roots of the idea appear ancient, explicit talk of ‘levels of reality’ is rooted in the late nineteenth and early 20th century. While explicit arguments attempting to motivate the talk were rare, an examination of the historical roots of the idea reveals three distinct (but inter-related) sorts of metaphysical intuitions feeding into the contemporary prominence of levels-talk. These are: Materialism, Scientific Realism, & Emergence.

Individually, none of these three entail the existence of levels. Collectively, however, the Levels-of-reality hypothesis can be seen as offering perhaps the best hope/support that these metaphysical views can be made consistent. As such, the support that the levels hypothesis draws from these notions essentially relies on two different sorts of assumptions: (1) that each of these theses constitutes a metaphysical intuition worth saving, and (2) that the levels of reality can make them consistent.

Much of what follows in the chapters to come constitutes an examination of the second of these assumptions. In following the methodology laid out above, materialism, scientific realism, and emergence can be seen as the constraining theories that the levels-of-reality hypothesis needs to be able to ‘fit’ in order to be justifiably accepted. While these three, admittedly, do not constitute a metaphysical consensus akin the acceptance granted Newton’s gravitational theory, they constitute probably the largest ‘bloc’ of metaphysical consensus in contemporary philosophical discussions. The next three
sections examine attempts to develop them specifically with an eye toward their potential relation to the levels hypothesis.

1.3.1 Materialism

The British psychologist and philosopher, C. Lloyd Morgan, appears to be the first philosopher and scientist to explicitly employ the notion of levels of reality in a substantive way (though the idea certainly appears implicit in authors who came before). Morgan was one of the ‘British Emergentists’, an intellectual movement primarily comprising the 19th and early 20th century philosophers John Stuart Mill, Morgan, C.D. Broad, Samuel Alexander, and others. Emergentism is a doctrine easy enough to identify with a slogan—"the whole is more than the sum of its parts". However, pinning down the doctrine further than that is not easy.

In such cases, one way to approach any philosophical school of thought is to first note the doctrines it is reacting against. In the case of the emergentist movement, they specifically were rejecting a kind of Cartesian dualism which attempted to divide up the world into radically distinct domains—a mental and a physical domain. They were equally suspicious of radical empiricist attempts to reduce reality to phenomenal experience, as well Kantian styled idealism. As the original emergentist saw it (it is not unusual for contemporary emergentists--such as David Chalmers (1999)—to actually hold views closer to Descartes than C. Lloyd Morgan’s), there is a sense in which everything is fundamentally cut from the same ontological cloth, but there is also a sense in which relations between fundamental ingredients can arise that bestow new causal powers upon particular ‘higher-level’ entities and processes. In his *Emergent Evolution* (1923) Morgan
sums his view of levels as being a kind of metaphysical blockade from determination from below—

"I speak of events at any given level in the pyramid of emergent evolution as ‘involving’ concurrent events at lower levels.... But when some new kind of relatedness is supervenient, the way in which the physical events which are involved run their course is different" (Morgan 1923, 15).

A big part of the intuitive pull of levels-talk, I believe, is its ability to connote the kind of sameness and difference, at one and the same time, which the early British Emergentists were so pre-occupied with. Consider the pixels lighting up my computer screen. There is a sense in which the pixels are importantly different. The relative differences in their color and spatial location determine the words and images displayed on my screen. But there is also a sense in which these pixels are all fundamentally the same—just tiny light emitting crystals. Speaking loosely, one could say there is a ‘level’ at which they are importantly distinct, a ‘macro’ level at which they constitute letters and images. But at the same time there is ‘a level’ at which they are all fundamentally the same—a ‘micro’ level of pixels.

This ‘level of sameness’, or fundamental commonality, can be seen as the crux of difference between the ontological claims of contemporary defenders of levels talk and a Cartesian, who wants to say that mind and body are two radically different sorts of stuff. The employers of levels talk imply that things which are metaphysically distinct in one regard, are fundamentally the same in some other. Levels-talk attempts to provide a conceptual space for the claim that different sorts of things can, ‘at bottom’, be cut from the same sort of ontological cloth.
This desire to convey a sense of fundamental sameness has a potentially enlightening historical precedent—the notion of the ‘great chain of being’. To see the link, consider Morgan’s fellow emergentist Samuel Alexander’s (1920) characterization of the six “levels of existence”:

- Deity
- Mind
- Life
- Matter
- Primary Qualities
- Space-time

Alexander’s metaphysical views make him something of an early 20th century successor to Spinoza in his materialist conception of God. “God is the whole universe engaged in the process towards emergence” (1920, 428). Regardless, Alexander’s placement of Deity atop the highest ‘level’ recalls an ancient and recurrent theme in intellectual history—namely the idea of a ‘great chain of being’ (see Lovejoy) leading ‘upwards’ toward God.

Explicit treatments of the ‘Great Chain’ date back at least to St. Augustine (4th century A.D.). At the heart of the Augustine’s conception of ‘the great chain’ lay the notions of plenitude, gradation, and commonality. Plenitude denoted God’s preference for a diverse universe over one with only the ‘highest’ beings. Gradation denoted a strict ordering relation of the plenitude in terms of nearness to God. Commonality denoted the ‘being’ of everything as pervaded by/dependent upon God.

While God’s Holy Spirit may have been Augustine’s sustaining commonality, the emergentists and contemporary employers of levels-talk have replaced God with matter as the fundamental ontological common denominator. Dependence is now seen as coming from below rather than from above. A material commonality, rather than the historically
posited spiritual one, now appears to motivate a good bit of levels-talk and its connotation of fundamental sameness.

There is a terminological distinction worth marking off here at outset. Many contemporary philosophers now use the term ‘physicalism’ to pick out the metaphysical doctrine of ‘materialism’ (both Dupre (1993) and Lewis (1999) recommend a return to “materialism” for reasons similar to my own). They do so because they wish to remain neutral about whether the fundamental constituent is matter (vs. fields, waves, strings, membranes, or some other yet-to-be-posited basic ‘physical’ element). This has brought about some confused discussion in contemporary philosophy. ‘Physicalism’ originally denoted a linguistic rather than a metaphysical doctrine (see Neurath’s (1935) & Carnap’s (1936)). Additionally, ‘physicalism’ (see Melnyk (2003)) can pick out a number of different theses regarding contemporary mathematical physics. As noted before, in what follows my concern is with ontology. Materialism, as I understand it, amounts to the claim that everything that exists at a particular place and time is made of the same stuff: matter. In what follows any discussion of ‘physicalism’ should be presumed to involve this ontological doctrine rather than any linguistic, epistemic, or quasi-scientific doctrine.

Before moving on it is also worth noting that levels have come to play something of a crucial (although typically implicit) role in contemporary philosophical debates over materialism. Over the latter half of the 20th century, the so-called “Causal Exclusion Argument” has been taken as the pre-eminent argument for materialism (both Sturgeon (1998) and Lowe (2000) call it the ‘only’ argument for materialism). The ‘Causal Exclusion Argument’ for materialism, I submit, is a prominent source of levels talk in philosophy. As usually formulated, the argument simply concerns the materiality of
mental phenomena. However, it can be extended to argue for the materiality of anything with causal powers. The argument's standard form:

1. Mental events cause physical events.
2. Physical effects always have physical causes.
3. Physical events are not systematically over-determined. Mental events must be physical events.

While this argument makes no explicit mention of levels, I believe many philosophers who defend 'levels' do so because of it. Levels enter on the heels of the exclusion argument because it fails to make clear what it means to call a 'mental event' (or a biological event, chemical event, etc.) a 'physical event'. The fact that the event is called 'mental' at all indicates that it is more than 'just physical'. Rather it must be mental in addition to being physical. And this 'two in one' hedge, commonality and difference, is precisely what the levels idiom is tailored to convey. The mental and physical are different on one 'level', but the same on some deeper level.

1.3.2 Realism

If the commonality implications of levels-talk provide the metaphysical cake of contemporary materialism, the implication of difference give levels-talk its potential empirical bite in regards to realism about science. Many philosophers who favor talk of levels, such as Jerry Fodor, do so in defense of a self-proclaimed 'industrial-strength' scientific realism. The relation between scientific realism and the levels-of-reality hypothesis has a straightforward analytical form. As Fodor sees it, if one accepts science is in the business of describing reality, and one then notes that there are in fact many different sorts of science around, then the conclusion that there are many different sorts (or levels) of reality appears to follow essentially. The common division of science into
physical, chemical, biological, and psycho-social realms is just a starting point. Cosmology, ecology, geology, bio-chemistry, meteorology, as well as many other putatively distinct sorts of science exist as well.

According to this line of thought, a given level of reality can be thought of as a kind of ontological correlate of a domain of scientific enquiry, such as biology, chemistry, etc... . Note that levels are not supposed to be lonely places. What makes plausible the talk of ‘a level’ of letters on my screen (over and above the pixels) is the existence of a set of relations among a specific set of pixel collections—the fact that they are things of the same type (i.e. letters), that they can interact to form words, sentences, and so on. A single squiggle would not sanction talk of a higher-level even though it might be thought distinct from the pixels that compose it.

This point is important. For a set of entities to be on a level, some sort of intra-level relatedness or ‘glue’ must exist that binds the set together as being on the same level. Accordingly, those who see an essential relation between scientific realism and levels propose that discerning this intra-level relatedness is the proper aim of the study of a higher-level science. Different sciences uncover different intra-level relations amongst different sets of higher-level entities. Much as there are real relations between letters (as well as words, sentences, paragraphs, etc.,) that determine the arrangement of pixels on my word processor screen, there are real relations between the composite entities that different sciences study that determine their lower level constituents.

A crucial feature of representing reality as possessing higher and lower levels running in parallel, as per Fodor and others, is that it simultaneously highlights a horizontal, intra-level, structure (such as the relations between words of a sentence on
my screen) along with a vertical, inter-level, structure (such as the relation between the letters and the words on this page). There are many scientific and worldly phenomena that can be usefully conceptualized in this kind of 2-dimensional way:

![Diagram of inter-level and intra-level relations]

It is worth noting here, however, that the utility of this sort of analytical structure invites a potential equivocation. While both philosophers and scientists (and I, in what follows) will often speak about intra-level relations in terms of 'a set' of relations, or properties, etc., or in terms of 'domains' of objects, it is important to keep in mind that such talk is loose in the current context. It conceptualizes a level as a static abstract entity.

However, what is at issue is the reality of levels in structuring the world. The domain of a science, understood in terms of a set of objects, laws, processes, properties, causes, etc., is a static entity. Conceptualizing a level merely as a domain gives the impression that levels constitute rungs on a metaphysical spice rack Mother Nature occasionally pulls an ingredient off of when cooking up an event. But the thesis under consideration is that 'the world runs in parallel at many levels'. Levels are not just collections of cake ingredients, but also the ways that the layers of the cake get baked. The levels of reality thesis entails that the intra-level/horizontal aspects of levels are not just abstract domains or sets. Rather they essentially constitute diachronic
causal/nomological dimensions of determination at work in structuring the events of our world over the course of time.

1.3.3 Emergence

According to the levels of reality thesis canvassed so far, the vertical dimension of levels can be understood as underpinning (as per the motivations canvassed in 1.3.1) a contemporary materialist commitment to fundamental commonality. The horizontal dimension of levels can be seen (as per the motivations of 1.3.2) as underpinning the different sorts of causal determination relations studied by different sorts of science. Correspondingly, the third and last motivation behind the levels of reality hypothesis—emergence—can be seen in terms of the intersection of these two aspects of reality. Different sciences study different types of nomological relations at work in structuring the world, but materialism implies all entities are fundamentally the same. What do we need different sorts of nomological relations for if everything is essentially of the same sort? Accounts of emergence try to resolve this tension by explaining how ontological difference can arise from fundamental ontological sameness.

Historically speaking, accounting for emergence appears the primary motivation behind the earliest explicit discussion of levels, C. Lloyd Morgan’s 1894 Introduction to Comparative Psychology. Here Morgan proposed that ontological emergence was essentially the result of the same sorts of evolutionary processes Darwin had recently proposed as giving rise to the origin of species. While greatly influenced by Darwin, it should be noted that Morgan’s proposal was in direct contradiction to Darwin. Darwin saw evolutionary processes as essentially gradual. Morgan can be seen as an early advocate of the kind of discontinuous evolutionary leaps championed more recently by
Stephen Jay Gould’s (see Eldredge and Gould’s (1972)) theory of punctuated equilibrium.

According to Morgan’s 1894 text, much as the ‘great chain’ envisioned each thing existing at a particular rank (i.e. one either is a nobleman or not, is an angel or not, etc.), psychological properties should be conceived as similarly all or nothing affairs (i.e. something either is conscious or not, either is rational or not). Morgan proposed that Comparative Psychology essentially ought to be concerned with the attempt “to gauge the psychical level to which any organism has been evolved” (emphasis added, 56). In contrast to Darwin (see Sober’s (1997), for a critical discussion of the Morgan-Darwin debate), Morgan argues that mental faculties, such as consciousness, cognition, and creativity, are conferred all-at-once after a certain “level” of evolutionary complexity is reached rather than being continuously distributed amongst life forms.

In other words, Morgan saw two ways a particular psychological property (rationality, for example) could have evolved; either a bit at a time in successive species, or all at once in an evolutionary leap. According to the Darwinian continuity hypothesis, snails, sea slugs, and the like would have a little rationality, cats more, and humans more still. According to Morgan’s emergent levels hypothesis, sea slugs need not be seen as having any rational faculty at all. Rather the property emerges when the brain evolves to a particular point of sophistication. The following conveys Morgan’s original idea:
<table>
<thead>
<tr>
<th>No levels</th>
<th>vs.</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rational &amp; Fully Conscious (man)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-rational, more conscious (ape?)</td>
<td>conscious</td>
<td></td>
</tr>
<tr>
<td>A little rational, a little conscious (snail)</td>
<td>rational</td>
<td></td>
</tr>
<tr>
<td>neither rational nor conscious</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Darwin vs. Morgan**

Morgan is vague regarding precisely how such properties were supposed to evolutionarily emerge from ‘lower levels’. And because of this Morgan and the other emergentists often conflated two different sorts of potential emergent relations: property vs. object emergence. Humans differ from sea slugs in a variety of ways. The evolution of consciousness is one type of thing, but the evolution of hands, lungs, stomachs, etc..., is potentially quite another. While it may make some sense to claim that a sea slug is semi-conscious, it is much less clear that it would make sense to claim that it is semi-handed. The conflation of these two types of emergent relations has continued to plague some later discussions of both emergence and levels. Because this distinction gives rise to distinct conceptions of levels discernable in contemporary philosophical discussion (and guides the division of material covered in the next four chapters) the next two sections will attempt to make it clearer.

### 1.3.3.1 Property Emergence

Judging from his early concentration on mental properties, such as rationality and consciousness, it appears Morgan likely had property emergence in mind. A property emergentist, typically, claims that while fundamental ontological sameness obtains in
terms of the bearers of all properties—i.e. everything that exists is a material object—fundamental differences exist between the types of properties different material objects possess. In other words, not all properties should be thought of as material properties.

There are two different approaches to property emergence in contemporary philosophy. The first is weak emergence; the sole concern of what follows in the subsequent chapters. The second is strong emergence; this is currently a less prominent approach in philosophy that I bring up here just to mark it off from the former.

Weak Emergence—a common way of characterizing a weakly emergent property is in terms of ‘multiple realizability’—the capacity of a property to be had by different types of material objects. Weak emergence presumes that (1) that there are material types of objects and (2) there are types that ‘cross-cut’ material types in such a way that these types cannot be classified as material. Shape, such as circularity or triangularity, was an early exemplar of the idea of a multiply realizable property (put forward by Hilary Putnam 1960). For example, a donut, a car tire, a race track, and the milkyway galaxy are all circular. Yet there appears little these objects otherwise have in common in terms of their material/chemical make-up. Similarly, certain mental properties, such as ability to feel pain, appear to be possessed by animals (such as octopi and humans) with radically different types of physiologies.

In both cases the shared property appears to have little to do with material structure. Thus weak emergentism claims that there must be properties ‘over and above’ material properties, even though such properties are presumed to be, in some way or another, dependent upon material reality. On the original Morgan conception of levels,
the inhabitants of levels can be thought of families of properties of the same non-material type.

Strong Emergence—A property is strongly emergent if physical duplicates fail to share it. Such a property is thought to be independent of material properties entirely. Imagine two octopi, physiologically identical in all empirically important respects. Suppose further that one can feel pain, yet the other cannot (or that one has a soul, while the other does not). If this is possible, then the property in question is independent of material structure entirely as the two octopi are physically identical. The bearer of such a property would appear to be something other than the matter the two octopi share. If there are strongly emergent properties, then materialism appears false—there are property bearing non-material objects. As materialism is assumed herein (at least in regards to that portion of reality that reveals itself through scientific enquiry), weak emergence is presumed to be the only sort of emergence at issue here.

1.3.3.2 Object Emergence

Morgan’s first substantive employment of the notion of ‘levels’ occurred in his 1894 textbook and then later in the early 1920's he came to employ it in a more pervasive and metaphysical fashion. In the interim, 1916 to be exact, the American philosopher Harold Chapman Brown (1916) proposed a seemingly distinct conception of an emergent ‘level’ of reality. His employment of the term appears to be unrelated to Morgan’s. His “A Materialist’s View of the Concept of Levels” (1926), later criticizes Morgan’s conception for its “metaphysical suggestion of a cosmic upward sweep unjustified by the facts” (114).

Brown’s conception of levels explicitly took ‘the theory of chemical composition’
as its model. In between Morgan’s 1894 textbook and Brown’s 1916 article, Einstein’s ‘miraculous year’ (i.e. 1905) had occurred and convinced most scientists of the truth of the atomic hypothesis. In accordance with Bohr’s ‘planetary model’ of the atom (put forward a year earlier in 1915) Brown asserted the existence of at least four ‘levels of reality’—the electronic, the atomic, the molecular, and molecular aggregate. And posited that “each level of the physical world, above the electronic, is then to be looked upon as containing entities constituted by an integration of entities on a lower level” (1916, emphasis added 339). In short, Brown’s levels are ordered material part/whole structures. It sees emergent ‘objects’-- molecules, cells, organisms, etc.—as the proper inhabitants of higher-levels rather than their properties.

While distinct from property emergence, there is a way to conceptualize part-whole emergence as also exemplifying a kind of multiple-realizability. Consider a wooden sailing ship, and the planks that make it up. Suppose the ship is made of 1000 planks. Now the relationship between the ship and the planks appears not to be ‘identity’, as we would not normally consider the loss, addition, or rearrangement, of a couple of the ship’s planks the end of the ship (though it would be the end of a specific plank-collection). The very same ship could just as well possess different planks. Thus there is a sense in which the ship-object will be multiply-realized by a number of different plank collections over its life span.

But the multiple-realizability in question as regards what I’m calling ‘object’ (rather than property) emergence essentially concerns a one-to-many relation between a single object (a ship) and its many parts (the collection of planks). Property emergence (being-a-nickel vs. being-nickel) concerns a 1-to-1 relation. While some philosophers
have sought to blur (Stich & Laurence 1994) or conflate (Baker 2000) this distinction, failure to grasp it has caused some confused debate regarding levels (as Block (2003) notes, also see chapter 4 below).

1.3.4 The World according to the Levels Hypothesis.

I started this section off by attempting to answer the question: what can levels explain? What motivates the idea that there are levels of reality? Surveying both the roots and more recent writing on the topic leads me to conclude that there are primarily 3 sorts of reasons (potential explananda) that motivate the levels advocate.

1. **Materialism**: many levels advocates have a sense that everything, ‘at bottom’, must be cut from the same sort of ontological cloth.

2. **Scientific Realism**: many have a sense that different sciences pick out importantly different, but still real, relations that determine the occurrence of events over time.

4. **Emergentism**: many have a sense that materialism is not a bar to, and its conjunction with scientific realism may well entail, the existence of ontologically important type distinctions.

We can represent the conjunction of these theses with the levels of reality hypothesis in the following way:
1.4 Levels, Realism, & the Realist Dilemma.

Having surveyed the motivations behind the levels of reality hypothesis, I now want to briefly motivate the claim that the idea is in need of closer scrutiny. There is, perhaps obviously, a tension between the materialism and emergentism inherent in the idea of levels of reality. Materialism embodies the intuition that world is populated by things cut from the same ontological cloth, while emergentism calls our attention to fundamentally important distinctions between types of things. That there is a potential tension between the claims that things are both fundamentally the same and importantly different, should be no news to a defender of levels. This tension between seeing the world as a unified whole vs. being populated with ‘plenitude’ is what motivates much of the levels-talk in the first place. The question arises, however, whether this tension is really ameliorated by the talk of levels.
This is particularly pressing for the scientific realist, as the dual claims of fundamental similarity and essential difference invite what Michael Redhead has recently characterized as ‘the realist dilemma’:

**The Realist Dilemma:**

“If you are a realist about scientific claims, there are two possibilities:

(1) ... the ideal of a unified scheme must be relativized to *levels*,
what you see depends upon how closely you look....

(2) There is a T(heory) O(f) E(verything)... superstrings or something of the kind.”

(emphasis added, 70)

Scientific realists appear potentially committed to either a unified worldview that consigns most of science to the study of ontologically derivative—the not quite so real, the less than fundamental. Alternatively, they must give up the idea that science presents a unified picture of reality, give up the notion of “one scientific world, one reality, one truth” (Hacking 48, 1996)). While there are certainly realists who feel comfortable with choosing, there are others who feel either option untenable and that a more integrated view of reality is needed.

1.4.1 The Problem of Inter-level Interactions.

As I see it, this is the central problem of the levels of reality hypothesis. In splitting off different dimensions of reality from one another, a leveled conception of reality is potentially unable to put reality back together again. It is a conception of reality that threatens to discourage inter-theoretic science by simply ruling it out *a priori*.

It isn’t particularly surprising that levels of reality would have this consequence. Robust interaction between levels threatens the idea that levels really are an ontologically important feature of the natural world. If the biological entities and objects (for example)
are not intimately tied down to the ‘biological realm’, then we have less reason to suppose that really is such a thing.

Another way to illustrate the problem is by way of Dan Dennett’s illustration of his concept of levels of reality. In his *The Intentional Stance* (see also his (1994)), Dennett introduces the notion of a ‘level’ by way of cognitive gestalt effects (Gestalt psychology also influenced Paul Oppenheim (see his 1955) who contributed much to the contemporary prominence of levels-talk in philosophy). We have seen that a fundamental connotation of levels is the idea that two apparently distinct things can really be one (at some lower level). Dennett illustrates this by way of the famous ambiguous images of Gestalt psychology. These are single images that can be viewed in two distinct ways, such as the famous goblet/faces image:

![Ambiguous Image](image)

The thing to point out here (which Dennett misses) is that (as discussed by Baars (1996)) while one may see *either* a pair of faces *or* a goblet in this picture, one does not see both *at the same time*. The nekker cube, in which one can alternately see a transparent 3-dimensional cube pointing towards ones lower left, or towards ones upper right, is another illustrative example.
Seeing it one way prevents one from seeing it the other, as both views rely on the same set of elements but connect them in essentially different ways. Ontological levels may have a similar consequence—i.e. they only allow one to focus on one level at a time.

1.5 The Road Ahead.

In section 1.3.3.1 & 1.3.3.2, I distinguished two different conceptions of emergence—property emergence and object (or ‘compositional’) emergence. While not enough contemporary philosophers have noted it, these different notions of emergence lead to two distinct conceptions of levels—what I call the compositional conception of levels (the CCL) and the property conception of levels (the PCL). The distinction goes back almost as far as explicit talk of levels does, with Morgan’s evolutionary conception of levels vs. Brown’s compositional conception.

A primary reason for the distinction, I believe, concerns the two different dimensions of reality that talk of levels bring to the foreground, the horizontal/lawful (that motivates Level’s scientific realist allies) and vertical/material (that motivates Level’s materialist defenders). Those with more reductionist/materialist leanings tend to advocate some version of the object-oriented CCL, while those more focused on macro-scientific realism tend to advocate some version of the property-oriented PCL. Given that there are 2 distinct conceptions, the next 4 chapters split their analysis between the two. Chapters 2 & 3 examine the pros and cons of the CCL; chapters 4 & 5 examine the PCL.
While chapter 2-5 are primarily concerned with the conceptions of levels currently on offer, chapters 6 and 7 constitute arguments against any future conception of levels as well. Chapter 6 argues an 'over-determination' problem essentially plagues the idea of levels. Chapter 7 argues that most of the ontological/explanatory of payoff of levels can be had by an alternate ontological conception—one that focuses on ontological mechanisms—that exacts a smaller ontological cost.
Chapter 2: The Compositional Conception of Levels

2.0 Compositional Ontological Levels

This chapter aims to develop and motivate considerations in defense of one of the two main versions of the Levels of Reality thesis—the compositional conceptions of levels (CCL). This idea was originally put forward in explicit form by Harold Chapman Brown (1916). It claims that there are levels of reality which essentially limn the ontologically and scientifically important part/whole relations. Chapter 3 will focus on the problems of the CCL.

According to the compositional conception of levels, levels “are ordered by size. Smallest things at the lowest level and largest things at the top... they essentially stand in part-whole relations” (Bechtel & Craver, 3 2006). According to the CCL, micro-physical parts combine to form the molecular wholes of the chemical level. Molecular parts form the organic/cellular wholes of a biological level. The process continues in likewise fashion ‘upwards’ to the psychological, sociological, and to whatever macro-levels may lie beyond these.

According to this view, while parts compose wholes, they are still (in some sense) presumed to be ontologically distinct. Consider a set of Lego blocks. Just because the Lego blocks may be composing a Lego-house at some point in time, they do not thereby lose their individual identity as blocks. Similarly, just as chemical parts may at some point in time compose a biological whole, they do not lose their individual identities as objects belonging to the chemical level.

Unlike Lego-blocks, as the quote from Bechtel and Carver above indicates, size as well as other properties conferred by the part/whole relation matter in regards to what
sorts of things can be counted as the proper parts of a given whole. The CCL posits horizontal dimensions of reality that are defined by causal interactions amongst intra-level neighbors. A table and an individual atom are presumptively not things that typically causally interact with one another in an empirically interesting fashion. According to the CCL, what explains this is the fact they exist on different levels. What determines the level of a thing and its causal capacities is its *intrinsie* make-up—i.e. its parts. Objects on a higher-level are supposed to be composed *solely* out of parts that reside on the next lower level.

Roughly and schematically we can represent the CCL model in the following way:

*Compositional Model of Levels*

Cellular Level

Molecular Level

Atomic Level

The horizontal lines above signify both the existence of a level of reality, as well a kind of ontological containment relation. When viewed at the cellular level, for example, the atomic entities may not appear to be separate entities for they are busy constituting the cellular constituents—lysosomes, ribosomes, etc.—under observation. The full ontological multiplicity is never really *viewable* according to the CCL. In viewing the world one way, the others are in some sense blocked out, much as the alternate pictures in the gestalt images discussed at the end of the last chapter are not viewable at one and the same time. Nevertheless, if we could adopt an ontological ‘view from nowhere’, the
CCL defender maintains we would see the *distinct* reality of each set of entities simultaneously occupying their own levels of reality while constituting higher-level entities as well.

### 2.1 Oppenheim & Putnam’s “The Unity of Science”.

In the historical wake of Morgan’s emergentism, levels-talk (and metaphysical discourse in general) waned. During the 1930’s and 40’s philosophers became pre-occupied with epistemology and experience as the positivist and phenomenologist programs rose to prominence in the West. ‘Reduction’, ‘scientific unity’, and ‘physicalism’ were still active topics of debate (at least by the positivists and their ‘analytic’ progeny). But such topics were not assumed to denote anything about the structure of reality. Emergentism largely fell off the intellectual map during this period.

As anti-metaphysical sentiments began to fade by the late 1950’s, Paul Oppenheim and Hilary Putnam’s canonical article “Unity of Science as a Working Hypothesis” appeared in 1958, reintroducing the notion of levels of reality. It proposed uses “of the terms ‘reduction’, ‘physicalism’, and the ‘Unity of science’ (that) should be carefully distinguished from… (their positivist) epistemological uses” (5). This article essentially re-introduced the compositional model of levels of reality that Harold Chapman Brown had advanced some 40 years earlier (unlike C. Lloyd Morgan, Brown remains uncredited by contemporary philosophers). More than any other, this article serves as the primary reference for much contemporary discussion of ‘levels’ in philosophical literature.

Oppenheim and Putnam put forward their notion of ontological levels in explicit opposition to “Psychism and Neo-Vitalism (which) assert that the various objects studied
by contemporary science have special parts or attributes...in addition those" of lower
levels (12). According to Oppenheim & Putnam, for every level except the 'bottom'
level, the entities of a higher level $B_2$ should be seen as "wholes which contain a
decomposition into proper parts all of which belong to the universe of discourse of $B_1$"
(Oppenheim and Putnam 6) one level below $B_2$. In short, a whole on any particular level
was to be divisible, without ontological remainder, into parts of the next lower level. The
inter-level, vertical, relation according to Oppenheim and Putnam's scheme was the
part/whole containment relation of axiomatized formal mereology.

The first two, largely informal, arguments that Oppenheim & Putnam offer up in
defense of their version of the CCL can be read off the title of their article and they
directly speak to two of the three central motivations canvassed in chapter 1—
materialism and scientific realism.

First, 'the unity of science' picks out the materialist commitment of the CCL by
proposing a way that the different sciences may all be seen in terms of a fundamental
commonality. According to their CCL, all of the sciences are (or at least should be)
engaged in studying the effects of materially constituted entities and discerning the
micro-material composition of those entities. To the extent that 'psychists and neo-
vitalists' propose non-material components of an entity or process, they are engaged in
non-science. According to the CCL, science is unified in its commitment to materialism;
it is unified by its study of entities fundamentally similar in at least one respect—they are
exhaustively composed of micro-physical constituents that exhaustively determine their
essential capacities.
The second informal argument denoted by the article's title "as a working hypothesis" concerns Oppenheim & Putnam’s (rare for the time period) scientific realism. They were impressed by what they saw as a preceding half century of micro-reductionist success in the empirical realm. They wanted to put forward a model of science that could help explain why, for example, morphological trait inheritance had been seemingly explained by lower-level bio-chemical processes. If one thought (as per the original ‘Unity of Science’ project, see Neurath’s (1935)) that science was essentially in the business of ever more closely refining and defining our language in terms of operational definitions upon sense experience, then the impetus of scientists to look increasingly toward the unobservably small for answers can be quite mysterious.

The explanation, according to the CCL is simply that all macro-processes likely are in fact determined by their lower level constituents. As Oppenheim and Putnam saw it (circa 1958 at least--Putnam will show up again and again in our narrative) science had simply revealed that macro-processes were in fact likely determined by micro-constituents.

2.2 The Logic of Part/Whole & Explaining Scientific Explanation

Perhaps the most developed argument in favor of the CCL that Oppenheim & Putnam give concerns the existence of an explicit formal interpretation (i.e. a logic) of part/whole relations that can model their ontological suggestion. Recourse to an explicit logic of part/whole relations provided a formally well-defined interpretation of levels talk. In addition to staving off mis-interpretation, Oppenheim & Putnam saw formal mereology (i.e. the logic of the part/whole relations) as developed by Leonard &
Goodman (1940) and others as expressing the right sort of relationship for modeling *inter-theoretic scientific explanation*.

Not only could the CCL help model empirical (part/whole) relations and explain recent scientific successes, but it also offered to help explain some features of *explanatory* relations as well. Given the standard construal of mereology at that time, the formal model provided hope for explaining precisely why micro-explanations were explanatory.

Formal mereology as originally developed by Lesniewski, Tarski, and others, sought to capture the mathematical power of set theory in a way that avoided some of the paradoxes of self-reference. Accordingly, a whole is formally defined as unable to be a proper-part of itself, in contrast to self-membership capacity of sets. Assuming a *unique composition* requirement (a given set of parts forms exactly one whole) on *unrestricted fusion* (any given collection of parts forms exactly one whole), along with an assumption of parthood transitivity (the parts of a part, are also parts of a whole) allows for a formal derivation of Boolean algebra with proper parthood replacing the set-member relation. The resulting system characterizes the part/whole relation as essentially transitive, irreflexive, and asymmetric (alternate formalizations of mereology that bring it much closer to set theory are increasingly common, see Varzi (2002)). Each of these features has potential explanatory import.

Transitivity, upon "the (certainly true) empirical assumption that there does not exist an infinite descending chain of proper parts" (parenthetical in original, O & P, 7) assures that everything is at bottom physical. The transitivity needed by the formal model to capture the truths of mathematics could justify, in the ontological case, the
claim that explanation could be grounded in an essentially materialist ontology of basic physical parts. It provided some hope that a given chain of explanation would have eventual stopping point.

Irreflexivity (the inability of a whole to be a part of itself) assured, when built into a model of reductive explanation, that no science could explain itself—in other words it provided some assurance that scientific explanation need not be seen as 'circular' (as some, for example, have charged the notion of 'evolutionary fitness' with being). As no whole can be its own part, no object or process could be its own explanation. Part of what it is to explain according to the CCL is to illustrate how a higher-level theory is vertically integrated with the theories above and below it.

Asymmetry assured that explanation, unlike deduction, would have a definite direction (i.e. the micro explains the macro, but not the reverse). Just as the formal mereologist sees the properties of an object determined by the mereological sum of its parts, the adherent of Oppenheim and Putnam's model of levels see wholes ultimately determined by their parts. This provided hope for an overarching ontological grounding of explanation in terms of the micro-realm.

The suggestion of an ontological ground for what makes an explanation 'scientific' was, again, fairly novel the time. In 1958, most prominent philosophical accounts of what made an explanation 'scientific' concerned its syntactic form. However, attempts to ground explanation (see Salmon (1989) for some discussion) in something other than the presumptive structure of world, such as in terms of deduction/predictive form, is that there appears to be little to prevent purely syntactic accounts from getting the intuitive direction of explanation (the explanans vs. explananda
relation) wrong. One can predict the height of a pole from the length of its shadow and the angle of the sun. But the shadow does not appear to be the explanation of the length of a pole. Rather the direction of explanation goes the other way round. The pole’s height determines, and thus intuitively seems the explanation for, the length of its shadow. But if explanation is cashed out purely in terms of deductive relations, absent assumptions concerning determination relations, there appears little reason to prefer pole height over shadow length as the explanans.

Mereology provided some hope unifying a syntactic account with plausible metaphysical intuitions. The power of the mereological assumption that a whole (as a simple mereological sum) is determined/explained by its parts, assures that the direction of explanation will always flow from the direction of determination (because everything flows from the micro) on the CCL model. The sort of intuition formal mereology made explicit in Oppenheim and Putnam’s CCL scheme is similar to one echoed by Nobel prize-winning physicist, Steven Weinberg—

"We have a sense of direction in science. There are arrows of scientific explanation that thread through the space of all scientific generalizations. Having discovered many of these arrows, we can now look at the pattern that has emerged, and we notice a remarkable thing: perhaps the greatest scientific discovery of all. These arrows seem to converge to a common source! Start anywhere in science and, like an unpleasant child, keep asking “Why?”. You will eventually get down to the level of the very small" (Weinberg 1987, 435).

2.3 In Defense of Compositional Levels.

We can take the existence of an explicit logic that (1) prevents mis-interpretation and (2) can explain certain features of scientific explanation, as the most explicit argument offered up in favor of the CCL hypothesis since Brown’s reliance on the Bohr model of the atom some 40 years earlier.
The next five sections develop further arguments in favor of the CCL beyond Oppenheim and Putnam's. As noted in chapter 1, the case for levels is underdeveloped in contemporary philosophical literature. In attempting to flesh out the pro-CCL case in the absence of canonical arguments, I run the risk of setting up a straw-man. But that is not the intent. These are the arguments that appear to be implicitly motivating the CCL advocates. Other arguments are almost certainly possible, but until they become actual I will have to rely on what I can devise and reconstruct.

2.3.1 The Argument from Compositional Realism

One argument in favor of the CCL that appears to motivate many of its defenders is what I call the argument from compositional realism. It concerns the emergentist credentials of the CCL, and its potential to reconcile a 'reductionist' view regarding some scientific entities and processes with macro-realism about others.

'Reductionism' can pick out a varied and slippery set of doctrines. The following quote from David Lewis' "The Reduction of Mind" (1994) may be the most succinct statement of a reductionism from the ontological point of view that exists:

It is a task of physics to provide an inventory of all the fundamental properties and relations that occur in the world. We have no a priori guarantee of it, but we may reasonably think that present-day physics already goes a long way toward a complete and correct inventory.... We may further think that the very same fundamental properties and relations, governed by the very same laws, occur in the living and dead parts of the world, and in the sentient and insentient parts, and in the clever and the stupid parts....

Imagine a grid of a million tiny spots--pixels--each of which can be made light or dark. When some are light and some are dark they form a picture, replete with interesting gestalt properties.... Yes, the picture really does exist. Yes, it really does have those gestalt properties. However, the picture and the
properties reduce to the arrangement of light and dark pixels. They are nothing over and above the pixels. They make nothing true that is not made true already by the pixels. They could go unmentioned in an inventory of what there is without thereby rendering the inventory incomplete....

[This] is supervenience of the large upon the small and many. In such a case, say I, supervenience is reduction. There's no hope of settling disagreement by some uncontested definition of 'reductionism'. Because the term is contested, and the aim of many contestants is to see to it that whatever position they may hold, 'reductionism' shall be the name for something else (292-4 ital. added).

The italicized passages, perhaps obviously, constitute the trouble-spot for a realist as concerns a reductionist position. It is not clear how to reconcile a claim of 'real existence' with 'could go unmentioned in an inventory of what there is'. The latter position is associated with 'eliminative reductionism' — the denial of full reality to macro-objects and processes—and is generally a thesis a realist seeks to avoid.

Now two prominent recent employers of the CCL have been Jaegwon Kim (see his (1998), (2000), and (2003)), and William Wimsatt (1994). Both advance part/whole conception of levels in defense of views supposed to be compatible with both macro-realism and reductionism, at least as regards some scientific processes and entities. Kim's sums up his reductionist intuition as follows: "it seems a fundamental precept of theoretical physical science that we ought to formulate microstructural theories of objects and their properties" (emphasis added, Kim 96, 1993).

Even though Kim and Wimsatt have reductionist leanings, they want to maintain the reality of macro-objects. Kim's reductionism amounts to the claim that the explanation for the properties of macro-objects lies in their micro-constituents. Now if macro-eliminativism is false and there are in fact wholes—ships, molecules, proteins,
organisms, organs, etc.—then it would be useful to have some sort of theoretical hold/ontological grounding for what distinguishes wholes from their parts. Materialism entails the reality of the micro-constituents, but something more is required to guarantee the existence of wholes over and above those parts.

Levels potentially provide the right sort of ontological soil. The CCL advocate can claim that what explains the existence of (at least some) wholes as something over and above a simple grab-bag of parts is the existence of ontological levels. Levels pick out certain part-collections as instances of ontologically important compositional acts that result in creation of stable objects with the ability to interact with other objects of the same level over time.

Something like this line of thought appears to be at work in Wimsatt when he claims that “theories come in levels, to analogize an observation of John Dillinger, because that’s where the entities are” (emphasis added, 1994) 219). On his view, theories are essentially concerned with the explanation of the behavior of a particular domain of inter-related objects. And what explains the presence of objects is the presence of a level.

The utility of levels to a macro-realist can be seen in the following line of argument. Macro-eliminativists, such as Peter Unger (1980) and Peter van Inwagen (1990), charge that macro-realism implies the existence of ‘magical atoms’. Consider a putative ‘table’, and the collection of atoms that compose it. Suppose the table was created atom by atom, each being added to the future table in a temporal sequence—i.e. first two atoms were joined, then a third, then a fourth, a fifth, and so on.
The eliminativist charges the macro-realist is committed to the idea that at some unique point of atom addition a table comes into existence. If there is no table at the start, and there is one at the end, then there must be some point in time between starting and finishing that the table came into existence. Prior to that point in time there was no table; after it, there was. This entails a macro-realist must deny the existence of a table when (for example) 9 trillion and one atoms are present, but assert its presence when 9 trillion and 2 atoms are present. The eliminativist pointedly asks: "what could possibly explain the difference?". The first non-table atom collection results from adding one atom to a collection of 9 trillion. The second atom collection also results from adding one atom to a similarly large sum. The exact same act (adding one atom to a vast number of others) results in two radically different results (no table in the first instance, a table in the second). If there is no difference in the act of atom-addition, then the eliminativist charges the difference must lie in the thing added—thus the emergence of wholes must be due to a 'magic atom'. But, the eliminativist argues further, there are in fact no magic atoms. Thus we should doubt composition really occurs at all. There is no more table at the end of the process than at the beginning.

To account for composition, parts coming together to form an object 'over-and-above' the collection, a compositional realist needs to claim either that (A) composition is just a brute unanalyzable fact (as per Marksonian's (1998))—roughly accepting the existence of 'the magic atom'—or (B) point to the existence of something other than the act or the atom as responsible for an object coming into being.

Compositional ontological levels appear to provide a macro-realist with a candidate for the second option. A CCL defender can point to a 'level' as underpinning
the difference between the two instances of atom addition. It need be nothing intrinsic to
the act or intrinsic to the thing added. Rather, in those cases in which atom addition does
produce a ‘whole’, an extrinsic ontological threshold (i.e. a level) has been passed.

Levels, on this view, would be something like nature’s finish lines. Atom-
addition that does not result in a new whole is simply one step toward that ontological
finishing line. The CCL defender thus can deny anything need be intrinsically different
about the atom added. The difference is extrinsic. The universe, according to this line of
thinking, is such that some aggregations of atoms will be stable, while others will not.
Levels pick out certain compositional stabilities. Once enough parts are added an
ontological threshold is crossed. Before reaching that threshold, the part-collection is
unstable and likely to dis-assemble. After the threshold is reached the object bears a
different relationship to its environment and the other objects around it.

2.3.2 The Argument from Micro-Origins

Compositional realism, by itself, may not make much of a case for the CCL for it
still leaves open the possibility of ontological ‘remainders’—non-material
parts/properties. The argument from compositional realism, as it stands, allows that it
could be the case that what explains the non-existence of a table concerning one atom-
collection and its presence concerning another is the addition of some non-material part,
the addition of some élan table, upon the passing of the ontological threshold. In other
words, the argument from compositional realism does not appear to bind levels to tightly
enough to materialism. By itself, it does not offer any explanation of what accounts for
the compositional stability conferred by reaching a particular threshold of critical
mass/complexity.
However, the argument, and its materialist credentials, may be strengthened by combining it with the semi-empirical argument from compositional origins (Oppenheim & Putnam point in the direction of this argument in their discussion of the principle of 'ontogenesis' (see 23-27)). I say 'semi-empirical' because what drives this argument is the assumption that wholes are temporally posterior to parts, and it is not clear in what sense this assumption is, in fact, empirically given.

Regardless, suppose (as seems plausible) that something like big bang cosmology is true and the universe in fact started out small. If this is true, then there must also have been a point in time at which there were no putative 'higher-level' entities (molecules, proteins, etc.). If there were no such entities, then it appears there could be no levels either. Recall that levels are crucially not lonely places. If levels require objects (and relations among such), then it appears that macro-levels could not temporally precede macro-objects. There couldn't be a social level until there were social entities to stand in social relations to one another. When everything was micro, there was simply nothing to occupy the higher ontological shelves of the CCL.

Now if before composition (parts coming together to form a whole) there were no levels and after composition there were, then the domains of higher-level science must be essentially related to compositional acts. How else could ontologically distinct domains come into existence apart from composition (indeed, presumably two or more part-collections coming together to form two related wholes)? As such, it would appear levels (and higher-level sciences in general) must track compositional acts of some sort.

Note that CCL defenders likely need to resist the idea that every compositional act brings a separate 'level of reality' into existence. Kim, Wimsatt, Oppenheim & Putnam,
et. al., are not claiming that nailing a couple of trouts to a couple of turkeys would result in a level of ‘trout-turkeys’ coming into being. Rather an ontological level is a defined, as noted in the first chapter, by an essential relatedness that helps to determine the temporal course of events.

The argument from compositional origins claims that the only materially respectable candidate that can account for the existence of such sets of related macro-objects are compositional acts.

2.3.3 The Argument from Arbitrary Objects.

There is a tension between the argument from compositional realism (CR) and the argument from micro-origins (MO). CR claims compositional realism is dependent upon levels, while MO claims levels are dependent upon certain real compositional acts. The argument from micro-origins asserts that composition is temporally prior to levels, while the argument from compositional realism asserts that levels are ontologically prior to (i.e. necessary for) real composite objects.

There may be a way out of this apparent bind. If levels are supposed to roughly track and explain the theoretical divisions within science, then a CCL defender needs a distinction between arbitrary part-collections (piles of sand, trash, trout-nailed-to-turkeys, etc.) that are not on the level and ontologically respectable wholes that are. Otherwise there would be infinitely too many levels. It is composition of a ‘certain’ sort that CCL defenders need to make dependent upon levels. Random gluing is not the type of composition act that levels are needed to explain. Rather, it is the ‘naturally occurring’ cases, those cases in which we are inclined to say that there is an object, ‘in addition to’
or 'over and above' the parts, those cases where the newly composed object bears an essential relatedness to sets of other naturally occurring objects in its environment.

Terminologically, we can mark off the distinction as one between 'arbitrary' or 'accidental' objects and 'natural' objects. Even without the apparent tension in the CR and MO arguments, a CCL defender needs to say something about the apparent natural vs. accidental composition distinction. CCL defender, William Wimsatt's notion of 'non-aggregative' property conferral (see his 1978 and 1997) can get at this distinction in more than a just terminological fashion. According to this, non-aggregative properties are conferred in those instances in which the resulting part-collection possesses a property that is (a) sensitive to a particular arrangement of parts, (b) decomposition and re-aggregation of parts, (c) and the loss or addition of a single part. Thus trout-turkeys get ruled out because they are insensitive to exactly where the trout would need to be nailed to the turkey. Cells get ruled in because you cannot take one apart and then put it back together again without destroying the cell.

With the distinction between accidental and natural objects in hand, a CCL defender can grant without contradiction that arbitrary objects are temporally prior to the existence of levels. The universe is such that every now and then it will throw together some seemingly arbitrary set of elements. To avoid the seeming contradiction between the claims that objects come from levels and levels come from objects, what the CCL defender needs to maintain is that it is accidental objects that give rise to levels. And then it is levels that give rise to natural objects.

The question now turns to whether or not more can be said on the CCL defenders behalf that makes natural objecthood plausibly dependent upon levels. As
they stand, Wimsatt's criteria apply not only to different objects in different ways, but they also apply to single cases and artifacts as well (such as the space shuttle).

2.3.4 The Argument from Causal Emergence

At this point a CCL defender can bring in what I call the argument from *causal emergence*. According to this line of thinking natural objects are dependent upon levels because they, in addition to being distinct from accidental objects by something like Wimsatt's criteria, essentially possess types of causal powers and capacities. They confer a set of relational properties upon a given part-collection. These are the sorts of changes one object can regularly produce in another. Thus what confers natural status on a particular arbitrary object is meeting a Wimsatt-like criteria that gives the part-collection a certain kind of temporal stability (unlike a pile of sand) *in addition to* the potential to causally interact with other stable part-collections. Discussions similar to what I am calling here the argument from causal emergence have recently been discussed by Kim (1998), Crawford Elder (2002, 2003, 2004), and Scott Sturgeon (1999), among others.

One way to see the dialectical force here is to consider the possibility that Oppenheim & Putnam's 'certainly true' assumption—*that matter is not infinitely divisible*—is in fact false. There are two things to note about the possibility of an infinite chain of smaller parts. (1) The eliminativist impetus to resolve the tension between the ontological priority of parts and wholes becomes incapable of satisfaction. If there is no fundamental part, if every part has a further part, then there is no reduction base to which the object eliminativist can make an ontological retreat. (2) A parallel point can be made in regards to causation. If causation must come from somewhere, and there is no
ontological base to provide the right sort of ontological soil, then levels become a natural alternative.

Now in considering the question of where to look for the origins of causal powers, a compositional realist can point to composition as the right sort of place to turn the ontoscope. What confers causal status and powers are instances of part-addition. The argument for this claim parallels the argument from micro-origins for levels. If material parts are all there are to the world. Then their coming together is going to be the place to look to find the origins of causal powers (because therein lies the origins of everything).

This kind of argument for causal powers tracking instances of part-addition doesn’t quite get us to a support of the CCL. At this point in the dialectic, we have (1) objects have causal powers, (2) the origin of these must lie in part-addition. Levels make their way into this picture upon the observation that causation is presumptively a two-place relation, i.e. $x$ causes $y$: the ice caused the car to slide, the foam caused the wing to crack, the baseball caused the window to shatter, and so on (whether it is more appropriate to talk about objects rather than properties as causes is a matter of controversy, but I don’t think anything hangs on it for present purposes).

Given that there are objects (anti-eliminativism), and given that objects have causal powers (causal realism) and given that causal powers require other objects to exert causal influence upon, then it appears to follow that there must be something that essentially relates the relata of the causal relation. The defender of the ontological levels can assert the cause and effect’s mutual ‘co-habitation’ of the same ontological shelf
constitutes this essential relation. This is what determines the two objects ability to interact with one another.

In his version of this argument Sturgeon employs what he calls a 'cause-and-essence' principle-- "C causes E iff C is sufficient to bring about what's essential to E" (Sturgeon 1998, 422). Both Sturgeon and Elder use this principle to leverage the conclusion that there must be multiple levels of causation as micro-components (a baseball's atoms, for example) are not essential to bringing about the macro-effects (such as a window breaking). The idea is that baseballs could cause window breakings even if they were composed of atomless gunk, rather than atoms. Thus the micro-parts of baseballs cannot be viewed as essential to window breakings. Only the macro-object is essential to the interaction with another macro-object. Baseballs cause window-breakings. Baseball atoms may cause window-atom dispersals. But what explains these essential relations among objects (the potential macro-causal relations between baseballs and windows, as well as the micro-causal relations between base-ball-atom-collections and window-atom-collections) is their mutual co-habitation of a particular ontological level.

2.3.5 The Argument from Natural Kind Essentialism

The next pro-CCL argument is one of the most influential amongst scientific realists (following, I suspect, Kripke's (1970) & (1980)). It has also drawn some of the strongest criticism (such as John Dupre's (1993)). It concerns the potential of micro-levels providing the right sort of referential base for macro-level 'natural kind terms'.

John Locke, a professed philosophical 'under-laborer' of natural science, notoriously proclaimed in his Enquiry Concerning Human Understanding that our names
for things “primarily” signify nothing but the ideas in our own heads. Ever since, the question of how and whether the names of our scientific categories and kinds (such as protein, gene, species, etc.) could signify world structure rather than mental structure (even if only ‘secondarily’) has vexed many ‘under-laboring’ realists.

The crucial problem concerning the nature of so-called *natural kinds* can be put as follows: when we assert some particular (such as a rock, or a cellular irregularity) belongs to a general category (such as being gold, or being cancer) are we making a *choice* or a *discovery*? Even following Boyd’s minimalist definition of scientific realism discussed in chapter 1—true knowledge of unobserved entities and processes—many feel realism of any sort is incompatible with the thesis that determining whether something is gold is a choice rather than a discovery.

While realism and kind-nominalism may not strictly contradict, there is a tension between holding that science can, for example, lay bare the *real* causes (the explanans) of cancer even though the explananda is a category of convenience. It would come close to maintaining that science is in the business of providing real explanations of fictional phenomena. If scientific categories are mere conveniences, it’s unclear how there could be definitive causes or effects strictly related to them. The categories’ boundaries would not be set and thus the properties, laws, and causal capacities associable with them could not be set either.

Even so, there are reasons for thinking that scientific classifications *must* be conventional. In making categorical judgments, the conventionalist will maintain we having nothing to go on other than observed (macro-level) similarity and difference. Similarity and difference are inherently relational qualities and come in degrees.
Something is only perfectly similar to itself. Additionally, the degree to which one sample resembles another would appear to be *non-intrinsic to an object*, but rather a relation one object bears to the everything else (i.e. “rock A resembles rock B more than my pen, my coffee cup, the sun, that rock over there, etc.”). Whether or not a particular law applies to something, on the other hand, is presumptively, non-relational (or at least not relational in the same way). The universe does not need to look at all the other objects in the world to know whether or not a particular law of nature applies to a particular thing. Given that (A) whether or not a thing falls subject to a certain natural laws should be determined by internal/intrinsic qualities, and (B) kind membership appears based on human judgments of relational/ holistic qualities, many realists have worried that our judgments about kind membership are doomed to miss the mark.

Seeing macro-objects as essentially products of micro-components, however, provides some hope that judgments about macro-qualities really are not judgments about relational properties. Rather macro-qualities provide hints to hidden micro-structure which can exhibit natural/intrinsic similarity to one another—for example the similarity between two electrons.

Consider the symptomology of a particular disease. Generally it takes time and research to realize that a particular virus may be the cause of a particular group of symptoms and cases (HIV was, for example, originally thought to be a form of cancer). But the similarities amongst cases often lead to the assertion that a group of particular cases all belong to the same category/natural kind (i.e. AIDS), and then researchers are able to proceed to look for similarities at the micro-level to determine what/whether a particular micro-level essence (such as the HIV virus) is at work in producing the macro-
level similarity. Thus what is, or is not, a case of AIDS is not a convention (or at least so says the kind essentialist), as the extension of the category can be revealed by appeal to micro-level essence.

Thus the fact that the CCL posits that macro-objects and categories are essentially related to their micro-constituents insulates the CCL defender against the criticism that our assertions of natural categories and kind membership is purely conventional, or as Locke might put it--a reflection of our habits of mind. Kind membership, on the CCL hypothesis, reflects the intrinsic relation between a thing and its micro-composition.

2.3.6 The argument from inter-level interaction

The next argument in favor of the CCL concerns the micro's ability to interact with the macro. For example, changing the micro-chemical properties of a pill will affect its ability to relieve the symptoms of illness. Similarly, altering the micro-chemical structure of biological organisms can subsequently cause them to have different morphological features. Altering the micro-chemical structure of a compound can change such macro-properties as color and malleability.

The CCL advocate can explain this type of interaction by appeal to the fact that each macro-entity is essentially product of the micro. We are able to change its macro-structure by changing its micro-structure because its micro-structure produces its macro-structure. The adoption of the formal mereological conception of composition entails this, as the formal model entails every object is just a sum of atomic parts, and thus is wholly determined by those parts.

However, the 'vitalist' or 'psychist' that Oppenheim and Putnam were concerned to dispute would have little recourse to explain this sort of ability of the micro to affect
the macro. They do not acknowledge any essential relation between the higher and lower level entities. The CCL advocate, however, claims that the micro can change the macro because the micro determines the macro.

2.3.7 The argument from ceteris paribus clauses.

The last argument I will canvass that appears to motivate some CCL defenders is related to the preceding one—the micro’s ability to determine the macro. It concerns what are sometimes called the essential ceteris paribus (everything else being equal) clauses of higher-level laws. The CCL defender can potentially explain these ceteris paribus clauses in terms of the ontological priority it assigns the micro-level.

The basic idea behind the argument from ceteris paribus clauses is straightforward. Consider a putative ‘higher’, or macro, level law—something of the form if x occurs, then y will. Any such law appears bound to be hedged—i.e. it will essentially be of the form ‘x will bring about y in normal circumstances’ for the following reason.

Suppose the law in question is ‘if tryptophan hydroxylase is transported across the blood/brain barrier it will be converted into the neurotransmitter serotonin in the brain’. This law is only going to hold in an individual case assuming that, for example, the person/brain in question is not annihilated by nuclear fission or something of the sort once the laws antecedent is fulfilled. The same would go for a psychological or sociological generalization as well. There are multitudes of potential events that could cause putative higher-level laws to fail to hold if the normal course of events is interrupted between an antecedent cause and its nomological effect.
According to the CCL, the explanation for why higher-level laws always come
couched with ceteris paribus clauses is because they are always subject to being pre-
empted by the determination of the micro by the macro. Again, on the formal model of
composition, every property of a whole is determined by its parts. The CCL assigns
ontological priority to the micro that explains why it can intervene to interrupt the
workings of some higher-level generalization. It is because the macro is subject to
determination from the micro.

2.4 Summarizing The Case For Compositional Levels.

Accepting the arguments discussed above for the moment, we can summarize the
case for the CCL thesis as follows:

(1). Materialism-- Provides a monistic explanation for the existence of different
scientific domains of material objects in terms of part/whole relations.

(2). Reductionist successes--Empirically plausible to the degree that some macro-
processes have been shown to be essentially related to micro-processes.

(3). Mereology part-1--Provides a logically explicit interpretation of levels talk.

(4). Mereology part-2--Promises to explicate certain features of inter-theoretic
explanation by assuming the direction of explanation and determination always
travels from the micro to the macro.

(5). Macro-Realism/Emergence—shows how compositional realism does not
depend upon the existence of ‘magic atoms’ or is inconsistent views about the
powers of part-addition.

(6). Micro-origins—provides an account of the origin of levels that is consistent
with contemporary cosmology.

(7). Causal Realism/Emergence--Can potentially account for the origin of
essential causal relations.

(8). Natural Kind Essentialism—Can provide an ontological grounding for the
reference of natural kind terms.

(9). Micro-Efficacy—can account for the power of the micro to affect the macro.
(10). Ceteris Paribus Clauses—can account for why putative higher-level laws appear to have essential 'ceteris paribus' hedge clauses.

In the next chapter I turn to a critical analysis of the CCL. My aim will not be to show the CCL is essentially inconsistent or wrong-headed. I do not question the desirability of a theory that can explain the above phenomena. Rather my primary aim is to look into the question of whether composition relations, playing such a central role in the CCL as they do, really can provide a theory of levels that delivers these explanatory goods. The question is crucial, for the reason noted at the end of chapter 1. The CCL is essentially motivated by a primary focus on the vertical axis of reality—the commonality relations between levels at given point in time. It envisions this axis in terms of part/whole containment/composition relations. The question now turns to whether this axis of reality really can be plausibly modeled along these lines.
Chapter 3: Composition and the CCL

3.0 The Essential Problem of the CCL

At the end of last chapter, I summed the potential explananda that a compositional conception of levels could help explain. This chapter will examine a central assumption of the CCL, namely the idea that composition relations alone really can produce an account of ‘levels’. I will be arguing that they cannot and because of this the CCL does not constitute an account of levels that can non-circularly explain what its advocates suppose it can. Ultimately, the CCL just draws attention to the difficulty of giving a plausible account of the vertical aspect of inter-level relations.

To succeed, the CCL needs to provide (1) some account of the vertical inter-level relation that makes good on the materialist/monist credentials of the conception, (2) some account of the horizontal intra-level relation that defines a group of objects as all being on the same level as some higher-level science, and (3) an account of the emergence of the natural objects higher-level science studies.

The CCL develops an account of (1) inter-level relations in terms of material part/whole relations. If the wholes of some level can all be identified as parts of something else, then this something else exists on a higher-level. Its explanation of (3) is parasitic on its account of 1—roughly, emergence is a (certain natural) relation between a whole and its parts. Its account of (2) is parasitic on its account of 1 as well, as the CCL defines intra-level relations in terms of a set of wholes with inter-related essential causal capacities.
Compositional Model of Levels

Cellular Level

Molecular Level

Atomic Level

\[ \text{inter-theoretic} = \text{part-whole relation} \]

\[ \text{Intra-theoretic} = \text{potential causal relations} \]

Given that the CCL’s account of emergence and intra-theoretic scientific realism depend on its account of composition, if the CCL can’t account for composition, it can’t account for the emergence or realism either. And in this chapter I will argue that the central problem with the CCL is that there is no univocal notion of composition and part-whole relations that can do the work that CCL advocates assume it can.

3.1 Level-eliminativism vs. Macro-eliminativism

There is a short route to the conclusion that there are no compositional levels I will not explore—namely, denying that there really are any composite objects at all. Such a strategy would not only be problematic given my ampliative methodology (eliminativists tend to be guided by ‘Quine’s Dictum’—prefer desert ontologies), it would fail to make contact with the aims of most CCL defenders by simply denying that there is any explananda for compositional levels to explain.

As discussed in the prior chapter, a prime impetus towards levels-talk for the materialist is a resistance to an eliminative reductionism—the denial of chemical, biological, psychological, and social macro-realities entirely. Macro-eliminativism has
recently been defended by Trenton Merricks, John Heil, Peter Inwagen, Peter Unger, and many others. Somewhat surprisingly, it is an increasingly popular ontological view. However, the reason many are increasingly being pushed toward the eliminativist picture is not that hard to see. It is difficult to see why we need macro-reality at all if it can really go "unmentioned in an inventory of what there is" (as Lewis claimed) without ontological loss.

Even so, I raise the issue of macro-eliminativism here simply to set it aside. My aim concerns the possibility of ontological framework that supports a robust scientific and metaphysical realism, largely honoring the motivations of levels' advocates. If object eliminativism is a consequence of a level-less ontology, then I take that to be a strong argument in favor of the levels of reality hypothesis. As I argue in chapter 7, ultimately I do not think that macro-eliminativism is a consequence of level-eliminativism. Regardless, here I will assume with the CCL advocate that there is a macro-reality in need of explanation.

3.2 The Vagueness of 'Composition'

There are many distinct intuitive conceptions of composition that appear to be at work in the discussions of philosophers regarding composition and levels. The plausibility of the CCL thesis, I believe, rests upon conflating these. The formal mereological model that Oppenheim and Putnam originally appealed to is the least suited to the task of building up an ontology of empirically motivated levels. While it may be suited to explicating the micro-level's vertical powers of determination over the macro, or explicating the essential monistic credentials of the model, it is wholly unsuited to explaining the horizontal dimension of intra-theoretic families of objects.
If CCL defenders can’t specify ‘which composition relation’ is relevant to their model, if it equivocates on the nature of inter-level relations, then it will wind up equivocating on the nature of intra-theoretic horizontal relations as well. We wind up with only the illusion of a model of reality, rather than a contentful thesis. Additionally, it will render the model useless in speaking to the sorts of theoretic debates Oppenheim and Putnam wanted it to. Oppenheim and Putnam explicitly motivated their account in the hope of having it speak to controversies over which objects and processes are ‘on the level’, ontologically speaking—and which are merely useful fictions.

Presumably astrological constellations (Virgo, Libra, etc.) don’t possess their own ontological level, even though they can be thought of as wholes composed out of ontologically proper parts (astronomical objects, such as stars). It would speak in the CCL’s favor if it could explain why astrological entities are not ‘on the level’, but presumably other cosmological entities are.

These sorts of disputes are pervasive. There are many active debates concerning whether certain wholes, such as species, are real or whether they are just arbitrary assortments of individuals (for some discussion see Dupre’s (1993)). Oppenheim and Putnam wanted to help explain why vitalism and psychism were misguided. But the CCL thesis without any explicit conception of the part/whole relation does little beyond highlighting such controversies rather than resolve them.

3.3 Why Formal Mereology Doesn’t Help

Formal models of composition do not provide anything like an adequate account of empirically respectable object composition. They are entirely too liberal as what may count as a part and whole. The formal models of composition allow for scattered wholes,
logically disjoint wholes, and infinitely many arbitrary spatial portions, to count as perfectly acceptable parts or wholes. The formal models require no physical change in, or coming together of, distinct and separate parts to form an object. This is simply a consequence of construing object-hood as primarily a logical, rather than a natural, relation.

Take a time slice, a divine snap shot of the universe, and all of the objects that will ever exist are present according to an ontology based the formal mereological approach. Most are just a bit 'scattered' at the moment. An ontology based on formal mereology counts not only the historically drawn astrological constellations as perfectly acceptable wholes, but it also would count any random collections of stars \textit{whateoever} as a perfectly acceptable whole.

Amongst contemporary philosophers, the most prominent defender of formal mereology as our primary guide in ontology is David Lewis (see his \textit{Parts of Classes}). And as he freely admits, the formal approach not only allows scattered and arbitrary wholes but also for \textit{logically disjoint} wholes as well. It not only sees an object (a trout-turkey) composed out of trout glued to a turkey, but also counts as a single object a trout currently in Lake Michigan \textit{or} a Turkey living Montana (a trout-or-turkey). Lewis counsels us to simply ignore such entities if we are bothered by their existence.

But even if one can countenance trout-or-turkeys as perfectly acceptable objects, or if, instead, one thinks that the formal notion, minus the formal consequences (such as disjoint wholes), can be extracted to do the necessary work for the CCL, I believe the formal mereological notion of the part/whole relation will still remain incompatible with the CCL thesis for another reason. The problems above speak to the issue that formal
mereology allows for 'unrestricted' composition and arbitrary objects. As discussed in the previous chapter, no CCL defender is going to want to allow this as it would allow arbitrarily many levels. Rather they are going to need to employ some extra-logical analytical mechanism to restrict what counts as a respectable whole according to the CCL.

However, arbitrary wholes are not the only pathway to arbitrary levels on the CCL account. A slightly different problem formal accounts of composition bring in their wake is the problem of arbitrary parts. According to the CCL, the parts of an object must reside on some lower level. If a given object has arbitrarily many parts and sub-parts, then it will also entail arbitrarily many levels even if the whole, such as a human cell, is a perfectly respectable empirical object. According to the formal model of composition, not only do the cell's macro-molecular components (such as the nucleus, mitochondrion, lysosomes, etc) count as parts, but also any arbitrary collection of the cell's atoms constitute a part of the cell. Thus according to formal mereology, 1/10 of a cell's atoms is a cell-part, 1/20, 1/23 of a cell, 1/230,000 of a cell atoms, etc....

The complaint here is not that the formal model entails, for example, a cell has as many parts as it does atoms. That would not be as bad a problem (at a minimum, it wouldn't be arbitrary). Rather the problem is that if we identify, for the sake of example, 10,000 of the cell's atoms, the formal model of composition entails that there are not only 10,000 atomic parts of the cell, but also a 10,001st and 10,002nd part... composed of half of the 10,000 atoms +1, +2,... According to the formal model, there are vastly many more parts of an object than atoms. The formal model is blind to which atom collections constitute empirically respectable part, such as a nuclei, and which do not. Thus to
ensure it captures all the parts we might want to talk about, it counts every atom collection, whatsoever, as a part of the cell.

In an interesting article, David Sanford ("Naïve Mereology" 1993) explored a divergence between the formal and the intuitive notions of ‘part’ with an example similar to the following:

I spilled coffee on part of my computer.
I spilled coffee on a part of my computer.

These sentences appear to have different meanings and rely on distinct notions of ‘part’. The latter seems to indicate that I spilled coffee on something like the keyboard, the monitor, or mouse (what Sanford calls a parts-list part).

The first sentence, however, indicates something akin to ‘I spilled coffee on less than the whole of my computer’. This sense of ‘part’ corresponds roughly to the notion of a ‘spatial portion’. This notion of part-as-spatial-portion is the one that Sanford sees as the intuitive conception of ‘part’ driving formal accounts of part-whole relations. It is the notion of part most clearly transitive, irreflexive, and asymmetric. For example, every part (−A) of a spatial portion (A) will also be part of any spatial portion (A+) of which the original portion (A) is a part.

*Formal Parthood=Parts as Spatial Portions?*
However, any notion of composition that equates parthood with portionhood appears doomed to producing infinitely more levels than any defender of the CCL thesis would ever want to concede. There are many more potential sub-regions of A in the above diagram alone than any CCL defender would want to concede. Thus CCL defenders not only need a restriction against arbitrary wholes, but a restriction against arbitrary parts as well.

Given the need for tighter restrictions on what counts as a part or a whole than the formal models of composition require or supply, the important question becomes what sorts of constraints on parts and wholes a CCL defender can put forward in a non-question begging way. This last bit is important, if in fact the model is supposed to speak to the nature scientific debates, as well as constitute an account of the horizontal dimension of reality. It won’t do for a CCL defender to try to appeal to some causal/lawful, or other horizontal or extrinsic relation among a set objects at this point as defining the intra-level domain, for those are supposed to be explained by the vertical compositional axis according to the present account. According to the CCL what defines a set of objects as being on the same level is the relation to their lower level parts.

In their “Unity” article, Oppenheim & Putnam nod the direction of precisely the sort of question begging response that I want to rule out, namely a restriction on composition that appeals to recognition by “present-day empirical science” (Oppenheim & Putnam 9). One problem with this idea is that it deprives the model of any ability to shed light on controversies within and around the sciences. Presumably if there is in fact a controversy concerning the reality of some set of entities, then a ‘vitalist’, or ‘psychist’,
will be able to claim that these are, in fact, entities recognized by (at least some) ‘present day empirical’ scientists and thus they are perfectly fine candidates for admittance to their own ontological level according to this particular criteria for admittance to levelhood.

But the more serious problem with this suggestion is that Oppenheim & Putnam’s CCL can no longer pretend to be an explanation of what underpins theoretical divisions or the emergent sorts of entities they study. If scientific theories are allowed to define the acceptable parts and wholes of the crucial vertical axis of the CCL then it is the horizontal axis that is the explanation of the vertical. To pretend otherwise is simply a metaphysical bait and switch.

3.4 Material Composition

Alternatives to the standard formal notion of composition exist. One could, of course, simply build the notion of ‘natural-part’ (or ψ-part) into formal mereology, as a kind of predicate modifier. But the properties of ψ-parthood would then need to be independently specified and motivated, rather than axiomatically assumed. In other words, once we move away from the formal notion, the properties the formal notion was supposed to secure for the CCL (such as monism and micro-determination via transitivity) have to be motivated rather than simply assumed.

To see some of the state of play in regards alternate theories of part/whole relations, consider a collection of Lego blocks. According to the mereological model, the blocks constitute an object (many, actually) regardless of how they may be scattered about the floor. Another, more intuitive, notion of composition would require the blocks to at least be ‘pieced’ together in some fashion or other to compose an object. We can
think of this kind of composition as ‘simple material composition’. For simple material composition to occur there must be some sort of contiguity or glue holding the parts together.

Restricting composition to simple material composition appears to be the move Jaegwon Kim (see particularly his 1997) wants to make. According to his account a welded metal rod’s ‘having a mass of ten kilograms’ marks a move up the micro-macro level ladder (1997 291) over the status of the pieces that make it up (such as ten 1-kilogram links welded together). As Kim characterizes the essential nature of ontologically important composition relations they involve (1) the conferral of a complete set of empirically recognized properties by a set of (2) parts that stand in a specific and static relation to one another. The properties such an arrangement of parts bestows upon a material object he calls ‘micro-based macro-properties’, and he requires that the conferred properties of a whole not be possessed by any of the constituent parts.

Thus, on Kim’s view, having a mass of ten kilograms indicates that a rod is genuine macro-object over above its ten-parts because none its parts has the property ‘weighing ten kilograms’. Similarly “being a water molecule, therefore, is a micro-based property in this sense: it is the property of having two hydrogen atoms and one oxygen atom in such-and-such bonding relation….such a property is not a micro-property but a macro-property” (1997, 292) as being a water molecule is not a property had by either the individual hydrogen or oxygen atoms. Similarly, on Kim’s view, a cell would count as level up from its parts because it possesses such capabilities as cell division and replication.
Substituting material composition for mereological composition eliminates the potential problems of logically disjoint wholes and scattered objects. It's not clear, however, that we want to rule out *all* of the scattered objects. Oppenheim & Putnam, included a level of ‘social groups’ above that of ‘multi-cellular’ things. Species, galaxies, economies, solar systems, weather fronts, gases, genes, patterns of neuronal activation, and a host of others putatively respectable scientific objects are also, arguably, scattered objects. An electron could similarly be argued to be a scattered part of an atom. In many of these sorts of processes (such as in a neuron firing or a weather front) the relations among the parts will not be static, but will be malleable/dynamic.

Additionally, while material composition may rule out many of our seemingly arbitrary objects, it does not solve the problem of arbitrary levels. Consider the object composed of a trout glued to a turkey. Neither the trout, nor the turkey, possess the property of being a trout-turkey, thus the trout-turkey may arguably be said to be a macro-level up from the trout and the turkey. Thus simple material composition would appear to allow plenty of arbitrary material objects that do not appear to be either intuitively or empirically warranted to have admission to their own ontological level.

Similarly, material composition courts the problem of arbitrary parts as well. Consider 4 Lego blocks (labeled A, B, C, D) snapped together to form a ‘material’ whole (call it W). There are the 4 blocks and there is the one whole, but there does not appear to be any non-arbitrary intermediary ‘level’ or parts. Should we consider A+B+C a ‘single’ part of W in addition to A and A+B? Defenders of the CCL presumptively would want to respond in the negative for the reasons canvassed above. They do not want posit a level of 2-atom objects, 3-atom objects, 4-atom, etc.... Rather, they want to
only admit a single 'molecular level' above the atomic. But simple material composition
does not appear to have the resources to distinguish a chemical, biological, psychological,
etc., part from any other sort of part. It can only distinguish between all of the parts and
the one whole (the presumed collector of all inherited properties).

Paul Noordhof has raised a similar point against Kim's conception of levels in a
slightly different context. In response to Kim's suggestion that ‘having a mass of ten
kilograms’ should be viewed as macro-property, Noordhof pointedly asked why not view
it as “the property of having two parts weighing 4kg and 6kg respectively” (Noordhof,
1999, 113). As Noordhof sees it, Kim is simply dodging the substantive issues regarding
which levels of nature there are, with talk of macro-properties. Noordhof pointedly
formulated what he sees as the real issue Kim ought to discuss as—“when do wholes
have powers, parts do not?” (Noordhof, 1999, 113). Simple material composition does
not have the ontological resources to distinguish ontologically significant compositional
acts from insignificant ones. Kim’s view appears to potentially entail ‘a level’ of 4
kilogram parts, 6 kilogram parts, 7 kilogram-part, etc., as all proper parts of a given 10kg
object.

3.5 Structural Composition

As simple material composition can be both too restrictive (ruling out social
groups) and too broad (including trout-turkeys), a better candidate for the CCL integrates
Wimsatt’s notion of non-aggregative property conferral (discussed in the prior chapter)
with what we may call structural composition. Recall Wimsatt’s criteria that for non-
aggregative property conferral were (a) sensitivity to a single part’s addition, (b)
sensitivity to a particular arrangement (c) sensitivity to replacement/re-aggregation.
Consider a complex artifact, such as a computer, and its many parts—the hard drive, the keyboard, the operating system, and monitor. Now if you had these parts separately, you could form a Kimian-style material object by simply gluing them together in any fashion what-so-ever. But simply gluing some computer parts together is not going to result in creation of a computer. Nor is simply having the parts scattered about (as per formal mereology) likely to be counted as having a computer. Rather computers need to be put together with their parts arranged in particular way, and with certain key elements (such as the CPU) present.

One might be tempted to call the difference between having a working computer and bunch of computer parts glued together a difference between material and ‘functional’ composition—only when the parts are put together will they be able to perform a certain function. However, ‘function’ is a philosophically over-burdened term of art (see chapter 4 for some discussion). And in regards to discussions of levels, ‘function’ is already typically identified with the notion of a multiply-realizable property that participates in a higher-level set of laws. Thus I will leave talk of ‘functions’ for later.

Besides, the constitutive relationship between parts that I mean to pick out need not have any clear-cut functional role. The fact that sodium chloride molecules bond in a predictably stable 3-dimensional arrangement (a crystalline lattice) is not (or at least not solely) a functional arrangement as many other ionic bonding patterns are possible.
I prefer to label this sort of composition relation ‘structural composition’. Some configurations of Legos are likely to exhibit more staying power, constitute more stable arrangements, than others. They can exhibit a kind of structural integrity (such as when put together to form a Lego-house, or Lego-car). For structural composition both glue and a particular arrangement is required. For a structural object to exist we need to know the parts are arranged in a particular ordering such as B,C,D,E-wise. The walls of the Lego house connect to one another and are bound by a roof and a floor.

Another way of explicating the notion of structural composition in addition to Wimsatt’s notion of non-aggregative property conferral, is through the notion of the parts standing in a specific relation to one another. What defines a floor as being a floor is its relation to the walls and the roof. What defines one of the lines of the triangle as being the hypotenuse is its relation to the other two sides of the triangle. When one part’s relations to the others assign that part a particular status (such ‘electron donor’ and ‘electron acceptor’ in the case of salt/NaCl) we can say that an instance of structural composition has taken place.
Structural composition may well solve most of the problems discussed above. Consider an empirically respectable putative scattered object, a sociological group, such as the middle class. What defines someone's place in a particular socioeconomic strata is their relationship to their peer group (i.e. similarity income levels) as well as their relation to the members of other socioeconomic groups (having higher income than some groups, and lower income than others). By contrast, what defines the status of the trout-part of a 'trout-turkey', however, has nothing to do with the trout's relation to its other part, the turkey, as there doesn't appear to be any essential relation between the two at all. Similarly, what makes a particular strand of DNA a gene is its relation to the other parts of a cell, such as messenger RNA, and its ability to be translated/to encode a particular protein for a specific function. What defines a star as being a Libra-part is not any essential relation to, or ability to interact with, other Libra-parts (the other stars). Rather, it is a relation all these stars bear to humans on earth when viewed at a particular angle from very far away.

Thus a CCL defender who was willing to accept structural composition as the operative notion for building empirically important objects could rule out trout-turkeys and astrological wholes on the basis that the parts of such wholes bear no essential relation to one another. They could similarly give defenses of a scattered social group with the roles it assigns it members, as well as a single individual cell with the different roles assigned its chemical components, such as the nucleus and mitochondria.

Structural composition also appears to defend against Nordhof's complaints regarding Kim. Noordhof seems right that a rod need not be seen as possessing any novel powers over and above the two halves of the rod; and thus the rod really has the
same ontological status as (at least some of) its parts. But the two halves of the rod do not constitute an instance of structural composition. They are not parts that bear any kind of structural relationship to one another. The properties they confer upon the whole when welded together (such as mass and length) are simply aggregative/additive properties that confer no new type of causal power upon the object they form other than the sum of properties of its parts.

3.6 Structural Composition, Ordered Levels, & Intransitivity

There is a serious problem, however, reconciling structural composition and the CCL thesis. Structural Composition does not yield the vertical inter-theoretic dimension of the CCL; to put the problem in the terminology of Oppenheim & Putnam, structural-parthood is not a well ordered transitive relationship that defines essentially related homogeneous sets of objects and homogeneous set of parts, sets of parts of parts, sets of parts of parts of parts, and so on. Rather it typically picks out heterogeneous and diverse classes parts and sub-parts. As such, it is a poor candidate for the essential inter-level/inter-theoretic relation. At best, it may define a relationship between 2 levels/theories, if there is a sense in which the collective domain of the higher-level theory could be construed as one big object/unity (such as the environment, or cosmos). But when you move to the ‘lower’ level, structural relations, both amongst and within the parts, diversify.

This problem, in turn, becomes a problem for the horizontal intra-theoretic dimension of the CCL. It entails structural composition does not yield lower-level constituting wholes definitive of the domain of a single ‘kind’ of science (such as chemistry). The relation of structural composition appears to lack a comprehensive
horizontal dimension. It is concerned with the horizontal dimension of solely particular objects/systems, rather than broad classes of such.

We can begin to flesh out the argument that structural composition does not deliver up classes of lower and lower level homogenous domains with the following example. Consider a computer and its parts—the disk drive, Monitor, Ethernet card, video card, RAM, CPU, operating system, and motherboard. Even if we grant that this rather heterogeneous class forms a level of computer-parts one ‘level’ down from the computer, the parts of these parts, the liquid crystals of the display, the magnetic disks of the drives, the software code of the operating system, are even more heterogeneous with little, if anything, in common. There is no reason to think a line of code, a tiny crystal, and a medium sized magnetic disk, essentially exist on the same ontological level as one another, ‘one level below’ the computer parts level and ‘two levels below’ the computer. Software code and liquid crystals do not bear any essential or direct causal relations to one another. They depend upon their place in a particular system (i.e. a computer) to causally interact with other system components. As is likely to be the case with structural composition in general, the interaction of the crystal and the code essentially requires macro-level intermediates. As such, structural part-hood implies no essential relatedness (between parts of parts) beyond the original specification of structure constituting parts.

To go back to the relation Oppenheim and Putnam posited as key, i.e. transitivity, one of the reasons that structural part-hood may not pick out a well ordered relation (rather it picks out increasingly diverse classes) is that it is often not transitive (see Tversky (1989) Simons (1987) Casati & Varzi (1999), Sanford (2004), and Johansson (2004) for more on intransitive part-hood). Consider that my desk is a part of my study,
my study is part of my house, but intuitively my desk is not a structural-part of my house. We could throw the desk out, and my house would be unaffected. Similarly, an operating system is an essential structural part of any computer in a campus computer lab. Nevertheless, the operating system does not appear to be a structural part of the lab. We could update, change, or remove the operating systems from the computers in the computer lab, and intuitively the lab would still be the same computer lab. Similarly the lines of code that make up the operating system do not appear to be literal parts of my computer at all. The part/whole relation is typically considered one where a whole possesses many parts, rather than a part possessing many wholes. But the software code appears to have exactly this latter relation, rather than the former. It is a part of many wholes.

If structural composition picks out a typically intransitive relation, if the parts of the parts of the parts...of an object bear no essential relation to the object, then two additional problems immediately present themselves concerning the attempt to build levels ‘up’ out of structural composition. First, the direction of determination, and hence explanation, would no longer be guaranteed to travel ‘down’ to the basic parts. This entails the potential explanatory nature of the CCL’s posited inter-theoretic relation becomes unclear and may be lost entirely. Second, and related, one could no longer make the appeal regarding a macro-object and its natural kind that its essence was a fixed relation to its basic micro-components. Rather, its relation to such micro-components would be contingent and the potential problem (i.e. non-lawfulness) concerning the natural kinds being individuated by extrinsic relations returns.
The potential structural nature of empirical part-hood questions the ability of partwhole relations to define a higher-level object's relation to the lower into question. The potential intransitive nature of empirical part/whole relations draws the ability of a lower-level to define the objects of the higher into question.

3.7 Intransitivity & The Natural World

Some may think the example of an artifact (some sort of derived intentionality or inherited function) is a cheat. It is only artifacts for which part intransitivity is plausible. Thus one might claim the examples do not illustrate general lessons about how structural composition operates within 'natural world'.

However, the natural world also possesses instances where a well-ordered transitive part/whole relation is absent. Consider the jump from the biological to the psychological and/or social. Now one's understanding of the 'parts' of psychology will obviously be influenced by what one sees as the wholes of psychology—be it attitudes, concepts, cognitive processes, conscious states, memories, perceptions, judgments, behaviors, etc.... Regardless, none of these have patterns of neurons as proper parts—no more than Windows XP Pro has transistors (rather than lines of computer code) as its parts. The 'parts' of a propositional attitude are representational—i.e. my belief that the corner store sells cigarettes is composed (in part) by my representations of the corner store and the cigarettes it sells. Similarly, such things as perception may include parts such as sensation and inference (i.e. my perception of the blue patch as a coffee cup). However, these and similar psychological wholes do not have neurobiological parts (CNS+brain structures and neuro-molecular interactions). But according to the CCL, the wholes of psychology ought to be composites of the next lower level, i.e. neurobiology.
Contra the CCL thesis, the relation between neurobiological and psychological entities does not appear to be the many-to-one part/whole relation. Rather it appears to be something much more like a one-to-one relation. Certain neuro-biological processes may correspond to things like perception and representation but they are not literally ‘parts’ of those phenomena.

Similarly, it is at minimum counter-intuitive to say that psychological entities, attitudes and cognitive processes, as well as social entities, economic classes and states, are parts of our Solar system or galaxy. Few (if any) sympathizers with the CCL thesis would want to maintain that the solar system as a whole has consciousness as part. Or again, at a minimum, it appears an open empirical question whether the gravitational forces governing the solar system really need to concern themselves with the putative psychological and biological parts of one of its planets. Solar systems don’t have hearts, brains, or feelings, I submit. Thus the idea that micro-parts must essentially be seen as absorbed by containing macro-entities again appears dubious.

Lastly, and this is a point that has been made by numerous authors, including Nobel physicist Laughlin (2005), and the philosopher Humphreys (1997a & b), the sub-atomic realm possesses many properties and relations that appear unlike anything found in the macro-world. Admittedly, the proper understanding of these putative properties is a matter of controversy (see Bohm). Even so, phenomena such as quantum wave interference (coherence and decoherence) constitute prima facie examples of essential parts of the micro world that have no correlate in the macro world. But transitivity requires that my more mysterious micro-bits are every bit an essential part of me and my macro-parts. However, as there are no macro-correlates of their more bizarre properties,
the claim that these micro-particles are essential parts of objects is open to dispute. My fermions and I differ radically. Their properties appear uniquely possessed by entities of their size and not by any other sort of ‘higher-level’ object or empirically studied part. Thus the idea that they are in fact essential parts of higher-level objects is largely unmotivated.

3.8 The Central Charges against the CCL

The above considerations lead me to the following claims. (1) Given a domain of natural objects, there is no single relation a CCL advocate can point to between those objects and their parts such that this relation picks out successively lower-level domains of natural objects that correspond to domains of current empirical enquiry. Rather biological entities will typically have biological parts, psychological entities will typically have psychological parts, etc. .... Furthermore, (2) the part/whole relation that characterizes the emergence of many natural objects and processes is not a transitive determination relation that can secure the ontological and explanatory aims of the CCL.

The CCL fails in its characterization of both the top-down, and bottom-up, characterization of nature. You cannot work your way up the vertical ladder of reality the CCL proposes and explain each higher level object solely in terms of its lower level parts, and you cannot work your way down the ladder and successively fill in the domains of lower level theories.

There are three different sorts of responses CCL defenders can make to the charges. The first is to ‘hold the line’, deny the examples show what they purport to. The second is ‘retreat’ with honor--accede to the examples but deny they speak against the possibility of an ontologically important part/whole relation that has the properties
they assume. The third is 'retreat and entrench'—admit particular examples, but deny any general lesson. None of the responses are convincing.

The first sort of response admits the oddity of the claim that attitudes are essential parts of solar systems, and that human parts are in states of quantum flux—but goes on to claim this is simply a counter-intuitive consequence of materialism in general. It is just part of the weirdness of the claim that people are essentially made out of the same stuff as tables. Additionally, it claims that while something like structural (de)composition may not immediately reveal sets of essentially related parts and sub-parts, (i.e. lower levels) if you follow the chain long enough, structural-parts and sub-parts will ultimately reveal a set of parts essentially similar kind that constitute a level.

This sort of move by a CCL defender, however, essentially misses the ontological difficulties the points above illustrate. For example, it confuses the identity claim of materialism (that everything is in some sense physical) with the mereological claim of the CCL thesis (that everything has micro-physical parts). More to the point, it confuses the one-to-one claim all materialist are committed to with the one-to-many claim of the CCL. The problem with the transitivity claim of the CCL is not that neuro-biological entities and mental entities are part of the same material realm. Rather the problem stems from the claim that the parts of mental entities are neuro-biological entities. One of the motivations behind the conception of levels I will explore in the next section is that certain inter-theoretic relations are one-to-one (token-identical as Fodor (1974) puts it), rather than one too many. On this sort of view it is wrong to suppose there is a neurobiological part of an attitude, rather one need look only for a neurobiological correlate of an attitude.
To illustrate the point, consider an complicated parallel (see Wilson’s (1987) for a fuller discussion)—the theoretical identification of heat in a gas with the mean molecular kinetic energy of the gas. It was not as though we identified the parts of heat as a number of molecules moving around. After all, one molecule can still have kinetic energy, i.e. heat. Rather we identified one process (heat transfer) with another process (kinetic energy transfer). Similarly when long-term neuronal synaptic activation potentiation is hypothesized as a mechanism of memory, it looks like what is being hypothesized is essentially a one-to-one relation, rather than a one-to-many composition relation.

It appears to be something of a category mistake (to use Gilbert Ryle’s famous characterization) to say of a psychological entity, such as a concept or perception, that it could have neurons, waves, and spin as parts. This is particularly pressing for an adherent of the CCL thesis who advances the model as an alternative to eliminativism and property-based accounts of the mental. If the model is going to account for the mental, it needs to show that the mental has the same sort of relation to other sciences that they have to those sciences above and below them. However, in the case of the mental/neurobiological, this appears to be a very different sort of relation than between, for example, biochemistry and molecular biology.

A different sort of response grants the ill-behaved nature of composition and part/whole conceptions, but claims that the apparent intransitivity of certain empirical part/whole relations need not hurt the metaphysical conclusion that each level is ontologically if not theoretically grounded in lower-level parts. This line of defense attempts to split off an empirical intra-level notion of part-hood from an ontological inter-level notion.
According to this line, what count as the intra-level parts of an object such as neuron, are those things identified by the cellular biologist (the nucleus, the membrane, etc.) that contribute to the proper functioning of the cell from the biologist perspective. However, from the inter-level (i.e. CCL) perspective the important parts of the cell are its molecular components rather than its structural components. On this view, a theoretically defined cell part (such as a centriole) need not be considered an organism part, and certainly not an attitude part. It would also help explain why each individual science typically generates its own micro-macro distinctions, i.e. chemistry's [atoms→crystalline bonding structure→solid] and biology's [cell→organ→organism].

However, the problem for this line of CCL defense is to point out that the inter-level/intra-level division can shift, whereas ontological levels are presumably supposed to be stable features of reality. Thus one cannot claim that intra-level part-hood relations are not the concern of the CCL.

To see how the distinction between intra-level and inter-level part-hood can shift, consider the phenomena of neuronal signaling (a more exhaustive and in depth of analysis of this kind of 'theory shifting' can be found in Bechtel and Richardson's (1993) discussion of oxidative phosphorylation). Neuronal signaling can take either a chemical (i.e. neurotransmitter) form when cell membranes are not touching, or an electrical form when membranes are touching (see Gazzaniga et. al. (2002)). Note that membranes, neurotransmitters, and electrons all appear to be on different levels, according to the CCL thesis, as cell membranes have molecules as parts, and neurotransmitting molecules (such as Serotonin) have electrons as parts. Nevertheless all three of these inter-level objects contribute to the same intra-level process. This illustrates that which objects are
relevant (membranes, molecules, or electrons) to a process of is not something
determined purely intra-theoretically or intra-level. Rather there is an interplay between
parts presumed to be on different levels. It was discovered that these inter-theoretic parts
play an intra-theoretic role in jointly contributing to the course of neuronal processes. In
other words, the idea that an intra-level process such as neuron-firings cannot have inter-
level parts, as this defense posits, appears both implausible and empirically unmotivated.

There is a third sort mixed-strategy response that one can attempt by pointing out
that much of the intuitive plausibility for intransitive part-hood rests on the
mental/physical distinction. Putting Quantum weirdness off to the side, what the
examples really trade on, a CCL defender can object, is the conferral of consciousness
and the like to macro entities such as planets, solar systems, galaxies, and the like. Given
this, why not suppose that the mental is not something the CCL thesis needs to make
room for. A defender of this sort of can point to the fact that Oppenheim & Putnam’s
original recitation of levels does not in fact make room for a level of mentality. Rather it
skips from living things, to social groups. As such, a defender of the CCL thesis may ask
why can’t we just put the mental to one side and construct the ontological model in its
absence (a strategy Kim’s 1999 employs).

However, this strategy is an ultimately defective defense as well. Its main defect
is that mentality simply appears to reappear at the social level. To see this consider a
social entity (such as a class, or a political entity, etc.) or process, or whatever
phenomena it is that you think social scientists study, for example, something like social
cohesion (see Burton & Dimbley). Now notice that the CCL would appear to have no
problem with attributing genuine levelhood to social phenomena. It was one of the
'levels' explicitly recognized by Oppenheim & Putnam. Social phenomena are composed of the interaction of complex lower-level parts, i.e. multi-cellular organisms such as people. Now note that if a defender of the CCL thesis does accept social entities and attitudes at the level of groups, it appears that it simply would have to allow psychological phenomena back in when trying to account for the parts of such processes.

For consider that the CCL thesis requires that \textit{that the objects at the social level must have some} parts if they are to qualify as genuine macro-phenomena. Then consider some social phenomena, such consumer confidence. Every month the Economic Conference Board surveys some 5,000 U.S. households and asks them to rate the economy along five different dimensions as either positive, neutral, or negative. Now I simply do not see any other candidates for the parts of U.S. consumer confidence other than the attitudes of the 5,000 people surveyed. Similarly, economics attempts to explain the behavior of various macro-entities in terms of the aggregate of rational actors with diverse attitudes regarding their preferences. But \textit{if attitudes can be the parts} at the social/economic level, then the CCL thesis requires \textit{attitudes to be wholes} on their own level. Thus it seems the CCL either requires the creation of a \textit{second hierarchy} (contra materialism) with a psychological level at the bottom to account for the sociological level it appears incapable of ruling out, or it is left with the problem intransitivity again.

Claiming, as someone might, that it is really behaviors rather than attitudes that constitute the wholes of sociological phenomena also does not seem to help. If behaviors are the parts of social phenomenon, then again they must be the wholes of their own level. But then they also will need a level of their own and the level at which one would seem to need to place them, individual psychology, again gets its own level, and neuron
firings appear no better candidates for the parts of a behavior (rather physical movements do).

Additionally saying that planet or solar system has political parties and mating behaviors as parts appears no less counter-intuitive than saying it is made out of conscious parts. And indeed, attributing to it living parts appears not much less problematic than attributing to it conscious parts. Thus the roots of the CCL's difficulties need not be seen as being essentially concerned with the mental.

3.9 Summarizing the Case Against CCL

Compositional conceptions of levels attempt to define a vertical axis of reality and the inter-level/inter-theoretic relation in terms of a transitive part-whole inclusion relation. A whole at a higher level \( n \) is supposed to be completely decomposable into parts which comprise the wholes of lower level \( n-1 \). This vertical relation secures the materialist credentials of the model and parasitically is supposed to provide an account for the emergent nature of objects as well as the horizontal domains of levels. Furthermore, as discussed in prior chapter it also is used to explain micro determination of the macro, micro-essential referents for macro-kinds, and the essential ceteris paribus nature of higher-level laws. All of these depend on the idea that putative higher-level objects are ultimately composed of some set of basic parts.

However, I have tried to illustrate that this concentration on the vertical axis has left the conception open to the complaint that the model does not in fact give an account of levels as it fails to give a plausible account of the horizontal dimension of levels. It assumes that given some set of wholes we can determine the wholes of the next higher level by simply looking at combinations of these entities. And it assumes that we can
determine the domain of the next lower level by looking at the parts of the whole.

According to the CCL, it we are given this relation:

\[
\begin{array}{c}
N+1 \\
\uparrow \\
N \\
\uparrow \\
N-1 \\
\end{array}
\]

Then the horizontal dimension of reality can be filled out as follows:

\[
\begin{array}{c}
N+1 \rightarrow N+1 \rightarrow N+1 \\
\uparrow \\
N \rightarrow N \\
\uparrow \\
N-1 \\
\end{array}
\]

I have argued that in general this assumption is false. If we start solely with some set of entities at level N-1 (as in the diagram on the left) and the notion of composition (be it simple material or mereological) then the combination of level n-1 entities appears guaranteed to produce many arbitrary different sorts entities for level N that bear no essential relation to one another, let alone domains entities that correspond to contemporary theoretical enquiry. There are lots of different ways of combining physical or chemical building blocks that are not going to constitute entities at a higher-level. Composition must be restricted in some fashion or another for combinations of lower-level entities to produce entities that can plausibly be thought to inhabit a horizontal level in which the entities are all essentially related.

If we work in reverse, and take a look at entities at some higher level that exhibit a kind structural integrity (i.e. is an instance of structural composition) and then look at
its parts (as in the above diagram on the right) then a similar problem arises. While the parts of such object are in some sense guaranteed not to be arbitrary, they do not bear any essential relationship to one another. There is no reason to think that the parts (and the parts of the parts) will bear essential horizontal relations to one another that would justify the claim that they constitute a single horizontal level of reality:

```
    Computer
     /   \
   /     \    \
Operating System  Hard Drive  Monitor  Processor
     |      |      |     |
  Computer code  ->  Magnetic disks  ->  Liquid Crystals  ->  Filaments
```

These problems call into question the assumption that the vertical composition relation can, by itself, constitute a theory of levels. Solving the problem of determining when an ontologically significant act of composition has occurred can only be solved by looking at how something interacts with other objects. One has to look at the horizontal dimension of reality. And when one is looking at that to define the relevant vertical axis of reality, the model can no longer pretend to offer an account of levels in terms of composition.
Chapter 4: Property Conceptions of Levels-The PCL

4.0 Property Conceptions of Levels (PCL)

The aim of this chapter is to develop the case for property conceptions of ontological levels (PCL)—levels of reality constituted essentially by properties and the lawful/causal relations among such. The primary focus of this conception of levels is on the horizontal axis of reality. It aims to explain how different sorts of lawful/causal relations obtain within ontologically distinct domains. Its main proponents are self-described philosophical ‘functionalsists’ who see levels of properties defining higher-level patterns that relate to an underlying fundamental material reality the same way that a computer’s software relates to the operations of a computer’s hardware.

Ned Block recently characterized the distinction between functionalist conception of levels (what I am calling the PCL) and Jaegwon Kim’s object oriented CCL as follows:

“(Kim) is using a notion of level keyed to objects. On his notion of level, the level of a property depends on what it is a property of. Properties of Socrates are on one level, properties of Socrates’ cells are on another level, properties of Socrates’ molecules are on another level, and so on. But there is another notion of level, which is keyed to relations among properties…. (On the functionalist notion) Socrates’ mental properties are at one level, his physiological properties are at another level and his atomic properties are at still another level” (142, emphasis in orig.).

Block’s use of the term ‘property’ here appears to mean something like ‘empirically important characteristic’. While less intuitive than the CCL, as the operative notion of ‘property’ tends to be either vague or technical, the PCL is both older (harkening back to C. Lloyd Morgan’s discussion of mental properties such rationality)
and more widely accepted among contemporary philosophers than the object-centered part/whole conception discussed in the previous two chapters.

There is a sense in which, as the quote from Block illustrates, my emphasis on properties vs. objects might be a bit misleading as CCL defenders are just as likely PCL defenders to engage in property talk, particularly when the causal/horizontal dimension of levels is emphasized.

Nevertheless I think Block’s point is well put—PCL defenders typically do take the notion of intra-level horizontal relations among properties as the key notion of their account (rather than a vertical relation to fundamental material reality)—and thus I will follow his (and Lloyd Morgan’s much earlier) characterization of this alternative to the CCL as essentially more focused on properties, than on entities or objects. Thus let the large circles below represent two lawfully related events—Socrates drinking poison (E1) and his beginning to die (E2), and let M, B, C, and P, represent the mental, biological, chemical, and physical properties of those events. Then we can represent the PCL picture as follows:

```
  E1                        E2
    \_____________________/ \\
     /                        /
   M1 ______________________ M2
      |                        |
     |                        |
   B1 ______________________ B2
      |                        |
     |                        |
   C1 ______________________ C2
      |                        |
     |                        |
   P1 ______________________ P2
```

The horizontal lines represent causation/laws of nature. There is no agreed upon philosophical view of either causal or lawful (nomological) relations. The two authors
most responsible for contemporary conceptions of the PCL, Jerry Fodor and Donald Davidson, treat the relations (in the present context at least) as one, i.e. causal laws. Davidson calls this the nomological character of causality.

There is, however, a potentially important distinction between laws and causes. Laws are supposed to be general—they have many instances. Thus ‘smoking causes lung cancer’ is a candidate for a law. Causes need not be general, they can be singular. Thus ‘his running out of cigarettes caused him to go the store and miss the deadline’ need not be a law. ‘Running out of cigarette’ events need not be generally correlated with ‘missing deadline’ events. According the standard functionalist line, however, higher-level properties (or ‘functional types’) are individuated by types of causes and effects. Thus they are general rather than specific and support counterfactual generalizations. Perhaps the best way to capture the relation most PCL advocates intend by the above lines is as follows “a C2 type event would not have occurred in the absence of a C1 type event”.

The interpretation of the vertical dimension of the above diagram, the fact that P1 is lower than C1 (which is in turn lower than B1, in turn lower than M1), is even more controversial. The most general way of interpreting the higher/lower relationship according to the PCL is in terms of asymmetric property covariance along the lines of “M properties never occur in the absence of B properties, and B properties never occur in the absence of C properties, and C properties never occur in the absence of P properties, and P properties can occur wherever and whenever they like.”
4.1 Arguing Over Properties-Preliminaries

Given that property talk is largely the domain of philosophers, constraints on theories about properties are largely self-imposed. Conceptions of their nature, number, and explanatory power, tend to be primarily guided by what a theorizer wants them to do, i.e. by the explanatory work talk of properties may be able to accomplish (see Armstrong (1993) and Swoyer (2002) for more on theories of properties). This is an area where pre-theoretical intuitions tend to fall somewhere between minimal and non-existent.

Because of this, while it may be a basically sound strategy to argue against the existence of a disjunctive object, such as a trout-or-turkey, in part by an appeal to pre-theoretical intuition, the same strategy has less pull when properties are at issue. The more our object-talk strays from ordinary usage, the less intuitive explanatory value such talk is likely to have. Property talk is a bit different in that its role in ordinary language tends to be much fuzzier. It isn't clear that there is much in the way of pre-theoretical intuition to draw upon at all. Most people likely have an intuitive understanding of the claim that an object emerges from the structural arrangement of its parts, much the way a Lego-house can emerge from a particular arrangement of Lego blocks; but few likely have a similar intuitive understanding of the claim that a higher-level property emerges from a disjunction of lower-level properties that serve the same causal/lawful role. Given that intuitive constraints on the nature of properties are minimal, if there is a reasonably motivated theoretical pressure for allowing the existence of, for example, disjunctive properties, then I take it that such a pressure is a prima facie argument for accepting such.

This may appear to counsel pessimism concerning arguments over levels being built out of property collections. After all, if properties can behave as one wishes, why not suppose they have arrayed themselves into a hierarchy of horizontal levels. But
pessimism concerning the task of analyzing and judging the PCL is unwarranted. As was the case with the CCL, the PCL thesis can be judged both in terms of how well and how much it explains. Additionally, the primary philosophical explananda discussed in the first chapter still constitute the minimal criteria an account of levels has to meet to support the claims of its historical and contemporary employers. Thus the PCL can be judged regarding (1) its account of a vertical axis of reality consistent with materialism, (2) its account of emergence, (3) its account of a horizontal axis of reality that can support macro-realist claims.

One cannot just leave the issue at the point where Block (as quoted above) and others often wish—one cannot assume that there is a ready-made conception of levels in terms of properties that explains anything. Simply assuming that we can divide up Socrates’ mental, physiological, and atomic properties, in the way that Block suggests, tells us nothing about the property relations within a particular set, that set’s relation to a domain of empirical enquiry, and that set’s relation to the other sets of properties.

4.2 The Preliminary Case for the PCL

Unlike the CCL, the PCL’s contemporary prominence in philosophical discussions is due less to a particular paper (though the Fodor paper discussed below certainly looms large) than a philosophical movement—namely, non-reductive materialism in the philosophy of mind. The primary non-reductive approach to the mind thought compatible with materialism is ‘functionalism’; discussions and defenses of a functionalist approach to the mind are a primary contemporary source of talk of levels in philosophy (for recent discussions of levels of properties construed along functionalist lines, see Block (2003) Witmer (2003), and Nordhof (2001)). Many philosophers have
written on functionalism and idea that the mind exists on a higher-level than the physical or neurobiological. Some likely do not intend for the term to be taken as anything more than metaphor. Many, however, appear to follow Fodor and Horgan, as quoted in chapter 1, in taking such higher-levels to be a deep feature of reality. Even so, none have taken the time to develop anything like an explicit case for the existence of such higher-levels. As such, piecing together a case for the PCL can be more difficult than the CCL. It has more metaphysically inclined adherents, but they typically employ the notion without explaining or defending it.

Different authors at different times have contributed to the evolution of the property conception of Levels. As I discussed in chapter 1, the notion has roots in the late 19th and early 20th century Emergentist movement; however, here I focus solely on its more recent incarnation as it has co-evolved with the rise non-reductive materialist and functionalist approaches in philosophy. It is in this context that the PCL’s relation to the three essential explananda of materialism, realism, and emergence, can most easily be addressed.

4.2.1 The Argument from Materialism.

The drawing power of the PCL in regards to the philosophy of mind goes directly to its materialist credentials and constitutes perhaps the most basic argument in its favor. A, if not the, central problem in the philosophy of mind is how the mind and body are related, even though what is true of the two (the former being apparently diaphanous and weightless, while the latter is solid and weighty) differs in kind.

One common contemporary way to resolve this difficulty involves the claim that mind and body are not different ‘things’ needing to be reconciled, but rather they are
different sorts of 'things true of' (i.e. properties) one and the same thing (whether this thing is best viewed as a brain, an organism, a person, a process, a swarm of molecules, or something else, is contentious, and typically left vague).

Some (not all) of the mystery of the mind/body relation is removed if we acknowledge that it is typically not thought unusual for there to be radical differences in the kinds of properties a particular object may possess (such as: being a father, having a particular mass, being a certain color, having a particular salary, etc.). In general, it is normal for very different kinds of things to be true of one and the same object. As such, the idea is that if we view minds and bodies as kinds of properties rather than separate objects or substances, headway can be made on their relation.

Given this, an 'argument from materialism' for the PCL can be framed as follows. If we wish to be realist (anti-eliminativists) about mental processes and properties, then to talk as if the mind were an object rather than a set of properties is to already beg the question against the materialist thesis. The only way the mental can be attributed to the material is if we move away from talk of objects and towards talk properties and processes.

Of course, questions remain regarding how properties of different kinds are related to one another, how properties within a kind are related, as well as the question of how many different kinds of properties there are. Functionalism is the most common way of fleshing these issues out.

4.2.2 'Functionalism' & Realism

Rather than providing an argument specifically in favor of the PCL, when considered in isolation, functionalism is best seen as providing an argument in regards to
its potential realist credentials. It demonstrates a way a higher-level property (construed as a type over a set of tokens, so as not to beg any questions) can plausibly be thought of as a property that determines the course of material events and therefore constitutes a proper object of empirical enquiry.

Hilary Putnam has a special place in the philosophical history of 'levels'; he not only co-authored the locus-classicus for the Compositional conception (the CCL), two years after co-authoring "Unity", his "Minds and Machines" (1960) laid the groundwork for the rise of functionalism and the CCL's leading contender, the Property Conception (the PCL). Following Putnam's early discussion of the term, functionalism in the philosophy of mind took its name and early analytical cue from the mathematical/computational notion of function (also called "Turing machine Functionalism"). 'Functions', on this view, map possible inputs to particular outputs.

A functionalist sees diverse collections of lower-level properties constituting instances of a single higher-level property. Though the example is imperfect due to complexities surrounding numerical identity, consider the infinite variety of the different arithmetic operations that could take in 2 as value and output 6: 'x + (8-4)', x + (10-6), x + (8/2), etc.... All of the operations can be as 'realizing' the higher level '+' functional type. They constitute different ways of taking in the same input and spitting out the same output. A functionalist views the mind as essentially something that takes in types of inputs and produce outputs through a variety mechanisms but is essentially guided and determined by higher level types (such as the 'add 4' relation above). One can think of the mind on the functionalist view as a kind of machine that directs channels of incoming causation into particular outgoing streams of effects according to higher-level
programming directives. The observable relations and lawful patterns (such as the essential similarity in the arithmetic operations above) constitute the proper object of higher-level empirical study.

The main metaphysical draw of functionalism is that the lawful connections between higher-level types, according to this view, are presumed to be just as fundamental and determinative of the nature and structure of reality as the physical properties through which they can be observed/inferred. As a mathematical function determines which number is output upon a given input, the functionalist sees the higher-level law as determining a given material output upon a given input.

Perhaps the best way to put the ontological point of functionalism is this—the functionalist could admit that as concerns the marks on this page there are just pixel-dots. There are (strictly speaking) no letters in addition to the dots, there are just dot-collections with certain properties. However, the functionalist claims that what determines the arrangement of the dots on this page is not (solely) the relations individual dots bear to one another as they are spit out by the printer. Rather it is the patterns formed by the dots (letters arranged into words, words arranged into sentences, sentences into paragraphs, etc.) that determine their lawful relations and ultimate arrangement on the page (as well as their meaning). Macro-level patterns, such as sentences and paragraphs, are the product of genuine laws and properties that operate at a 'higher level' ultimately structuring the behavior of lower-level entities, such as pixel-dots. Accordingly, higher level properties and relations can be seen as just as real as printed words, sentences, and so on. It is this potential for conceptualizing real sets of higher-level properties and laws as both determinative of, and inferable from, lower-level
patterns that makes the functionalist approach attractive to certain scientific realists.

Now, as with all philosophical 'camps', functionalists differ with one another over many issues. Some of the differences are minor, some major. Not all functionalists are materialists (see Chalmers (1999)). Not all functionalists are realists (see Dennett's (1993)). And not all functionalists are anti-reductionists (see Lewis' (1994)). Nevertheless, I think it fair to say that following Fodor's "The Disunity of Science as a Working Hypothesis" (1974) most functionalists are realists and non-reductive materialists. It is these sorts Fodorian functionalists that I intend to pick out by blanket term 'functionalist'.

Before moving on it is also worth noting another approach to functionalism prominent in some philosophical discussions. So-called 'teleological functionalism' (see Robert Cummins (1975) and Eliot Sober (1985)) takes its cue from the biological and social theory. It conceives of functions in terms of the relation between components and systems, such as a heart's function to circulate a blood to the body or the media's function to filter information to the members of a society. Sober defines his notion of function as "a property of a part to contribute to the containing system's having whatever properties it has" (Sober 104 (1985)). On this line of thought, and in contrast to the more widely held view, a blood-bank dialysis machine would not fall under the functional-kind 'kidney' as it is not part of a kidney containing system (i.e. a living organism), even though it maps the same sorts of inputs and outputs as kidneys (dirty blood in, clean blood out). On this view, functions are essentially individuated by systems. The prior notion, however, is specifically system independent. The conflation of teleological and mathematical/computational functionalism is a source of some philosophical confusion.
Teleological functionalism is generally not the sort of functionalism to which PCL adherents are committed, and is not an intended target of my use of the term "functionalism".

4.2.3 Multiple-Realizability and Emergence

The support a property centered ontology offers materialism, along with plausibility of seeing functional properties as causally determinative certain inputs and outputs, provide some initial materialist and realist creditability for the PCL. The next issue to consider is whether the PCL can generate any plausible account of emergence. In recent philosophical literature this question has typically centered on the issue of multiple-realizability. Multiple-realizability, by itself, I submit cannot constitute the whole PCL story in regards to emergence. But it can play a crucial role in such an account. Thus for this reason, as well as prominence in recent philosophical discussions, this section will examine the notion of multiple-realizability and property emergence in some detail.

Multiple-realizability was briefly discussed in chapter 1. There I develop the notion in relation to a property in some sense independent of its material composition. Historically speaking, however, the notion of multiple-realizability was developed specifically in relation to natural 'kinds' or 'types'.

The putative difference is that properties are typically understood as characteristics of objects/processes (such as my being a father). The properties of most things are constantly changing. Kinds/types identify sets of objects/processes and the laws that are thought to govern the behavior of such (such as my being a male human). Kinds are often associated with many different properties some of which are considered
essential to the thing and its continued persistence through time. If I lose the properties of living, breathing, etc., then I cease to exist, cease to be a member of the human kind, though my material body may hang around for awhile. This example helps illustrate how kind membership can be thought of in terms of the existence of some entity ‘over and above’ material composition. According to the PCL view, emergence is not essentially about parts coming together in the creation of some new material object. Rather it concerns a set of properties that a material body may have that determine its capacities/the laws that govern its behavior.

Having noted the potential difference between a property and a kind, it is also worth noting that membership within a kind can be thought of as a property as well. Thus the putative distinction between kinds and properties can be collapsed. When a distinction between the properties definitive of a kind and the property of being a member of a kind is made, these latter properties are usually either called 2\textsuperscript{nd} order or higher-level properties.

The importance of multiple-realizability in the individuation of kinds was brought to the fore by (again!) Hilary Putnam’s 1967 article “Mental Predicates”. Putnam was reacting against certain “Type Identity” theories of mind (see J.J. C. Smart (1959)). Type-Identity theories proposed that mental-kinds (such as ‘depression’) just were neurophysiological-kinds (such as ‘irregular serotonin levels’). In response, Putnam proposed that mental processes might be \textit{token identical} to brain processes, in the way that a person just is flesh and bone. Nevertheless, token identity still allows for \textit{type} distinctions, such as the distinction between a living person and \textit{a dead hunk} of flesh and bone.
For example, suppose there are many true psychological laws concerning macroorganisms and ‘pain’—they don’t like it, they flee it, seek to avoid, etc. If you grant that many different sorts of things—birds, sea creatures (or more dramatically even silicon based Martians)—can (or at least could) feel pain and behave in lawful way we associate with human pain, then it follows that many different sorts of physical states can realize this very same type. Thus the mental ‘kind’ cannot be identified with any particular neurological kind as all of these things have very different sorts of brains. Putnam concludes that many psychological types are best viewed as essentially distinct from their multitude of potential neurological realizers. Rather they should be viewed as essentially multiply realizable types. Money, acid, protein, liquid, gas, and many, many, other terms as well, are all kind-terms that can pick out different material structures and thus arguably cannot be strictly identified with a particular material type.

As such, a multiply-realizable kind is seen as essentially independent of a particular material composition. Granting that there are such kinds, implies (1) not all kinds are material, which in turn entails (2) not all natural laws are physical laws (assuming the standard view that laws range over kinds). Such a view allows token-identity between a material event and a mental event, but type-distinctness. The token-identity theorist will allow that everything is in some sense a material/physical token (the same way that a football team is token-identical to a collection of 22 people), yet claim that token identity allows for many sorts of ontologically important types of distinctness (such as the distinction between 22 fans in the stands and the 22 people on the field).

The concept of multiple-realizability (MR) has been historically important to the rejection of mind/body reductionism, as well as a general shift away from talk of
composition and objects and shift toward talk of properties and kinds. In doing so, it paved the way for the eventual broad acceptance of a functionalist approach, first to the mind, and then to virtually everything else. Even so, there is no direct analytical path from M-R to the PCL. Even a functionalist would have to admit that there are multiply-realizable kinds within levels—springs, pendulums, waves, etc., are all kind terms of Physics, ‘multiply realizable’ in many ways by many different material structures. There is even a sense in which Newton’s ‘reduction’ of terrestrial to celestial motion had the notion of multiple-realizability at its core as it asserted there was just one type of motion realized in apparently different ways. As such the notion of multiple-realizability does not entail, by itself, the existence of emergent ‘levels’. It is a broader and separable notion from the idea of a higher-level of properties as postulated by the PCL. To repeat, levels are not lonely supposed to be lonely places; but the fact that there are kinds/types that are not material, does not imply that there are kinds of M-R kinds that form the inter-related domains posited by levels. M-R, by itself, supplies no ‘horizontal glue’ to bind a set of M-R properties together as belonging on the same level.

Before moving on to the PCL argument for that claim, note that while multiply realizable kinds may not be enough, by themselves, to leverage a conclusion for emergent levels, their mere existence does provide the PCL advocate with one important analytical weapon. Namely, a PCL defender can cite the existence of such kinds as a rebuttal to the argument from Natural Kind micro-essentialism for the CCL. Realists want a defense against the claim that our categorizations of kinds are mere convention. The CCL adherent will cite micro-essences and their powers of vertical determination as explaining our ability to discern ‘nature’s joints’ in macro-reality. The PCL defender, however, can
point to the fact that there are kind terms in Physics (spring, wave, pendulum, etc.) that apply to things not according to their composition, but rather according to the course of their behavior over time. If kind terms can be defined in Physics according to objects behavior over the course of time, then there appears little reason other sciences cannot make similar recourse to this strategy. Thus the PCL defender need not be swayed by the CCL argument from micro-essences as they can point to the potential of horizontal/temporal relations determinative of kind membership as well.

4.3.0 Populating PCL Levels

The discussions of section 4.2 illustrate the mutual support that the PCL can offer and draw from materialism, realism, and emergentism in the following ways: (1) it allows for the potential dissolution of a central stumbling block for materialism by illustrating how the mind/body problem may be better conceived in terms of properties rather than objects; (2) it coincides with independent functionalist characterizations of how ‘types’ can be causal controls over token inputs and outputs; and (3) it can draw on independent accounts of the essential nature of emergence in terms of multiple-realizability.

However, while functionalism and multiple-realizability may offer some plausibility to PCL thesis, neither entails multiple levels of reality, nor does the PCL constitute much of an explanation of an essentially functionalist character for higher-level science or an essentially multiply-realizable character for emergent relations. The reason for this is that functionalism + multiple realizability allow for a kind of two-levelism (advocated briefly by Putnam, see his “On properties” (1970)).

While (again) the example is imperfect, consider the example of a mathematical function, f(x+2)=x +6, where x = (y+1). Suppose, further, we consider ‘y’ as denoting an
essentially 'lower level' variable, such that the input and output of the (multiply realizable) function is seen as essentially co-coordinating lower level inputs \('<\ y + 3', 'y +7'>. Then allowing our function to stand for a higher level property, it appears we can represent a potential 'real' world process this function is representing as follows:

```
Higher Level Function

Lower-Level y-state 1 -------MR state ------- Lower-level y-state 2
```

All acceptance of the ontological import of functionalism and multiple-realizability get one is an acceptance that the world possesses at least some determination relations along these lines. The problem for the PCL advocate is that if all higher-level types work in this way, then there is nothing to bind higher-level types together into different domains. The only type of higher-level type on this view is 'being a non-basic type'. Being a protein, being an acid, being a desire for love, all would simply be non-basic, multiply-realizable types rather than belonging to different higher-levels.

Levels, on such a view, would turn out to be lonely after all, and only occasionally inhabited, for there is no inter-level glue implied in the above picture. There is nothing to distinguish a letter, for example, from an equally multiply-realizable squiggle. What is needed is some sort of argument/explanation of how and why a collection of certain 'higher-level' functions come to be considered as constituting a domain of 'higher-level' types.
4.3.1 Davidson on Homonomic Laws

To leverage a conclusion for domains or families of lawfully related higher-level properties we must consider a pair of seminal philosophical papers from the early 1970’s, Donald Davidson’s “Mental Events” (1970) and Jerry Fodor’s “Special Sciences” (1974).

Donald Davidson’s article, “Mental Events” (1970), is cited by Jaegwon Kim (1999) as the one most responsible for shifting the discussion of the mental/physical relation to a discussion of mental and physical properties. This article was also responsible for re-introducing (the early PCL defender) C. Lloyd Morgan’s term “supervenience” back into the philosophical discussion of mental/physical relations. It also is the main wellspring for contemporary discussion of the ‘exclusion argument’ discussed in chapter 1 for materialism/physicalism. It is a rich article. But my main concern is with its arguments against what Davidson calls ‘hetero-nomic’ (114) laws.

A heteronomic law is one that would mix (for example) mental and physical terms. Davidson’s argument against such laws starts out with the plausible (upon the assumption of materialism) assertion that every event that can be described as mental, such as my desire for coffee, will also be capable of some description in a purely physical vocabulary. By ‘physical vocabulary’, I don’t think Davidson is thinking of ‘kind-terms of micro-physics’, rather I suspect he uses ‘physical’ to mean roughly ‘non-mental’, thus a neuro-biological, or chemical, etc., description would work just as well. Given that we can describe any mental event in terms of some physical event, we can also describe any mental event pair (‘the memory of her father’s death, caused her to feel sad’) in terms of a physical event pair (‘the neural activation pattern caused a release of serotonin’). Given this, we have a choice if we wish to make a generalization (or as a Davidson prefers “a law-like” statement) regarding the mental and physical event pairs. We can form either a
homomic law statements—mental to mental or physical to physical—or we could form a heteromonic law statements—mental to physical, or physical to mental (i.e. ‘the memory of her father caused a release of serotonin’).

Davidson then goes on to argue that homemonic are essentially more law-like than the latter (i.e. heteromonic). The moral for the realist is that the former must be more indicative of the determination relations actually at work in the world. They provide the only hope that of being sharpened into (nearly) exceptionless laws.

Probably the easiest way to see why homemonic laws are better bets for ‘strict’ status than heteromonic is to re-focus on multiple realizability. If it is true that psychological properties, such as being in stress, can be realized by a multitude of states, a mixed mental to physical generalization will have the form:

“this neurological state or that neurological state or potentially some other neurological state will bring about a desire for coffee”.

If a kind is multiply-realizable, then any mixed law statement that involves its realizers (rather than the ‘higher-level’ kind) appears essentially susceptible to further exceptions (i.e. “or potentially some other neural state”). However, a homemonic statement “stress makes caffeine addicts seek coffee” does not suggest potential exceptions. From these considerations Davidson concludes “Nomological statements bring together predicates that we (can) know a priori are made for each other….Mental and physical predicates are not made for one another” (114).

4.3.2 The Software Analogy

Davidson’s notion of the mental comprising a set of essentially homemonic laws along with Putnam’s earlier discussions functionalism and multiple-realizability suggest a way of thinking about the mind, and by extension levels generally, that has become very
prominent amongst functionalism’s advocates—namely in terms of hardware and software analogies. The idea is that as a computer can be directed by a series of instructions in a multitude of different programming languages--Html, Java, Lisp, Basic, etc.--even though (for a given CPU) all of these different languages must eventually be implemented in the same ‘object code’ or machine language consisting of nothing but ‘chunks’ of 1s and 0s, so can physical reality be directed by laws couched in terms of a higher level “vocabulary” of multiply realizable properties.

At a basic level, any program must be compiled and turned into something the CPU execute. But when we take modern day operating systems into consideration, we may encounter layers of programming instructions and compilers, such that a program is written in one set of instructions, compiled and then implemented into another language, and then compiled and then implemented again into the machine language. Many functionalist see this as providing the right sort of model for thinking about how ‘higher-level’ laws get ‘implemented’ at some basic physical level.

Many functionalist also consider it instructive and important that given a particular bit of machine code there will be myriads of different languages that could be responsible for the implementation of a particular executable instruction. It illustrates how a functionalist perspective defeats a certain kind of reductionist thinking—namely, the idea that we should be able to deduce higher-level laws from lower ones. Just from looking at the implementation of a series of machine code instructions, or even possessing a detailed knowledge of the parameters those machine code instructions must take, one cannot deduce the actual higher-level programming language (i.e. whether it was a program written in Java, or Perl, or Basic, etc.). Similarly, just by looking solely at
basic physical properties, functionalist will claim we can’t deduce the (higher-level) laws that actually determined the instantiation of those physical properties.

4.3.3 Fodor, Disjunctive Laws, and Disjunctive Properties.

Putnam’s notion of a multiply realizable type, Davidson’s thesis regarding the essentially homonomic nature of laws, and the software analogy, all give us some purchase on the notion of what a level of lawfully related properties might amount to. As the notion of the PCL stands, however, the \textit{vertical} inter-level dimension still is still largely mysterious. As noted, the notion of a multiply realizable property, by itself, won’t do as those exist at the lowest and highest levels that PCL defenders posit.

To give a full account of the inter-level relation, I believe the PCL (as per Fodor 1997 and Clapp 2001) requires the notion of a \textit{disjunctive property}. To explain this we need to turn to Jerry Fodor’s seminal article “The DisUnity of Science” (1974).

As the title indicates, Fodor’s article proposes a different sort of realist ontology of science in opposition to the Oppenheim & Putnam scheme of levels related by part/whole relations. Fodor’s realism places a greater emphasis on laws, diachronic/horizontal relations, the structure of the course of events over time, than on the vertical composition relations of Oppenheim & Putnam.

Much like Davidson in “Mental Events”, Fodor is often ambiguous about the exact nature of this ‘horizontal’ relation, alternatively characterizing it in terms of \textit{‘bringing about’}, \textit{‘causing’}, and \textit{‘law’}. The core idea appears to be an empirically confirmable counter-factual supporting diachronic generalization such as “sunlight causes carbohydrate synthesis”, “friction brings about heat”, “John’s constant desire for coffee,
often causes him to seek out coffee”, etc. It is important to his argument that the relation is confirmable and essentially comes couched in ‘natural kind’ terms such as ‘friction’, ‘heat’, ‘sunlight’, ‘carbohydrate synthesis’, ‘desire’, and ‘seeking behavior’.

Fodor attempts to re-orient the realist conception of science towards the horizontal by first arguing against the possible success of a certain reductionist project advocated by the Unity of Science movement of the 1930’s. The ‘reductionist’ project in question had less to do with ontology than language. It sought the development an all-encompassing linguistic framework for inter-disciplinary science. Even though the relationship of this older project to Oppenheim and Putnam’s model of science in “Unity as a Working Hypothesis” is tenuous, Fodor’s focus is historically justified. An explicit aim of the original ‘Unity of Science of Movement’, as embodied in the writings of Otto Neurath and others in early 20th century, was the building of bridges across theories in terms of their different vocabularies. If Fodor can show that this cannot be done, then disunity of a sort has been established.

Another potential motivation for Fodor is the fact that Davidson’s thesis regarding homonomic laws does not entail that homonomic higher-level (or mental) laws will be preferable to lower-level homonomic laws. Indeed many, such as Kim, (1992 & 1998) have argued that Davidson’s views entail lower-level laws will always be the preferable ones. All Davidson’s argument entails is that homonomic laws are preferable to heteronomic ones. Thus in addition to arguing against the original Unity advocates, Fodor may also have wanted to motivate the idea that higher-level laws could be preferable to their lower level counter-parts.
Fodor’s argument begins by stressing that if mental laws, such as ‘depression causes restlessness’, are translated into lower-level homonomic laws, then the resulting homonomic lower-levels laws (such as a neurological law, for example) will be disjunctive (i.e. Low Serotonin or High serotonin brings about Low dopamine or high catecholamine levels). Fodor then goes onto argue that disjunctions are essentially bad candidates for empirical generalization. It is a consequence of his view that disjunctive properties, rather than disjunctions of properties are the real candidates for higher-level science. While this may sound like hair-splitting, the argument is straightforward.

Consider a putative higher-level kind, such as being in pain, and a class of heterogeneous realizers of this property—i.e. Octopi and humans. As these realizers are biologically diverse, different neuro-biological states would be involved in the realization of pain in each. For simplicity’s sake, suppose there is a single biological property involved in human pain, call it property $P_h$, and a single property responsible for octopi pain, $P_o$ (the fact that there may be many only strengthens Fodor’s argument). Now suppose it’s a law that Pain causes wincing, which again will be realized by different biochemical states in Humans and Octopi—$W_h$ (human wince) and $W_o$ (octopi wince).

Logically speaking, the formulation of the higher level law—if in pain, then wincing, $(P \rightarrow W)$—when formulated in the lower level vocabulary results in the following disjunctive hypothesis: if an object has $P_h$ or $P_o$, then it will soon have $W_h$ or $W_o$. This much is uncontroversial. The crux of Fodor’s argument however is:

*Fodor’s No-disjunctive Law thesis*

$P \rightarrow W$ is a law.

$(P_h \lor P_o) \rightarrow (W_h \lor W_o)$ cannot be.
This point is related, though different, than Davidson’s (Fodor’s 1997 comes closer to Davidson’s point). Davidson’s worry appears to be that $\text{Ph v Po} \rightarrow W$ is a poor law because there are lots of different things that might wince but would be unaffected by human or octopi pain. The disjunctive nature of antecedent implies an ‘ineliminable ceteris-paribus’ clause to the effect that some unrelated Px entirely would be the cause of a cat wince. He is also worried about ‘fake wincing’, i.e. that the disjunctive nature of the antecedent implies there can be winces in the absence of the lower level property.

Fodor’s claim however, will hold even in the absence of fake wincing and a universe solely populated by humans and octopi. His point is that $((\text{P}_h \lor \text{P}_o) \rightarrow (\text{W}_h \lor \text{W}_o))$ will not be confirmable by its instances, and thus it is not a law at all. The argument for this last claim is informal as Fodor offers no formal theory of what it means to confirm an empirical generalization. In fact, he has remained consistently skeptical that there is a formal theory of confirmation to be had. Even so, he thinks the point will stand.

Intuitively, if we allow that disjunctive laws like $((\text{P}_h \lor \text{P}_o) \rightarrow (\text{W}_h \lor \text{W}_o))$ are confirmable, it appears they can confirmed by the wrong sorts of things—namely instances of human pain followed by octopi wincing. Our putative disjunctive law, that the property of human pain or octopi pain brings about human wincing or octopi wincing $((\text{P}_h \lor \text{P}_o) \rightarrow (\text{W}_h \lor \text{W}_o))$, shifting back into the formal mode, is implied by human pain bringing about octopi wincing ($\text{P}_h \rightarrow \text{W}_o$). Thus it would appear confirmable by an instance of human pain followed by octopi wincing. And this, Fodor claims, cannot be we mean when we say a lawful generalization has been confirmed. Rather, according to Fodor, confirmation requires observation of properties that are actually, rather than
simply logically, related. It is the higher-level property pain that causes wincing, not a disjunction of its instantiations.

A defender of the idea that putative higher-level properties are best understood in terms of logically disjoint lower-level properties might respond that this is not a big problem. If $P_h$ does not in fact bring about $W_o$, then there will few observed instances of the two together. With any genuine causal regularity, such as smoking causing lung cancer, there is always the chance that a given person’s smoking was not directly involved in their particular case of lung cancer. Thus there is always a chance that evidence taken as confirmation does not involve any genuine determination.

Even so, there is another problem with treating laws as operating over disjunctions of properties. If the consequent of our putative laws are taken as simple disjunctions of properties, then observations of human pain followed by human wincing will be allowed to confirm a generalization about Octopi pain without ever having observed an instance of Octopi pain (or indeed Octopi) at all. Indeed, the same evidence regarding humans and their pain would also be allowed to confirm a generalization about Octopi pain causing octopi laughing. It is a fact about the logical nature of disjunction that if human pain causes human wincing, then human pain causes human wincing or octopi laughing!

The upshot of all of this Fodor urges is that if there really are higher-level confirmable generalizations that quantify over properties like pain (and it pretty much non-negotiable in his view that there are), then the property of being in pain must be something over and above the disjunction of types of pain (human pain or octopi pain or Martian pain, etc.). Thus when we confirm some generalization that happens to hold for
humans and octopi, it is not as though the observation of the causal powers of an essentially human property confirms something about the causal powers of an essential octopi property. Rather we are confirming something about a single causal property that can be realized by a disjunction of lower level types.

A common way of talking about such properties these days is the notion of a disjunctive property (see Bontly (2002), Clapp (2001)). A disjunctive property is a property with diverse instances (such as "being red or being blue or being yellow") yet the diversity of the instances does not preclude a shared commonality among such that they aren't also instances of single higher-level property as well (such as being colored).

4.3.4 Disjunctive Properties vs. 2\textsuperscript{nd} Order Properties

It is perhaps worth noting that the notion of disjunctive property is sometimes developed in terms of a 2\textsuperscript{nd} order property (see Kim 1997, Block 1997). This bit of jargon is probably unhelpful as the notion of 2\textsuperscript{nd} order property is treated ambiguously in the philosophical literature. Hilary Putnam (yet again!) (1970) originally characterized a 2\textsuperscript{nd} order property as the 'property of having a certain property', thus making it the property of an object. More recently (again, see Clapp) a number of authors have characterized the notion of a 2\textsuperscript{nd} order property in terms of a property of a property. In what follows I will assume that the operative notion for levels is something like the latter.

The former notion of a 2\textsuperscript{nd} order property, tied as it is to an object's possession of a property would likely just throw the issues back to the question of levels of objects discussed in the prior chapter. It may also entail the kind of 'two-levelism' discussed earlier—a level of the 'real properties' of objects and their '2\textsuperscript{nd} order' siblings. There is a
sense in which all second order properties on the original Putnam scheme turn out to be
the same property—i.e. the property of instantiating a property. For example, ‘being
colored’ is really the ‘property of instantiating blue’. It is not a property in the same
sense as blue. But the PCL appears to require both higher and lower level properties are
properties in the same sense. Their possession bestows genuine causal powers and lawful
determines certain behavior of their bearers.

4.3.5 From Disjunctive Properties to Levels

The notion of a disjunctive property can justify the realist intuition idea that the
sciences in general are concerned with study of real properties and determination
relations. It also presents a logically coherent picture of an ontological structure that
could build up a strict ordering relation. Every property would belong to particular level.
And every property on this model would be either a physical property or intimately
related to such properties. But most importantly, at least as it regards my purpose of
fleshing out a notion of the PCL, disjunctive properties appear to be able to meet the
requirement of defining a well-ordered vertical inter-level relation.

To see how this might work consider the following schematic diagram:

<table>
<thead>
<tr>
<th>Biological Property</th>
<th>[(A v B) v (C v D)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Property</td>
<td>[A v B]</td>
</tr>
<tr>
<td></td>
<td>[C v D]</td>
</tr>
<tr>
<td>Atomic Property</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

According to the disjunctive property model, suppose we have some spatio-temporal
region (i.e. Socrates) with (perhaps roughly) defined borders that appears to exhibit a
high degree of what Richard Boyd (1988) has called a 'homeostatic property clustering'—i.e. the things true of this spatio-temporal region correlate with one another to much higher degree than they do the things true of the non-Socrates regions of the world. (The point of all this talk of regions is to remain true to Block’s aim to have a notion of levels not tied essentially to objects.)

Now when we look closely, i.e. at the atomic level of the Socrates region, we can see properties associated with certain arrangements of certain smaller regions (i.e. atoms) such as 'being alanine'-CH3-CH(NH2)-COOH and ‘being arginine’: C(NH2)-NH-(CH2)3-CH(NH2)-COOH. Looking a little less closely, i.e. at the chemical level, we have properties which can be instantiated by a disjunction of atomic arrangements, such as being an amino acid (being (arginine or alanine)). On the biological level we have the property of being protein which can be instantiated by a disjunction of amino acid arrangements (being a peptin or collagen).

4.4 Summarizing The Case for the PCL

Accepting the above as the proper way to develop and motivate case in favor of the PCL, we can be sum the argument for the PCL as follows:

(A) It allows for a materialist ontology that does not require the existence of mental (or chemical or biological) objects.

(B) It can offer an account of natural kinds, such as Solar Systems, not essentially tied to their material composition.

(C) It can draw on functionalist accounts to explain the potential determination powers attributable higher-level properties.

(D) It can account for emergent properties in terms of disjunctive properties that participate in laws/causal relations.

(E) It provides an explanation of why scientific theorizing tends to be domain specific with its own unique theoretical vocabulary.
(F) It can account for a vertical dimension of reality with a discrete inter-level ordering relation amongst a finite series of levels.

(G) It can account the horizontal dimension of reality in terms of a set of higher level lawfully related properties.

The main work PCL defenders have sought to use it for is explaining why the materialist commitment to a fundamental vertical axis of reality need not overshadow the importance and robustness of the horizontal aspect of levels of reality. This has been true to some degree since its origin in British Emergentism. The PCL advocate maintains that there are many laws of nature such that the kinds they quantify over can be made of a variety of various material. As such, it would be incorrect to view such laws as material/physical laws, rather they are best viewed as higher level laws connecting instances of higher level properties.

Now, similar to the prior chapter, in the next chapter will turn to a central problem with the PCL. Again my aim will not be to show the PCL as essentially inconsistent. Rather my focus will be on how the model, in focusing foremost on the horizontal dimension of reality, does not give a robust or plausible enough account of the vertical axis of reality. It does not allow for a plausible account of *inter-level interactions*. Similar to CCL, I will claim this problem runs deep and goes to the heart of PCL’s plausibility as an account of reality as empirically revealed.
Chapter 5: Against the PCL

5.0 The Case Against The PCL

Using the same criteria we used in critiquing the CCL, and which were canvassed in chapter 1, we ought to expect the PCL to be able to (1) account for a material vertical axis of reality, (2) an account that can make some sense of emergence/important ontological distinctions (3) an account of the horizontal axis of reality that allows for a realistic interpretation of higher-level science.

In the previous chapter we saw that crux of the PCL account of levels relies on the notion of a diachronic causal law to underpin its account of these crucial explananda, much as the CCL relied on the part/whole relation. According to PCL, the horizontal dimension of a level of reality is defined/explained by sets of 'homonomic' laws that range over singular properties (i.e. Pain, rather than disjunctions of properties such as: Pain in Humans or Pain in Octopi …) and which discovered/confirmable by empirical investigation. One looks to the divisions of science and their theoretical vocabularies to determine the presence of a level, rather trying to build them up from below (as per the CCL).

The sort of emergence (as per 2) the PCL acknowledges is a kind of 'weak' property emergence—emergent properties are lawful multiply realizable properties independent of a particular material structures and which can be realized by a disjunction of lower level realizers. The materialist credentials (per 1) of the PCL reside in the claim that all lawful/projectible, multiply realizable, 'higher-level' properties entail some disjunction of base properties that can fulfill the higher-level properties role in some law.
Now, much as I claimed the Achilles heel of the CCL lay in the heart of the model's reliance on an implausible conception of composition, in this section I will argue the crucial weakness of the PCL lies at its core in its reliance on implausible conceptions of laws. In particular, it is unable to account for empirical causal regularities that cross levels. Roughly put, my criticism can be boiled down to the thesis that empirical practice is crucially more inter-theoretic/inter-level that the PCL advocate sees it.

Let 'E' be a higher-level property of an event. The PCL assumes the lawful cause of E must be some intra-level property C. It assumes that given E, we can fill in an arrow connecting it some C, and C to some disjunction as follows:

The world according to the PCL:

```
horizontal level

C → E

Ca ∨ Cb
```

vertical inter-level relation

I will argue that this often is not the case. Rather, our empirical practice sanctions lawful connection between E and, to put the matter in Fodor's terminology, a disjunction of properties:

```
E

Ca ∨ Cb
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A vertical connection between Ca ∨ Cb and some C cannot be assumed. Problematically, the PCL, not only offers no explanation, but rules out, such inter-level lawful connections. Additionally, I will argue that the PCL cannot coherently account for the essentially hedged nature of most natural laws specifically because it needs to rule out
such interlevel lawful relations. To account for the ceteris paribus clauses, it must acknowledge that their source often lies in the interlevel causal/lawful relations it seeks to ban.

5.1 Heil against the PCL.

This is not the first argument targeting the PCL thesis in recent the philosophical literature. John Heil’s “Levels of Reality” (2003, see also his 2004) appears to have that distinction. While I don’t regard Heil’s argument against the PCL a success, as Heil is currently the only other author engaged in the task of seriously questioning the ‘levels of reality’ hypothesis, some analysis of his thought is worth examining.

The central thrust of Heil’s anti-PCL argument is as an attempt to block the presumptive support predicate-kinds offer for the existence of ‘property-kinds’. Once the link between the two is broken, he believes that the vertical dimension of the PCL, the ability to build up levels out of multiply realizable kinds of properties, will crumble. There will be no reason to think putative higher-level properties bear any essential relation to lower ones.

Heil starts his argument by noting that one can and should distinguish between properties (the characteristics of things we wish to pick out) and the predicates we use to pick them out. He then argues against the PCL by arguing against the “predicates beget properties” thesis that he believes many PCL defenders tacitly (if not explicitly) hold. According to ‘predicates beget properties’ thesis,

“(w)hen a predicate applies truly to an object, it does so in virtue of designating a property possessed by that object and by every object to which the predicate truly applies (or would apply)” (210).

He believes this leads inexorably to the following line of reasoning:
“If being red is a higher-level property possessed by an object by virtue of its being some determinate shade of red – crimson, say – then surely the object’s being crimson is itself a higher-level, multiply realizable property; and the properties realizing this property are themselves higher-level properties relative to their realizers. The upshot is a layered conception of reality, a conception of reality as incorporating irreducible levels of being” (213).

In opposition to this, Heil asserts that “many predicates apply to objects by virtue of properties possessed by those objects, but few designate properties shared by every object to which they truly apply” (211). Thus he wants to claim that while the predicates ‘is red’, ‘is a belief’, ‘is a protein’ apply truly to many things in virtue of their properties, this does not entail there are corresponding properties possessed by all and only red things, proteins, and beliefs.

Adopting the view that predicates do not directly refer properties, Heil takes as crucially undermining the idea that there are any levels of reality. The argument for this appears to be that if the predicates-beget-properties thesis is false, then there is no reason to think that the properties different theoretical terms pick out can be arrayed in anything like hierarchal categories. There is no essential relation between biological and chemical predicates on his positive view, rather all predicates refer directly to physical qualities, rather than to intermediate disjunctions of such. According to Heil, predicates

“are made for picking out a range of objects that are, in a particular way, less-than-perfectly-similar to one another. The concept applies to objects by virtue of properties possessed by those objects, presumably an extremely complex and diverse class of physical properties.” (215)

5.1.1 Problems with Heil

The most serious problem with Heil’s argument, given the context of the present project, is that it is inconsistent with a robust scientific realism. It simply denies the second and third explananda (scientific realism and emergence) that the levels hypothesis
attempts to explain. Now as I noted in chapter 2, scientific realism does not, or at least not obviously, strictly imply realism about natural kinds. One could hold that our kind-terms allow us only to discern ‘true knowledge of unobservable processes, properties and entities’ *obliquely*, allowing that there may be essential slack between our theoretical terms and the genuine properties at work in the world.

But this is not the sort of position that Heil is pushing. His position is not that language is an imperfect guide, but rather the no-predicate-to-property link for him is essential. He implies that ‘less than perfect similarity’ = no such property. And our predicates above the micro-level do not pick out perfect similarity. Thus, ultimately, on his view there can be nothing like ‘proteins’, ‘cells’, ‘molecules’, or the many other entities that the scientific realist claims there are. There couldn’t be, for if there were then there would be some property (or set of properties) that they all would share that defined them as being of the kind. And that would contradict Heil’s the no predicate-property-link hypothesis. Thus ultimately on Heil’s account, (outside of the subatomic?) there can be no *real natural kinds* or properties for natural kind-terms to pick out. On his view there are just individuals that are roughly, and rather mysteriously, “similar”.

It’s not even clear if we should call them ‘individuals’ on his view. He ultimately urges the adoption of the view that “there is but a single substance: space-time or some all encompassing quantum field” (214) ever changing in its qualities.

Arguments, such a Heil’s, that hinge on the essential failure of most science to pick out genuine properties I count as not admissible as a critique of the PCL in present context. It is the analytical equivalent of the object-eliminativist option in regards to the CCL thesis.
Even so, there are other criticisms of Heil worth mentioning, if for no other reason than to mark off dialectical strategies that strike me as unlikely to succeed. First, to the extent that Heil’s argument hinges on a level-realist being committed to new levels for each and every multiply-realizable predicate (a level of crimson, a level of red, etc) he is right that such a commitment would prevent one from having a coherent conception of levels (this is roughly equivalent to my complaint with the formal notion of the part/whole relation in regards to the CCL producing an infinite series of arbitrary levels). There would be arbitrarily many levels if this were the case.

But you don’t need to divorce our conception of properties from predicates to see why this so. Consider the ‘multiply realizable’ kind ‘being taller than 6 feet’. This will be realizable by a series, such as being between 6 and 7 ft, or being between 7 and 8 ft., or being between 8 and 9 ft., etc.... Each of these, will in turn, be realizable by a series such as being between 6 and 6’6” or being between 6’6’’ and 7. Each of these will in turn be realizable by a further series such as being between 6’ and 6’3” or being between 6’3” and 6’6”. And so on ad infinitum. The fact that there will be infinitely many ‘in virtue of which’ relations that an object could possess to satisfy the predicate ‘being taller than 6 ft.’ has nothing to do with the predicate failing to pick out a genuine property of an object, or an objects to failure possess properties that satisfy the predicate. Rather it has to do with the nature of the property at issue. Thus the no-predicate-to-property link is ancillary to the issue of the infinitely many level-begetting properties.

The question is whether the laws of nature can be attuned to the sorts of course-grained distinctions—such as being male or being female—natural and theoretical language are more suited to drawing. Just as no CCL defender would want to claim that
every compositional act entails a new level of existence, no PCL defender will want to
claim every multiply realizable predicate picks out a higher-level property. The question
is whether the PCL defender can find a non-arbitrary way of marking off the multiply
realizable terms that do carve off ontologically important distinctions from those that
don’t. This question is never taken up by Heil. But as we saw in the previous chapter
Fodor has a kind of response to this issue—our empirical practice for preferring some
generalizations over others is a non-arbitrary guide for determining which higher-level
properties and predicates carve out a higher-level.

Regardless, even if we were to grant Heil that none of our current predicates
denote genuine higher-level properties, the conclusion that there are no higher-level
properties does not follow. The PCL defender, as a realist, does not want to claim that
levels come into existence with the creation of predicates. The divisions our terms now
apply to might only get at the real divisions obliquely, much the way alchemical kinds
got at chemical kinds obliquely. But that doesn’t preclude us from finding the right sets
of predicates, theoretical divisions, and corresponding properties, in the future.

And even if a PCL defender were to grant Heil that predicates were somehow
essentially incapable of mapping what properties there really are, it still does not lead to
the conclusion that there are no higher-level disjunctive properties. It appears open to a
PCL defender to claim that the structure of our linguistic (and particularly our scientific
linguistic) practice provides some evidence about the structure of actual laws and
properties at work in the universe, even if that practice is at best a crude reflection of the
actual properties at work. Thus the fact our predicates may never perfectly pick out
properties still does not force the conclusion that there are no higher-level properties.
One last problem with Heil’s focus on language/predicates is that many functionalists are ‘token-physicalist’ and grant the existence of an ideal complete physical description (say, in terms of atomic properties) of the processes in question. As such, they could agree that the terminological differences among the sciences are dispensable (ideally speaking). Even so, the PCL defender (plausibly) denies that a purely atomic-level description of a monetary exchange entails there are no monetary exchanges. The fact that a computer program written in C++ must be compiled into a binary machine language of 1s and 0s does not entail that there are no C++ programs. And the fact that we could give a description of the dots that make up the letters on page in terms of their Cartesian co-ordinates does not entail there are no letters or words on this page.

Thus again nothing need follow from Heil’s thesis regarding a broken link between properties and predicates. A token-physicalist will grant that biological could, in principal, be dispensed with. Even so, they will nevertheless claim that scientific linguistic practice can be taken as some evidence that there are scientifically and ontologically important properties in addition to those picked out in the equations of physics.

5.2 Kind-splitting

Suppose one does not want to follow Heil in asserting a clean break between predicates and properties, but does wish to acknowledge there is often some empirically important slack between our current predicates and the properties at work in the world. Both and Fodor and Davidson emphasize the nature of natural kind terms and put the nature of our explanatory practices in play to motivate their arguments. However, both
appear to disregard an often a crucial element of this practice. Fodor, in particular, gives
the impression that there is an essential direction, an 'upward sweep', at work in our
explanatory practice—it travels essentially from the particular (i.e. tyramine) to the
general (i.e. protein). Heil wants to argue that this linguistic practice offers no support
for genuine higher-level properties. However, one could instead grant such practices as
ontological evidence, yet question whether our practice does in fact have the upward
sweep Fodor imputes to it.

There is, I submit, a problem in this area for the PCL defender. Fodor, Davidson,
and functionalists generally, emphasize that scientific practice counsels we look for the
broadest and strongest generalizations possible. Strong generalizations are ones that
connect more general properties to one another; they connect disjunctive properties,
such as pain, rather than the more specific disjunctions of properties, such human pain or
octopi pain. The picture they appear to have in mind is that the practice of lumping
seemingly diverse processes together into broad generalizations and categories is the
essence of the scientific endeavor.

However, while lumping and categorizing is a crucial part of science, there is a
common countervailing practice as well—the phenomena of 'kind-splitting'. For
example, while we once thought that Hepatitis was a single disease of the liver, we now
know that there are 5 different viruses that can attack the liver and produce the symptoms
originally associated with the disease. Thus we now have Hepatitis A, B, C, D, and E.

There is a commonly discussed philosophical example of this sort—the fact that
Jadeite and Nephrite are two distinct kinds of Jade. However, the philosophical focus on
the Jadeite/Nephrite case example, has been misleading. It can give the impression that
kind splitting is relatively rare and simply involves a correction of past empirical practice (as per Fodor (1997)). What we once thought was one kind, turned out to be two.

A better example, prominently discussed in the U.S. a few years back, would be the genetic identification and classification of over 1,200 different strains of *Bacillus anthracis*, i.e. Anthrax. Each of these identified strains, as defined by a set of certain genetic markers, has unique characteristics relevant to determining such things as how deadly it is, how long it can survive in isolation, its causal origins, etc.... When samples of Anthrax were sent by mail to a number of Federal offices in Washington, D.C., researchers were quickly able to identify it as the “Ames” strain (Dalton (2001)).

In both the Hepatitis and the Anthrax case, the exact reverse of the process the functionalist likes to draw attention take place. Rather than lumping diverse kinds together, we split a single kind apart. Rather than just multiply realizable properties, we also often appear to have multiply dissociable properties at work in the world as well.

What the Anthrax example illustrates, and the Jade case conceals, is that kind splitting need not, and typically does not, have anything essential to do with a claim of prior mistake. It is not essentially about the claim that what was previously thought to be a natural kind (such as Jade) is actually two or more (Jadeite and Nephrite). Rather kind-splitting it is often like the Anthrax case where few would deny that the different strands of Anthrax are intimately (i.e. genetically/historically) related to one another and that sound generalizations (regarding the size of the bacteria, the sorts of environments conducive to its reproduction, etc.) can be made in regards to the 1,200 strains collectively.
Rather the impetus to further divide the category is that we think there are relevant properties shared by amongst sub-categories within the lumped-kind that affect the causal powers/lawful behavior of its members. Kind-splitting, I submit, represents as pervasive a trend in science (the lumpers vs. splitters distinction crops up outside of science as well, see Berlin’s (1953)) as the kind-lumping that motivates the PCL.

5.2.1 Split Kinds, Disjunctive Laws, and Ontological Inflation

One way of looking at Fodor’s argument is that empirical practice, and certain realists principles, compel us to look for the broadest generalizations possible. We do this is because we want as much confirmation as possible that a particular property and law are in play. A generalization concerning ‘John’s hang nail causes him to wince on Tuesdays in March’ is not going to afford much opportunity for (dis)confirmation.

But less pragmatic reasons are at work in the preference ‘pain causes wincing’ as well. A different sort of reason for preferring ‘pain causes wincing’ to ‘John’s pain causes him to wince on Tuesdays in March, or Fridays in April or Thursday in June….’ is the idea that the laws of nature and the important properties they quantify over are not unduly profligate. It’s likely constitutive of the idea of a law of nature that it is general, it covers many instances. Thus we don’t look to narrowly defined predicates such as ‘pain on Tuesday’ or ‘Pain in an Octopi’, because we don’t think nature would bother with pain-on-Tuesday laws, when pain laws would do just as well. We don’t think nature would bother with a bunch of different properties and laws when a single one will do.

This pushes the functionalist toward the claim that science is essentially about the search for ever more general laws. Towards the end of his (1997) Fodor defends this of move in the following terms:
(Higher-level) laws are stronger than the corresponding (lower-level) ones, and, ceteris paribus, we want the strongest generalizations that our evidence confirms. Accepting the strongest generalizations that one's evidence confirms is what induction is about. (158).

However, what kind-splitting indicates is that empirical practice pulls in both directions—there is an (upwards) pull towards generality, but there is a (downward) pull toward specificity as well. And it is not clear how the PCL can account for the latter. According to the disjunctive property hypothesis, what underpins the success of generalizations about Bacillus Anthracis is the existence of a distinct property that the 1200 strains share. According to Fodor, the putative lower-level generalization “strain A or B or C.... brings about cutaneous or inhalation anthrax poisoning” is inherently unsuited to being a law of nature. But empirical practice indicates the latter generalization rather than the former is often one of interest to researchers.

Each strain can differ in empirically important ways. In this case, what would appear to be ontologically profligate is attributing an additional law beyond those governing the individual strains. The importance of this can be summed as follows. According to Fodor, the idea that there are higher-level laws that account for lower-level connections between properties is supported by our empirical practice of seeking the strongest generalization possible. The strength of a generalization is defined in terms of the total number of potential confirming instances of that generalization.

However, kind-splitting indicates empirical practice does not tell us to always to prefer a broader category over a more narrow one. Often there is a preference for generalizations that will have fewer, rather than more, confirming instances. Given this, there is an equally strong argument from empirical practice against the thesis that nature,
always and everywhere, prefers homonomic or non-disjunctive laws. Sometimes it is 
more useful (in terms of causal intervening) to have a generalization of the form 
(Hepatitis A or B or C or D or E is causing the patients liver to fail) rather than simply 
(Hepatitis is causing the Liver to fail). Given this, the PCL’s ban on mixed or ‘inter-
level’ laws appears dubious. Supposing that there is always a higher-level law in 
addition to a lower level disjunctive one would then appear to be sometimes as 
ontologically inflationary as supposing that there ‘John’s pain on Tuesdays law’.

5.3 PCL Responses.

The anthrax example need not be taken as definitive. Particular cases may 
indicate no general lesson. A PCL defender can admit the example as an anomaly and 
deny any general principle. But one would like to know exactly why the case does not 
indicate a metaphysical conclusion opposite to the one Fodor draws. Why doesn’t kind 
splitting indicate that there can, after all, be laws of the form ‘either Anthrax A or 
Anthrax B or Anthrax C…caused the deaths’? In this section I want to examine some 
potential responses, none of which I believe succeeds.

5.3.1 Lawful Property Disjunctions as Indicative of Mistake

In his follow up to ‘DisUnity’—“Still DisUnified After All These Years” (1997)—
Fodor adopts this ‘admit but deny’ strategy in regards to the Jadeite/Nephrite example. 
The Jadeite/Nephrite case had been pressed by Kim (1993) as a counter-example to 
Fodor’s ‘no-disjunctive-law’ thesis. Fodor responds by arguing that Jadeite and Nephrite 
pick out no kind, thus there can be no ‘Jadeite or Nephrite’ laws. Previously we were 
mistaken, we were confusing two different kinds. Thus there may be Jadeite laws, and 
there may be Nephrite laws, but there are no ‘Jadeite or Nephrite’ Laws.
While Fodor’s response may be plausible in the Jadeite case, I believe it is not in the Anthrax case. Jadeite and Nephrite have different chemical properties and do not appear to be related to one another in terms of many of their causal/lawful properties. The sorts of causal relations they can enter into, how they will respond to various stresses, how they will react to different chemicals, will differ. It appears that if ‘Jadeite or Nephrite’ is accepted as a lawful property, then one will may have to accept ‘trout or turkey’ and other heterogeneous disjunctions as lawful properties as well.

However, the same cannot be said for Anthrax (and similar cases). The various strains of Anthrax are genetically similar and have a much more closely related causal/historical relation to one another. There is a large amount of overlap in their apparent causal powers, they all can kill humans pretty efficiently. They constitute a family of some of the largest known bacteria. They produce similar biological effects when handled or inhaled (much of the crucial difference in terms of toxicity stems from variance in the life span of a strain and its reproduction rate). Thus if we individuate lawful properties in terms of something like similarity (or overlap) amongst the causal powers of their realizers (following Clapp), then a disjunction of strains will be a lawful kind. A causal-similarity criteria also appears destined to return a verdict that the genetically unrelated Hepatitis viruses also designate a disjunction of properties that participates law-like causal generalizations, (i.e. Hepatitis A or B or C will cause one’s liver to fail). And in both cases there is an empirical preference for the disjunctive law rather than the non-disjunctive one.

If one accepts that Anthrax and Hepatitis strains do, in fact, designate lawful disjunctions of properties, then the supposed essential link between lower-level
disjunctions of properties and higher-level lawful disjunctive properties is broken. The only thing assuming the higher-level property achieves is filling in a spot on the vertical axis of reality, but there would not be any laws around for the higher-level property to participate in if we allow that the lower level disjunction can participate in lawful/causal generalizations. We now need an argument that a higher-level property must, in addition to the disjunction, be lawfully related to the typical effects of Anthrax or Hepatitis and not simply ontologically profligate.

5.3.2 Open vs. Closed Disjunctions

There is another strategy that Fodor employs in ruling out Jadeite/Nephrite as a PCL counter-example worth discussion. He claims that Jadeite/Nephrite is in some sense a ‘closed disjunction’ in this world. If we were to discover some greenish, translucent, rock on a distant planet that was chemically different from Jadeite and Nephrite we would not (according to Fodor) consider it Jade—much like we don’t consider cubic zirconium kind ‘diamond’ even though samples bear the superficial properties of diamonds. In this world, it is established that Jade is either Jadeite or Nephrite, thus empirically we know that there are in fact two different sorts of laws at work and have no reason to posit a higher-level law. However, this is not the case with pain. Pain is an essentially open disjunction, and there are things that may be governed by pain laws that bear no essential relation to the realizers of pain now known, thus we have good reason to posit pain laws independent of any disjunction of realizers.

Fodor’s point here is a bit strange for a self-described ‘industrial strength’ scientific realist. Realism is not obviously consistent with the thesis that the distinction between a genuine higher-level property and a disjunction of lower-level ones is mind
dependent (i.e. tied to our knowledge). To illustrate why, consider—suppose the
President of the U.S. decides one day to launch all of the country’s nuclear weapons and
end life on the planet as we know it. At the time of decision he will know that all
biological kinds now constitute closed disjunctions, there will be no more biological
organisms of the earth-bound sort. It would appear to follow from Fodor’s claim, then,
that all high-level biological properties would be reducible to their lower-level realizers
because of the President’s knowledge. This, I submit, is inconsistent with any sort of
realism. The President’s knowledge should not be able to make a set of laws simply
blink out of reality if those laws are really mind-independent in the way that most realists
conceive them to be.

Even if someone were to attempt to employ this sort of response—i.e. claim that a
particular taxonomic practice, itself, affects whether or not a higher level property is in
play, the response is not available in the Anthrax case. We can easily imagine a
government laboratory slightly modifying the genetic makeup of the ‘Ames’ strain
(perhaps to hide its origin), but the new strain would still be Anthrax. Indeed, this sort of
thing is known to have happened in the former U.S.S.R (Dalton (2001)). The new
genetic strain was still considered Anthrax.

Thus the implication that it is the essentially ‘open’ nature of a kind that drives
empirical practice in the direction of disregarding lower-level realizers as law-like
appears mistaken. Indeed, the Anthrax case illustrates that an essentially open disjunct—
i.e. the possibility of some new strain of Anthrax being developed—often leads to a
preference for formulating a lower-level disjunctive law. If a new strain of Anthrax
comes along, we want to know it. If we were empirically content with the higher level
law, we wouldn’t care. But the only way we would be able to tell a new strain had come along is by paying attention to the lower-level disjuncts rather than formulating simple ‘Anthrax’ laws.

5.3.3 Metaphysical Openness

There is one last (and related) Fodor-inspired move that a PCL defender might employ to argue that Anthrax and Hepatitis don’t express lawful disjunctions of properties. Fodor argues that real higher-level properties may be ‘metaphysically’ open in a sense in which disjunctions of properties are not. Something is ‘metaphysically open’ in Fodor’s sense if and only if it could be realized in a way that it is not in the actual world (1997, 158).

The idea would be that kind splitting only occurs when we have reason to think that as a matter of physical (or physio-chemical, in the biological case) law, there could be not realizer of the kind unlike those in the actual world. A PCL defender might try arguing that the reason that Anthrax can be split is that anything not genetically related to the strains we now have could not fall under the kind.

However, this response also appears to miss the mark. One problem is that when dealing with questions about possibility and possible realizers there are always difficulties in determining how much is to be held constant, how much is to be allowed to change. And in the context of the present dialectic, the claim that Anthrax could not have been realized other than how it is in the actual world is simply be question begging. Given that what makes inhaled Anthrax so deadly is the fact that human lungs provide the perfect incubation environment, the main restrictions on Anthrax having the biological form that it does in this world is pretty much the evolutionary history of
humans on planet Earth. In other words, the things that restrict Anthrax to its possession of the biochemical realization that it has in this world are the same sorts of things that restrict the realizers of acid, protein, pain, money, social status, etc. to the sorts of realizers that they have in this world—namely the contingent facts associated with the evolution of life on this planet.

If we hold this constant when examining the space of possibility such that it comes out necessarily true that Anthrax could not be other than the way it is, it is also appears necessarily true that humans couldn’t be other than the way they are, and the evolutionary history of organisms on planet Earth could not be different than it has been. And none of the relevant properties that functionalist are inclined to call higher-level properties turn out to be higher level at all. If all of that it is true, then it is doubtful there really are any higher level properties.

If the foregoing analysis is right, and there really isn’t any principled reason for denying split-kinds as picking out disjunctions of properties that can participate in lawful generalizations, then the support the PCL can draw from Fodor and Davidson-style analyses of our empirical practice appears to be substantially less than they assume.

5.4 Ceteris Paribus Clauses & Homonomic Laws

The issue of split-kinds involves both a formal and informal convergent point. The formal point is that sometimes disjunctions of properties appear perfectly acceptable candidates for participation in the laws of nature that diachronically determine the course of events. It is not “hepatitis causes liver failure”, but rather “hepatitis A, or B, or C, or D, or E, causes liver failure”. These lawful property disjunctions do not (pace Fodor) sanction the assumption of a higher level property and law that subsumes them. The
informal point is that empirical practice indicates that there is not only a pull toward the
general and ‘higher-level’ but also toward the more specific and ‘lower-level’. Both
points converge in picking out a similar weakness of the PCL, its intolerance toward
seeing causal/lawful determination as coming from below. The last point I wish to press
against the PCL makes this point even more broadly—the PCL cannot account for law-
like interference from outside a particular level in general, regardless of whether it comes
from ‘below’ or ‘above’, without acknowledging that all laws are, in fact, inter-level.

Now while there are many general philosophical difficulties with giving an
account of the nature of natural laws (see Armstrong (1983) & Lewis (1999) for some
discussion), most of these are irrelevant here. One, however, is relevant—the problem of
the essential ceteris-paribus clauses. The problem points to the inability of the PCL to
account for lawful determination of something within a level by something outside of that
level. It points to the fact that the PCL can give no explanation for why higher-level laws
seem to be so riddled with exceptions.

The hedged status of virtually all laws was discussed previously in relation to the
CCL. To simply recap, a biological regularity can be disrupted by radiation, a
psychological regularity can be disrupted by chemical intervention, seemingly any
regularity could be disrupted by something like a nuclear bomb, etc…. Many lawlike
regularities in nature, things such as—the widespread presence of a trait in a population
traits can be explained in terms of its contribution to reproductive success; Water is made
of H20; a body traveling in rectilinear motion will continue to travel in that direction
unless acted upon by intervening force; demand bears an inverse relation to supply;--are
anything but exceptionless when it comes to confirming them. Rather exceptions tend to
be the rule.

This has lead some, such as the philosopher Nancy Cartwright (1994), to hypothesize that laws are best viewed as true of highly contrived laboratory settings rather than the messy world at large. While one can doubt about Cartwright's thesis, it does bring up an important property about typical conceptions of natural laws. Namely, many—if not all—working scientists assume that intervention from outside of their own theoretical domains can occur. When we state that a simple harmonic oscillator will behave in a certain way over some course of time, or when we say of a pendulum that its period will equal some particular amount, what we are assuming is 'absent outside interference'—in other words—assuming I don’t put my hand out to stop it or ‘assuming that the president doesn’t irradiate the planet in the next 5 seconds’ or ‘assuming that a rhino does come in and trounce all of our research subjects’—etc..

Suppose, as I think plausible, that a key reason that laws have to make assumptions, contra Cartwright, doesn’t really have anything to do with experimental setup. Rather the problem is that we must assume no determination from outside the domain under study. In defense of the supposition, consider any putative law of nature you wish, and the kind of setup required to confirm it. Then suppose further that in between the time of the antecedent (t1) and the consequent (t2) a giant meteor strikes the earth and smashes it to bits. It would seem that whatever the relation is between the events connected by our putative law, it cannot be one that simply glues an interlevel cause and effect together because of the possibility of causal intervention from outside a particular domain, or 'level of reality'.

Now if this is right, then consider the form that an actual diachronic law must
have to be in effect. It must contain a ceteris paribus clause that rules out these ‘intervening’ causes. But if a law has to rule such events out, then that law must essentially make mention of those event-types that it is ruling out. But this means, that contrary to Davidson’s ‘homonomic law’ thesis—that laws involve only predicates made for one another (i.e. are intra-level) every law will involve every type of event (because it has to rule those alternate event-types out). In other words, laws would have to be of the form: ‘If no physical, chemical, or biological causes intervenes, then trauma causes depression’. Every law, it seems, must be heteronomic. The ceteris paribus clause, in other words, if fleshed out would have to explicitly acknowledge and quantify over other domains/levels of determination. But the motivating assumption of the PCL is laws are essentially level-bound. Once the recognition is given to the heteronomic nature of ceteris paribus clause this thesis is simply untenable.

5.5 The Case Against the PCL

In developing the case for the PCL that could meet our 3 requirements for being a theory of levels, we depended upon (1) an argument (pace Davidson) to the effect that the natural laws come couched in terms made ‘for one another’ and that pick out properties similarly made for one another, as well as (2) an argument (pace Fodor) to the effect that lower level disjunctions of properties could not be seen as lawful if we let out empirical practice be our primary ontological guide. In this chapter I have argued against both ideas. Lower-level lawful disjunctions are not ruled out by our empirical practice and do not always necessitate the assumption of a higher-level law at work. Additionally, to the extent that laws of nature contain ceteris paribus conditions, and it appears that they must, they are essentially heteronomic and ‘intra-level’ rather than homonomic and
‘intralevel’. The PCL case as it appears to typically be relied on simply does not explain, or really give any account, for what is supposed to bind a family of properties essentially together on the same discrete ontological level. The laws of nature simply do not provide what the PCL advocate assumes that they do.
Chapter 6: Over-determination & Levels

6.0 Over-Determination

This chapter will focus on a final problem I want to discuss in regards to levels—namely, the over-determination problem. Any account of levels will likely possess this problem. Even ignoring my prior criticisms, one could judge most conceptions of levels too problematic for this reason alone (though Bennett (2003), Sider (2003), and others, have all argued over-determination is not, in fact, essentially problematic). However the discussion of over-determination here is not intended solely as one more anti-levels argument. There is at least one conception of levels, discussed below, (as well as by Kim (2003) and Wimsatt & Bechtel (2006)) that avoids the problem. And one could (as Bennett and Sider counsel) accept that over-determination is the price of an empirically motivated ontology rather than a problem. As such, I will be developing my discussion of the problem with an eye toward illustrating how the problem of over-determination highlights certain needed elements of what I believe is a superior ontological model—one that replaces talk of levels with complex mechanisms, which I will discuss in the next chapter.

6.1 The Over-Determination Problem(s).

Intuitively, the problem of over-determination isn’t hard to grasp. In a nutshell, if there are many parallel levels (psychological, biological, chemical, physical) of reality at work structuring events over the course of time, as well as a single vertical dimension of determination that defines the relations between these levels, then it seems that we have one more dimension of determination than we really need. Co-ordinated horizontal and vertical dimensions of determination appear to over-determine one another.
Not only do levels imply one more dimension of determination than it seems like we need, but the many horizontal levels of determination themselves seem bound to potentially over-determine one another. For example, consider my reaching for my coffee cup. One might see the psychological level (my desire for coffee, coupled with my belief there is some in the cup) as the genuine determiner of my reaching. Alternatively, one might see this event as being determined by certain ‘lower level’ neurobiological processes relating to caffeine addiction and arm movements. Roughly put, it may be my brain that does the reaching rather than my desire. Further on down the line, one might see my neurobiology as simply a higher-level epiphenomenon completely determined by the course of the atoms out of which neuronal events and arm movements are composed.

There is a good bit of philosophical literature concerning the question of whether the PCL’s commitment to property supervenience entails a commitment to synchronic over-determination along the vertical axis of reality (see Pereboom and Kornblith 1991, and Yablo 1992, 1997, Bennett 2003, Block 2003, as well as many by Kim). The question, as typically formulated, concerns whether a PCL defender can consistently maintain (A) two people with identical neurophysiological properties must, necessarily, possess all the same mental properties and (B) that property necessitation is not ‘determination’ proper.

However, this literature tends turns on technical characterizations of ‘supervenience’ which, I believe, are unnecessary to illustrate the nature of problem(s) and conceal the distinction between the horizontal and vertical dimensions of reality that I have been at pains to pull apart. A common way to characterize supervenience (see
Kim 1993) is as an asymmetric necessitation relation where \( x \) (be it a property, event, or object) is said to supervene on \( y \), just in case a change in \( x \) cannot happen without a change in \( y \). However, horizontal and vertical determination can be both be formulated in terms of supervenience without regard to any potential distinction. Horizontal determination can be seen as diachronic, across time, supervenience—certain changes in the future require certain changes in the past to have occurred. Vertical determination can be seen as a species of synchronic, at a given instant of time, supervenience—certain changes in a whole (or its properties) require changes in its parts (or in the object itself).

The fact that over-determination discussions are typically couched in terms of supervenience conceals the fact that often different sorts of over-determination relations are at issue (for a discussion of some, but not all, varieties of over-determination relations see Funkhouser’s (2002)). As such, what one author takes to be a solution to the potential problem can appear to another author as failure to address the real problem (see the Kim-Noordhof 1999 exchange, for example).

In what follows I will first focus on the problem of horizontal over-determination in relation to the PCL. This stands in contrast to most of the functionalist literature in contemporary philosophy that focuses on the PCL’s potential problem along the vertical axis and the question of whether property necessitation amounts to property determination. If I am right that the PCL has an over-determination along the horizontal access alone, independent of the question of whether property necessitation is property determination. Following this discussion I will turn to the problem of vertical over-determination and focus primarily on the CCL.
6.1.1 Over-Determination Along the Horizontal Axis

Discussions of over-determination in philosophy these days typically occur against the backdrop of what I noted in chapter 1 has been called the ‘only argument’ in favor materialism:

*The Exclusion Argument:*

1. Mental events cause physical events.
2. Every physical effect has a physical cause.
3. Physical effects are not systematically over-determined.
   Mental events must be physical events.

This argument consists of the principle of causal interaction (P1), the causal closure thesis (P2), and a no-over-determination thesis (P3). In chapter 1, I claimed the levels hypothesis drew support from this argument by providing an interpretation of the conclusion. Even so, I now will argue that this support is tenuous at best because the 3rd premise of the argument ultimately contradicts the levels-of-reality hypothesis.

It is worth noting that the exclusion argument (not unique in this respect) is taken by different authors to be an argument for slightly different things. In Davidson’s “Mental Events” it occurs (less explicitly than the formulation above) as part of an argument for ‘token physicalism’. Recent discussions stem largely from Jaegwon Kim’s reading of Davidson (see Kim’s (1998)); Kim sees it entailing reductive or ‘type’ physicalism. Other commentators (see Sturgeon (1999), & Lowe (2003)) now take it as the ‘standard’ argument for materialism simpliciter.

There is something of a historical problem with reading the ‘exclusion argument’ as an argument for materialism simpliciter. Namely, Davidson took materialism to be *part of the justification* for premise 2, the causal closure principle. Some (Sturgeon (1999), for example) have objected to premise 2 of this argument on the grounds that the
most common interpretation of quantum physics, the Copenhagen Interpretation, implies that certain physical effects arise only upon the ‘measurement’ of a given physical system and measurement is (arguably) an essentially intentional/mental phenomena. Thus, the objection goes, this is a question begging argument for materialism at best.

However, this sort of objection of strikes me as wrong-headed for a couple of different reasons. The first is that the Copenhagen Interpretation of Quantum Physics is an instrumentalist inspired interpretation (see Loewer 1998) and in discussions of metaphysics it seems a rather odd interpretation to assume. As both Barry Loewer and, more recently, Hilary Putnam (2005) note, the Bohmian causal/ontological, or ‘pilot-wave’ interpretation (see also Goldstein 2006), in which the Schrödinger equation is assumed to describe the working an actual physical guiding wave, would seem to be the interpretation most consistent with a realist approach to science and metaphysics.

Even so, there does seem to be something question begging about the causal closure thesis in regards to the Exclusion argument’s status as an argument for materialism. It does, after all assume that physical effects cannot have purely mental or intentional causes. However, Davidson didn’t take the justification for premise 2 to be the empirical practice of physics. Rather the original intent of ‘physical’ in above argument is simply means what I have been calling material, or physical in the broadest, non-technical, sense. Davidson’s argument openly relies on the supposition that every mental cause, such as my desire for coffee, has a *broadly* physical description, such as a description of my momentary neurobiological state—or a description in terms of my space-time co-ordinates at the moment of my desire.
But this is because arguing for materialism isn't his aim, rather he was interested in resolving a central paradox of materialism—namely that beliefs and desires are presumed to have (broadly) physical effects and such effects also appear to typically have broadly physical (neurobiological) causes as well. Thus materialism is in fact part of the justification for accepting that one can uniquely pick out a mental state by identifying where and when it occurs. The analytical task for Davidson is establishing that the properties picked out in this physical description of the *where and when of a particular desire for coffee* are those that are lawfully correlated with the *where and when of a particular reaching for coffee*. Davidson's interest lies in determining what kind of materialism the exclusion argument entails, rather than establishing materialism itself.

While this may call the exclusion argument's credentials as an argument for materialism into question, I still believe it fair to accept the exclusion argument as representative of the *commitments* of contemporary materialism independent. And the commitment embedded in the causal closure principle is fairly minimal, and less strident than is often assumed. It states effects that occur in space and time have causes that occur in space and time. And this does seem like a plausible commitment of the materialist point of view.

Now as also noted in chapter 1, the exclusion argument can be given a general form in terms of levels that can be seen as offering support such views as the PCL:

1. Higher-level events can have certain types of lower-level effects.
2. Every effect has an intra-level cause.
3. No type of effect is systematically over-determined.
4. Higher-level events are lower-level events (in some sense or another).

Capturing this 'sense' of sameness is the task of giving an account of the intra-level, vertical, axis of reality in a theory of levels.
As noted, the PCL fleshes out the sense of sameness by claiming that higher and lower-levels consist of sets of properties of the same event. Thus psychological causes have neurobiological effects by being properties of events that also have neurobiological properties. Given that the PCL can explain the materialist commitment embedded in the conclusion of the exclusion argument, the PCL is presumed inferentially strengthened according to an inference-to-the-best-explanation strategy.

However, all is not well for a PCL defender in regards to the exclusion argument. It is unclear whether and how the PCL can be made consistent with premise 3—no-systematic-overdetermination. While Kim and others have pressed the problem of vertical over-determination (the question of whether property necessitation is a kind over-determination), what commentators fail to see is that the PCL has a problem with purely horizontal _causal_ over-determination as well. If I am right, then the thornier question of whether property necessitation is 'bad overdetermination' can be set aside.

To see the problem the PCL has with causal overdetermination, note that the ban on systematic over-determination embedded in the exclusion argument would appear to be primarily concerned with horizontal/causal over-determination. The exclusion argument seeks to leverage a claim of metaphysical identity by banning systematic _causal_ over-determination of the physical by the mental. The ‘no-overdetermination’ principle invoked was aimed at ruling out the following kind of relation:

\[ \text{M1} \]
\[ \text{P1} \rightarrow \text{P2} \]

Now note that the ban on the M1 to P2 relation, again, is not the empirical practice of neurobiology and psychology. Rather, as discussed in chapter 4, the ban is
ultimately justified by the no-hetero-nomic law thesis. Desires for coffee, according to Davidson, cannot be lawful causes of arm reachings because there are many desires for coffee that are not in fact followed by arm reachings. Desires require certain physical conditions (such as the presence of coffee cups) before they are going to cause anything, they have ineliminable ceteris paribus clauses when correlated with types of properties outside of their own domain. Similarly, 'low serotonin levels' is the not right sort of the thing lawfully cause depression because it would only do so given a certain type of functioning brain and psychology (it wouldn’t cause depression in someone in a coma, for example). Thus Davidson holds such hetero-nomic generalizations (ones that involve mental states and physical movements, or monoamine levels and moods) cannot be considered real causal laws. Thus the no hetero-nomic laws thesis, on the Davidsonian account, rules out the following:

\[ \begin{array}{c}
\text{H1} \\
\text{Banned by No-Heteronomic-Laws thesis} \\
\text{L2}
\end{array} \]

According to this line of thought, if L2 is the result of a law/cause and not an accident, the only homonomic relation sanctioned by the no-heteronomic-law thesis would be couched solely in L2's level specific vocabulary. Thus the Davidsonian sees the only lawful/causal relation possible given an event's set of higher and lower level properties and a lower level effect as follows:

\[ \begin{array}{c}
\text{H1} \\
\text{Justified by homonomic law thesis} \\
\text{L1 \longrightarrow L2}
\end{array} \]
According to the Davidsonian line, if L2 has a genuine cause, then that cause must be the result of some law. The only genuine (or ‘strict’ as Davidson prefers) laws involving L2, are those that pick out properties (and therefore predicates) that are homonomic (i.e. ‘made for one another’). Thus any physical effect must be determined by some similarly physical cause (thus P2). And any putative higher level cause is ruled out as non-strict (thus P3).

Following Kim, it has become common to see the Davidsonian ban on heteronomic causation differently. However, the switch in justifications for what we may call the Davidsonian no-heteronomic, ‘no downward/upward causal laws’ thesis has left a hole in the argument that contemporary commentators have failed to see. The failure to see this ‘hole’ explains the potentially misplaced emphasis on the issue of ‘property necessitation as determination’ issue.

As Kim sees it, the ban on the H1 to L2 relation is that it is unnecessary given L1’s lawful determination of L2. Where Davidson argues H1 and L2 “are essentially unsuited for one another”, Kim interprets the problem with H1’s lawful relation to L2 as being ontologically profligate. It would be over-determining in the sense that it would be as if nature, in order to bring about a single death by gunshot, always co-ordinated its laws to ensure that no one was ever shot by a single shooter. Rather it would be as if nature always required multiple shooters coming from multiple angles to bring about the death of any one person.

The implausibility of ‘systematic’ over-determination is now typically taken by contemporary philosophers as the justification for ruling out the causal efficacy of H1.
While Kim’s gloss on the Davidsonian justification for no-systematic-overdetermination may be more convincing, it conceals an important fact. Given some event, L2, the Davidsonian has a justification for assuming the existence of some event, L1, and a causal relation between it and L2, (L1 \rightarrow L2). The Kimian lacks such a justification. This important point has not been commented upon before to my knowledge. Without a ban on heteronomic laws, it isn’t clear what justifies the Non-Davidsonian in assuming that every effect has an intra-level cause. Given some chemical effect (C2), what justifies the assumption that there is some intra-level C1 that brings it about? For example, the breakdown of the amino acid tyrosine into the monoamine tyramine is typically due to the action of the bacteria enterococci and this would seem, on its face, to be a biological cause of a chemical event (chemical breakdown during digestion, perhaps obviously, involves many similar putative bacterial/biological causes of chemical events). Given the intuitive plausibility of thesis that many biological processes (respiration, digestion, reproduction, etc.) have chemical effects, what precisely is the non-Davidsonian justification for assuming every Chemical event has a chemical cause?

\[ \text{C1} \rightarrow \text{C2} \]

It simply isn’t clear that there is any independent justification for this beyond something like a ban on heteronomic laws and the PCL’s concomitant assertion that a level ‘just is’
a set of lawfully related properties. And if this is so, then the PCL rather than explaining a commitment of materialism is actually importing a potentially irresolvable commitment to systematic causal over-determination into materialism.

Some might claim the ‘causal closure of physics’ justifies the assumption of intra-level laws. And at least for a base (or lowest) level (which preoccupies Kim), this may be so. According to this line of thought, materialism implies a commitment to the idea that the behavior of matter can, in principle, be explained without recourse to social, mental, biological, and chemical causes. However, not only does this go well beyond the claim that spatio-temporal effects have spatio-temporal causes, it also does not imply the causal closure of any other higher level domain—such as the biological or psychological.

To simply rehearse a prior consideration with special reference to the current context, note that if a higher-level arises after a lower one, (in much the way that a computer program requires someone/something to write it) then one cannot argue for the causal closure of that higher level. The following relation appears necessary to account for the higher-level:

\[ \text{H2} \rightarrow \text{L1} \]

\[(\text{Causal Origins of Levels})\]

But if such ‘upward’ causation is necessary to account for the origins of higher-levels generally, then causal overdetermination along the horizontal axis of reality appears to be necessitated by the PCL. This is because wherever causation lawfully occurs, the PCL necessitates intra-level causal properties:
The PCL assertion of essential intra-level relations

H1 → H2

L1

Over-determination Again?

When a higher-level-coming-into-being event re-occurs (such as the formation of a cell, perhaps) the PCL asserts there will be a higher intra-level cause of that event as well as any lower level one.

Thus (for example) given that non-life beget life, and presumably could and would do so again (i.e. as a matter of law) given the same sort of circumstances, the PCL defender cannot argue the coming together of some set of physio-chemical elements is not a proper cause of the origin of a biological entity. They may rightfully insist that once a higher-level comes into existence living things will typically be brought into existence by other living things through sexual and asexual reproduction (the H1→H2 relationship above). But granting the L1→H2 relation was once causal, there appears little reason for thinking it does not continue to be a perfectly lawful/causal relationship on into the future.

A similar argument can be given in regards to the psychological (and social as well). It appears an essential part of materialist doctrine that psychological states must have arisen originally from neurobiological ones. If biological events are sufficient to bring psychological events into being at some point, an upward causal relation between (at least some) neurobiological states and (some) mental states must be allowed. And once an upward causal relation is allowed it appears that there will be some mental states
(such as fear) that are likely to have both plausible psychological and physiological causes.

Many of the same arguments that speak against the no-heteronomic-laws thesis, thus also argue that causal over-determination is unavoidable on the PCL thesis. And given this, the PCL should be untenable to someone wishing to hold on to the exclusion argument’s materialist commitment to no-overdetermination.

It may well be that the PCL also suffers from an overdetermination problem along the vertical axis, similar to the problem discussed below in regards to the CCL. That it does, has long been a claim of Kim and others. If so, then obviously, that would only strengthen my argument here that PCL is inconsistent with the materialist commitments in so far as a materialist is committed to the idea that the world is not systematically overdetermined, that nature does not in fact require the co-ordination of multiple ‘shooters’ to bring about its causal effects.

6.1.2 The CCL and Over-determination along the vertical axis.

The over-determination problem arises in a slightly different form for the CCL, but it speaks directly to an advertised strength of the model, namely its ability to account for inter-level interaction in terms of micro-determination of the macro. According to the CCL, the vertical dimension of reality consists of a transitive part/whole relation in which everything that exists at some higher-level can be seen to be a composite of the same sorts of basic parts. The potential over-determination problem of the CCL comes into play most forcefully along this vertical axis. Succinctly put, the part-whole relation is often a determination relation, both intuitively, as well as on the CCL view.
No CCL advocate I know of denies this; with good reason, its denial would rob the model of an ability to explain inter-level interaction. In terms of the causal inter-level interactions, the CCL advocate is in little better position that PCL advocate. *Inter-level* causal relations would rob the model of an account of the intra-level relationship. According to the CCL, baseballs cause window-breakings, baseball-parts cause widow-part breakings. If micro-parts can causally interact with parts on levels below or above themselves, then the reason for attributing one to a lower-level and one to a higher-level is unclear at best. If causation is an essentially part of the glue that binds objects together as being on particular level, then it can't be the case that causal inter-level interactions are allowed (it would, perhaps obviously, also court the problem of horizontal overdetermination).

Regardless, the specific problem of concern here isn't causal interaction, but vertical/compositional interaction. If the parts of an object determine the properties of that object at some time t, then it isn't clear why it wouldn't determine those properties at every later time t1, t2, t3, etc. Thus the CCL advocate is faced with the following picture of objects, levels, and their interactions over the course of time.

*Overdetermination & the CCL*

\[
\begin{align*}
\text{Part/whole} & : \quad M_1 \rightarrow M_2 \\
\quad & \quad \rightarrow \quad \uparrow \\
\quad & \quad \rightarrow \quad \uparrow \\
\text{determination} & : \quad B_1 \rightarrow B_2 \\
\quad & \quad \rightarrow \quad \uparrow \\
\quad & \quad \rightarrow \quad \uparrow \\
& \quad \rightarrow \quad \uparrow \\
\quad & \quad \rightarrow \quad \uparrow \\
\quad & \quad \rightarrow \quad \uparrow \\
\quad & \quad \rightarrow \quad \uparrow \\
\quad & \quad \rightarrow \quad \uparrow \\
\quad & \quad \rightarrow \quad \uparrow \\
& \quad \rightarrow \quad \uparrow \\
\end{align*}
\]

For every level above a 'bottom' level, an object is going to be over-determined by a vertical dimension of reality at a particular point in time and its causal/horizontal
relations over the course of time. Thus both the PCL and the CCL are going to face problems of over-determination:

\[ \begin{align*}
\text{PCL Overdetermination} & \quad \text{CCL Overdetermination} \\
H_1 \rightarrow H_2 & \quad H_1 \rightarrow H_2 \\
L_1 \nearrow & \quad L_2 \uparrow
\end{align*} \]

While both of these models may provide hope of escaping a certain kind of over-determination—causal over-determination from above, both face an equally pressing problem over-determination problem from 'below'.

One might think that there is a way out of overdetermination on the CCL model. Kim has recently, if reluctantly, toyed with an idea that Lewis has always advocated. Namely, one can see all causation as part of the workings of the micro-realm, the for any higher level putative causal relationship, what is really going on is the following.

\[ \begin{align*}
H_1 & \quad H_2 \\
L_1 \nearrow & \quad L_2 \uparrow
\end{align*} \]

However, while this may be a plausible view of reality, it can't be a plausible view of levels for (as I think Wimsatt, Bechtel, and Craver all see) as you do not have any intra-level relationships or 'glue' on this view. There isn't any ontological reason to group one set of putative higher-level phenomena together rather than another. All of the intra-level glue has seeped down to the lowest level. At best this would produce a kind of two-levelism, one higher and one basic, and this would not address the kinds of issues that motivate levels hypotheses in the first place.
6.2 Should We live with Over-determination?

One could, of course, simply abandon the no-systematic-overdetermination as a tenet of materialism in defense levels. This line of thought has recently been pushed by Karen Bennett (2003) and Ted Sider (2003); both specifically argue that over-determination *from below*, along a vertical axis of reality, is a kind of over-determination materialist should learn to live with (the argument above against the PCL would still stand as a potential problem). And in defense of this kind of analytical maneuver, one should note that there is something intuitively plausible regarding the idea materialism doesn’t strictly *entail* any commitment to a world without over-determination. This may due the ancient the roots of materialist doctrine in atomist conceptions of the world. If atomism is taken to be the central tenet of materialism and we assume there are laws that exclusively govern their behavior, then it become difficult to see how vertical, micro-macro, over-determination can be avoided.

Nevertheless, dropping a commitment to a non-systematically over-determined universe strikes me as an ad hoc and poorly motivated move for a couple of reasons. First, a world that is vertically over-determined from below is perfectly consistent with the falsity of materialism. To see this, consider a world where the smallest constituents of matter are vertically over-determined by the movements of some super-tiny ethereal quantum angels.

```
  M1   M2
     ↑   ↑
  B1 → B2
     ↑   ↑
  C1 → C2
     ↑   ↑
  P1 → P2
     ↑   ↑
Quantum Angels   A1 → A2
```
The consistency of such a world illustrates that materialism is both distinct from, and consists in more than, the atomistic claim that matter is composed of tiny bits that can causally interact. Overdetermination from below poses no more or less of a problem than over-determination from 'above'. The materialist needs some leverage against the claim that events within the spatio-temporal world are not at the same time determined by forces outside of it. The least question-begging way to do this is to assert that events are not systematically over-determined.

A second sort of problem with the proposal of accepting systematic over-determination from below is that it isn't clear how it can be made consistent with realism about macro-causal relations, as well as the macro-world in general (as Trenton Merricks (2003) has recently argued). The same counterfactuals regarding two presumed higher-level events would presumably come out true regardless of whether or not some higher level event is considered a cause or not.

One author who has recognized this is John Dupre, who in his *The Disorder of Things* (1994), advocates a position he calls 'permissive realism', and the current author would call realism in name only. According to Dupre's position, every science above basic physics (whatever that is) is bound to have multiple competing explanatory classifications (think of the different possible definitions of 'acid' in chemistry, or 'species' in biology) and all of these different classificatory schemes must granted equal reality. His argument for granting them equality starts with the assumption of vertical property determination from below (he would put it in terms of 'dependence' rather than 'determination'). He sees this as entailing that all higher level causal generalizations depend on the causal relations of the micro. But, he goes on to argue, (similar to Heil's
arguments against the PCL discussed at the beginning of chapter 5) it would be miraculous if the classificatory schemes of higher level science perfectly corresponded to the micro-entities genuine causal regularities. Most were in the process of being developed centuries before the atomic hypothesis was widely accepted. Additionally, each discipline often develops conflicting classification schemes (for example, it biologist differ over whether it is more proper to individuate species according to genetic similarity or morphological similarity). It is impossible for such inconsistent schemes to pick out the same sets micro-entities and causal powers. If, for example, garlic is classified as within the genus tulip, tulips will be associated with one set of causal powers; but if garlic (as is more common) is classified within the genus onion, then tulips will be associable with a different set of causal powers.

Given that differing classification schemes will identify different sets of causal powers (as they identify different sets of micro-entities), and given that we have little reason for preferring one set of micro-entities (at the biological level) than some other, Dupre concludes all classificatory schemes in use in a science pick out ‘equally real’ sets of entities and potential (micro) causal relations.

In a sense, Dupre’s argument is simply rehearsing the point made in previous chapters that realist conceptions of levels need some sort of causal/horizontal glue to bind a set of entities together as being on the same level. Without such, there isn’t anything to qualify the entities as all belonging together of the same metaphysical sort.

Lastly, I submit that dropping the ban on over-determination also substantially weakens the content of materialism and the insight of the materialist commitment. If the Occam-razor of causal over-determination is cast aside, then little motivates discounting
spiritual, astrological, and other unworldly causes. The justification for materialist explanatory preferences appears little more than prejudice if one assumes there are always many equally important determiners of an event. When a neurobiological explanation of a hallucination is posited, for example, it could always be reasonably challenged by an assertion of an actual visitation of demons from astral plane. Once ontological ground for explanatory preference is lost, we can no longer pre-empt alternate demon-based explanations on the ground they are not needed. Giving up the ban on over-determination renders the notion of an unnecessary explanation obsolete.
Chapter 7-Mechanisms vs. Levels: Solving the Problem of Over-Determination.

7.0 Beating the Ontological Competition

In his “Explanation & Inference in Metaphysics”, Chris Swoyer lists ‘nobody does it better’ as a primary line of defense for any ontological postulate. In this last chapter, I aim to undermine this as a potential defense of levels. The prior chapter indicates the levels of reality thesis, in either its property (PCL) or object (CCL) guise, entails over-determination. Here I explore the possibility of avoiding overdetermination a with level-less ontology that can achieve the explanatory aims of the levels hypothesis. If we can avoid over-determination while explaining what levels aim to explain, a defender of levels cannot claim ‘nobody does it better’ in terms of ontology.

Empirically motivated macro-realist ontologies that dispense with levels are mostly absent from contemporary philosophical discussion. Currently, the denial of levels is virtually equivalent to the denial of emergence and the advocacy of macro-eliminativism.

However, the central ingredient of a level-less ontology I want propose is the ‘ontological mechanism’ and neither the notion of a ‘mechanism’, nor its treatment as a crucial ontological ingredient, is entirely original to me. Nancy Cartwright (1999) recently championed a similar ontological ingredient (a nomological machine) in her A Dappled World. Additionally, CCL defenders William Wimsatt and William Bechtel have written extensively about mechanisms and their potential place in naturalistic
ontology. But the primary focus of these authors is explanation, not ontology. Their aims and conclusions differ from mine; I hope to illustrate how mechanisms can be employed to do important work from a primarily ontological point of view.

7.1 Learning From Levels’ Mistakes

Many of the problems discussed so far concern the difficulties of fitting the horizontal (across time) and vertical (at a time) dimensions of reality together. Though the analogy isn’t perfect, the problem of fitting these together recalls problems associated with Copenhagen-style ‘wave collapse’ interpretations of Quantum Physics. These interpretations posit that over the horizontal dimension a particle exists only probabilistically. Paradoxically, along the vertical axis of reality, when measured at a given point in time, a particle determinately (i.e. non-probabilistically) exists. How to reconcile these apparently incommensurate conceptions of particles has never been clear.

Levels seemingly involve a similar problem. The intra-level dimension of determination they posit is at odds with the vertical. Intra-level determination lacks any real purpose, if the macro-properties of an object can be explained at any given moment by vertical determination relations alone. At a particular moment, or time slice, a vertical dimension of determination, with the micro-determining the macro, appears to determine everything there is to determine about the macro.

Much like the impossibility of holding two different gestalt images in your consciousness at the same time, it appears equally difficult to make the vertical and horizontal dimension of the levels of reality fit together into a complimentary whole. You can focus on the horizontal dimension, as per PCL, and the laws of nature, but if the
analysis of chapter 5 is right, then you cannot infer from this any plausible account of micro-macro (vertical) interactions.

Similarly, you can focus on the vertical, as per the CCL, and part-whole relations, but if the analysis of chapter 3 is right, you cannot infer from the resulting model the right sorts of horizontal relations that underpin scientific domains. While levels may initially seem to offer help/hope in fitting these two dimensions of determination and reality together, ultimately they do not. They only make the tension explicit.

Given this, the question arises as to what we can take away from the intuitive appeal of levels talk. Are the motivations behind all the 'levels talk' metaphysically salvageable? Those motivations, recall, are (1) accounting for the ontological sameness (i.e. materialism) of a world that appears varied, (2) accounting for ontological difference (i.e. emergence) in a world where everything is assumed to be cut from the same ontological cloth, (3) giving an ontological ground for the existence of different sorts of science (Macro-Scientific realism).

In addition to these motivations, two other 'ontological goods' worth pursuing became apparent in the previous chapter. These are: (4) giving an account of inter-level causation and (5) giving an account of the possibility of macro-determination.

In regards to inter-level causation, a central problem with the PCL is that by defining a level in terms of a collection of lawfully related properties, the PCL entails inter-level determination is problematic. According to the PCL, the occurrence of some higher-level property, B₁, follows only upon the occurrence of some intra-level determining property Bₒ. But this picture is not justified by empirical practice and ultimately entails a type of over-determination. Both ontological and empirical
considerations lead to the conclusion that the horizontal determiner of B1 can be a lower (or higher) level C_0 that does not imply the presence of any B_0. To avoid over-
determination, horizontal determination needs to be able to cross theoretic domains, the
levels hypothesis (in any non-overdetermining guise) rules out.

\[
\text{Inter-level Causation}
\]

Ruled out by Levels

In regards to macro-determination, a crucial problem with the CCL is its claim
that the micro-parts of an object determine all of its macro-properties. While this thesis
gives the CCL advocate an account of inter-level interaction, it entails overdetermination
of the horizontal by the vertical unless all causation is pushed 'down' into a
'fundamental' micro-realm. And the analytical consequence of this move appears to be
macro-antirealism.

Over-determination is not the only problem that follows on the heels of the
assumption of micro-determination. As argued in chapter 3, micro-determination
conflicts with the notion of structural composition, the most plausible candidate (among
composition relations) for accounting for the composition most natural kinds of objects.
What determines a thing's nature is not only its intrinsic micro-part and properties, but its
extrinsic relations to an environment. Part-whole determination cannot account for this.
Both of these problems suggest that we should try to build an ontological framework that
can tolerate macro to micro determination, as well as micro to macro determination.

\[
\text{Macro Determination Macro}
\]

Ruled out by Levels

\[
\text{Micro}
\]
7.2 Mechanisms

I now want to begin to make the case that the 5 ‘ontological goods’ listed above can be had without positing levels. To see this we need to explore an explanatory device that is related to the notions of object and law, yet also distinct—namely a mechanism. Many explanations appear to come couched essentially in terms of spatially and temporally bounded systems of causally interacting elements (rather than universal laws). Such mechanistic systems have received growing attention from philosophers of science over the past 15 years (see Bechtel (1993), Wimsatt (1994), Sterelny (1996), Glennan (1996) Cartwright (1999), Machamer, Darden, and Craver (2000), Craver (2001), and Glennan (2002) among others). Exemplars of mechanisms vary wildly from author to author, but the basic idea should be familiar to anyone who has had to put an elaborate children’s toy together:

*A complex mechanism*

Mechanisms consist in specific sets of causally interacting objects that behave in a regular (if rarely perfectly predictable) way. Just as there are many ‘copies’ of a particular toy on the market, nature’s mechanisms are presumed to have multiple copies on display in the natural world:

“Mechanistic systems consist of stable arrangements of causally interacting parts. In virtue of these arrangements, the systems as a whole
have certain stable dispositions that promote their proliferation" (Glennan 2002, 343).

*Nature’s Mechanisms:*

A clock engine  
A bacterial transport  
An Anthrax Attack

A mechanistic explanation consists in a description of a set components and an account of how that set can causally interact over the course of some finite period of time. Mechanisms explain

"not by fitting the phenomenon into a web of inferential relationships but by characterizing ... pathways in a causal nexus; a phenomenon is explained by showing how that phenomenon fits into a pattern of causal processes and their interactions" (Craver 2001, 25).

As some philosophers of science have come to see the notion of a ‘mechanisms’ as fundamental to explanation, I propose we view them as fundamental to reality. They explain by modeling the way that reality is put together, much like a blueprint. Additionally, they provide a better model for thinking about the integration of horizontal and vertical dimensions of reality.

There are three key contrasts between mechanisms and levels worth initially stressing:

(1) Mechanisms have spatio-temporal boundaries, insides and outsides. They are not presumed to extend across the universe, or until the end
of time. Bounded determination relations entails that there may be some times in which the micro is more fundamental than macro, and other times in which those very same micro-macro objects/properties may have the reverse relation with the macro determining the micro.

(2) The boundaries of mechanisms, unlike objects, are ‘soft’. They delineate a set of objects, an array of potential causal pathways, and a range of time, but they don’t exclude causal interaction with the outside world. Just as a child can walk across the train track disrupting carefully laid causal pathways of their new toy, nature’s processes can cross pathways and disrupt one another. The general explanation for the ceteris paribus nature of scientific explanation on the mechanist view is causal influence from outside the mechanism (rather than determination from ‘below’ or ‘above’, as per levels).

(3) Mechanisms can overlap. An object that is part of one mechanism can enter into a stable pattern of causal interaction with objects outside of that mechanism and thus become part of two mechanisms at one and the same time. Thus the electric current carried by the body can simultaneously participate in different mechanisms that are primarily physical, chemical, and biological. Similarly, human pheromones can simultaneously play causal roles in chemical, biological, psychological, and social systems of interaction.

7.2.1 Mechanisms, Functions, & Science

While writings on mechanisms and mechanistic explanation have been growing in the philosophy of science, mechanisms have received little attention in contemporary metaphysics. This is may be due to some conceptual overlap between the mechanist approach to explanation and the system-relative version of functionalism discussed briefly in chapter 4. As noted there, Elliot Sober (1984) and Robert Cummins (1975) have recommended a system-relative notion of functionalism (also known as ‘teleological functionalism’) whereby types are individuated according to the properties they contribute to containing systems. Perhaps because of this some have assumed mechanisms offer little beyond the notion of function, as this type of functionalism also puts great emphasis on systems.
But this is a mistake. There are important distinctions between mechanist and ‘system-relative’ (i.e. teleological) functionalist approaches to science and ontology. First, a mechanist approach to ontology will take objects and their causal capacities as fundamental. A mechanistic explanation proceeds by specifying a set of objects and a set of potential causal interactions among them over a set period of time. However, system relative functionalism cannot take objects as fundamental as it sees an object’s identity defined by the system it is presently in. A system relative functionalist maintains a dialysis machine connected to a person is of one kind, while a dialysis machine at a blood bank differs in kind.

Another distinction is that the primary impetus behind all functionalist approaches to ontology is to posit object independent notion of laws and lawful determination. Mental laws, for example, are conceived on the functionalist line as essentially things very different sorts of objects—Martians, angels, octopi—all can possess. Functionalists view laws and the properties they range over as determining the behavior of an objects. Mechanists, on the other hand, tend to be dubious of ‘laws’ and see properties as determined by micro-composition and environment.

Consider a complaint that John Searle (see his 1980) has long voiced against functionalist accounts of the mind, namely that they imply you could build a mind out of virtually anything—such as a set of Legos. Searle notes that if a higher-level mental property, such as being in pain, is just that which lawfully determines pin pricks are followed by wincing behavior, then it seems that you could gerrymander any set of elements that could wince (such as a Lego-man) in such a way that it lawfully behaves as if it is in pain. But the functionalist has no recourse to the notion of ‘acting as if’ one was
being determined by higher-level property. If the behavior is lawful, then the assumption is that there is a higher-level law determining it. Thus a Lego-man behaving as if he is in pain is being determined by pain-laws according to a functionalist.

A mechanist, however, would typically deny that there is any pain-wincing law, rather there are plenty of circumstances (such as professional sport) in which someone who was in pain would not wince because they did not want anyone to know they were in pain. What determines whether or not pain causes wincing is not, on the mechanist view, any higher-level function of pain. Rather it depends upon something’s physiological makeup and the circumstances in which it finds itself.

The third important distinction is that mechanisms evolve and can change, while functions do not. Mechanists see systems of causal interaction as changing and evolving through time as their components are altered by causal interactions with one another. However, properties and functions are gained and lost, rather than evolving and/or changing. Modify a mouse trap such that it no longer takes in live mice and outputs dead ones, then it’s no longer a mouse trap. When the leaves turn from green to brown, they lose one property and gain another.

If it is allowed that mechanists in philosophy of science are presenting a substantive alternative to functionalism, there may be another factor leading to mechanisms being largely ignored currently in ontology. Unlike functionalism—a doctrine fleshed out to help address the metaphysically oriented mind/body problem—recent interest in mechanisms has been spurred primarily by issues regarding the nature scientific explanation. Thus early sources of the recent interest in mechanisms include Peter Railton (1978), who argued that scientific explanations are, essentially,
explanations that cite causal chains, Wesley Salmon ((1984) & (1989)) who viewed scientific explanation as citing causation amongst persisting structures, and Nancy Cartwright (1983), (1994), & (1999), who has long argued against the idea that science is fundamentally an inquiry into ‘laws’ of the nature.

These authors advanced views of scientific explanation in specific opposition to the deductive-nomological (D-N) and inductive-statistical (I-S) models of scientific explanation. According to the D-N model, a scientific explanation should cite a universal law and a deductive prediction that law makes (see chapter 2 for a discussion of a main problem with this view). According to the I-S model, science explains by citing probabilistic relations between event-types. One event-type (the thing to be explained—such as lung cancer) is explained by a second event-type (such as smoking) when the probability of observing the former (the explananda) increases upon the observation of the latter (the explanans). A problem with the inductive/statistical approaches is that the cause of an event can actually lower its probability. For example, suppose government subsidies to the poor alleviate most poverty, and thus lower the probability a child would be born into it. However, suppose these subsidies, by providing fixed-costs associated with child birth, lead to some additional child-births amongst the poorest of the poor. The subsidies would appear to lower the probability of a child poverty generally, yet also lead to (and explain) some specific instances of children being born into poverty.

Even though the origins of the mechanistic approach may lie in such debates over the nature of explanation, the fact that mechanists seek to ground explanation in the causal structure of the world should stir more interest in metaphysically inclined philosophers. Many of the issues and problems that motivate the approach, such as the
problematic nature of natural laws, speak directly to the issues I have been grappling with in the present project in regards to levels.

7.2.2 Mechanisms & Laws

In chapters 4 and 5 we saw that it was a standard tenet of functionalism that laws should employ thick-grained properties (Pain causes Fleeting) rather than fine grain disjunctions (State1 or State2 can bring about State 3 or State 4). But this PCL conception of the horizontal dimension of reality and its essential lawfulness is one most mechanists have come to reject. On their view, there are repeatable, recognizable, and informative causal patterns in nature that are disjunctive and not particularly law-like.

Consider the use of “mechanism” found in discussions of Evolutionary Biology (see R. Wilson, among others). In this context, the term typically picks out a particular type of causal event or process that can bring about two very different outcomes, such as decreasing or increasing the group fitness. Regardless of how ‘thick-grained’ one thinks a property can be, it does not seem that nature would bother with a law such as ‘property A will bring about either a decrease or an increase in group fitness’. One can well imagine Fodor complaining that such a property would not be projectible as the laws it would figure in appear to be bound to be confirmed regardless of what is observed. Even so, recognizable causal patterns that can produce these kind of contradictory effects are easy to imagine.

Consider successfully using a pesticide to kill off most of a mosquito population. After the pesticide, the total number of mosquitoes will drop decreasing the group’s fitness. However, suppose the mosquitoes that live made it because they are resistant to
the pesticide. They then pass this trait to their offspring, and within a few reproductive cycles a larger population results with increased fitness due to the group not being immune to the pesticide. Thus pesticide use would appear to have both fitness decreasing and increasing effects.

Evolutionary biologists aren’t the only ones drawn to the notion of mechanisms. The social science theorist, Jon Elster, has claimed the central aim of the social scientist ought to be the identification of “causal pattern(s) that we can recognize across situations” rather than the identification of “a scientific law” (47). And the primary case he sets out against laws again concerns contrary effects similar to the pesticide example. For example, there is both theoretical and neurological evidence that there is a single “Fight or Flight” mechanism, whereupon the same stimulus and neurobiological response will cause one person to stay put, yet another to flee. A similar sort of mechanism seems to be the explanation of the fact that a run of wins on a multi-deck blackjack table will cause about 50% players to decrease their bet (apparently believing the poker Gods will want to even things out soon), while the other half of players increase their bet (believing the poker Gods are smiling on them). In both cases, a single cause, a run of winning hands, appears to be the cause of two opposite types of behaviors.

The notion of contrary effects isn’t new. They are a prominent topic in Economics where consumers are assumed to have varied preferences. For example, a high marginal tax rate lowers the opportunity cost of leisure (by increasing the net cost of wealth) and encourages many people to work less. However, a high income tax lowers peoples’ income and spurs some to work harder to maintain their standard of living.
These two effects, 'substitution' and 'income' effects, typically are assumed to operate in direct opposition making point-valued predictions often impossible in Economics.

Contrary effects show up in many circumstances in many domains of science. They are often expected and considered un-mysterious. They are frequently observed in patterns of behavior, psychological organization, and environmental impact. Their study is important to our ability to understand, predict, and manipulate our world. Even so, they don't appear to be lawfully generated. For roughly Fodorian reasons (confirmation, projectability, etc.), "tax raises cause people to either work more or less" is no candidate for a law. The effects are too disjunctive. As such, many mechanist have abandoned the idea that laws are particularly crucial science, rather it is patterns of causation that are crucial.

7.2.3 Mechanisms & Science

Mechanists appear more united concerning what they don't like (law based accounts of scientific explanation and theory) than what they do. There are lots of different things about law-based accounts of science one can take issue with and particular mechanists may see the 'real' problem with laws in different ways (see Craver's (2001) for a review). Additionally, there are non-mechanist alternatives to a law-based account of science (such as the model-based accounts of Ronald Giere and Patrick Suppes). Regardless, in searching for an ontological alternative that can eliminate the problem over-determination, the mechanist approach is a natural one to explore as it denies the fundamentality of universal laws in determining the course of event. As such, it entails no parallel levels of lawful determination threatening to run afoul of one another.
On the mechanist view, many putative laws are only *law-like* generalizations supported by particularly stable causal mechanisms. Rather than connecting instances of higher-order properties or types (such as ‘pain’ and ‘wincing’), such generalizations are simply rough tools for the identification of novel ‘patterns’ and the investigation of natural properties. A pattern is a temporally ordered sequence of interactions that can be instantiated by different sets of objects. Causation concerns one object’s ability to bring about a change in another. Causal powers are determined by both an object’s composition, environment, and place in a temporal stream of events. Thus the causal powers of the child’s toy train, for example, depend upon (1) the train’s internal parts, (2) the array of the track, and (3) the temporal sequence of events (picking up, or dumping, cargo) the train encounters as it travels.

Note, I see the critical issue in mechanist critiques of laws as concerning causal/horizontal determination laws—putative laws that operate along the horizontal axis of reality and are supposed to determine the course events over time. Frederick Suppe (1989) has called these ‘laws of succession’ (as opposed to laws of ‘co-existence’ and laws of ‘interaction’) These are the sorts of laws that typically come couched with apparently ineliminable ceteris paribus clauses due to the fact some external factor (like a comet smashing the earth to bits) can always presumably disrupt the chain of predicted events. These are the sorts of laws the PCL was primarily concerned with.

In proposing that mechanisms are a centerpiece in the ontology of the natural world, I am not endorsing a reduction of all scientific explanation to causal explanation. I take it that composition/ micro-macro relations are important to science as well. Additionally, what Suppe calls *interaction laws*—“nothing can exceed the speed of light”,
“one can’t know the position and momentum of a fermion at a given point in time”, I presume are not lawlike generalizations over real world causal patterns. Rather, they express property relations. And I take it that property relations are also a crucial area of scientific inquiry.

Interaction laws are typically postulated by way of the construction and consideration of abstract models (or idealizations) of natural phenomena. The nature of interactions of point masses on frictionless surfaces and markets with perfectly informed rational consumers, are not generalizations of observed causal patterns since such things do not exist. Rather, idealizations postulate relations between properties in an attempt to understand a property’s effects on the things that have it. Nothing I can see in a mechanist approach to ontology entails skepticism about properties and relations among such. Rather, the claim is that the properties that determine causal powers, are both internal (i.e. compositional) and environmental (i.e. system-relative).

7.3 Mechanisms & Inter-theoretic Interaction: Avoiding Over-determination (part I)

I believe a mechanism based approach to ontology can help illustrate why cross macro-micro/theoretic causation is unproblematic. Mechanisms are something of an ontological hybrid between a fixed domain of lawfully related entities (such as the horizontal dimension of a PCL level) and an individual with an internally complex structure that defines its capacities (such as the vertical dimension of a CCL object). There are two immediate metaphysical payoffs to positing this sort of hybrid. First, it obviates the need to provide ‘horizontal’ glue that individuates a mechanism according to its relations to every other thing within its theoretical kind (as per the PCL); a mechanism
is individuated by a set of causal relations among its parts rather than by the kinds of its parts. Second, it obviates the need to individuate a mechanism according to vertical micro-macro relations (as per the CCL) as mechanisms can have many different kinds of parts.

Because of these features, the on ban inter-level causal interactions is lifted. Causation is not, according to the mechanists, essentially something that travels between the members of a theoretic kind or a micro-macro class. One can imagine a mechanism composed of very large system of dominoes, standing perpendicular to a surface, starting with the incredibly micro, and increasing in size to the very large, and then descending once again to the very small. Tip one, and the rest fall in order. However, there is no need to imagine some place where one causal chain (somehow) breaks into two (as levels require), and then reunites into one. The mechanism is defined by its single causal chain running from micro to macro to micro. The ontological division is simply the array of dominoes and their potential causal interactions. Similarly, aggregation of electrical charge in a neuron’s accumulation of activation potential can be seen as consisting of an electro-physical part, free-flowing electrons, as well as chemical part, ionized sodium. They both are seen as essential parts of a single mechanism, independent of how we might normally characterize such objects within theoretic kinds.

If the horizontal axis of reality is modeled primarily as a collection of mechanisms then at least one of the problems of over-determination is dissolved. There is no over-determination implied just from objects of different domains causally interacting. Indeed, Bechtel (1993) has characterized mechanisms as essentially inter-level. As such, there is no problem with a causal chain of the following sort:
7.3.1 Mechanisms, Theories, & Horizontal-Glue

To be fair, explaining *inter-theoretic interaction* was not a primary goal of the ‘levels of reality’ hypothesis (and it has been a central motivation of authors such as Bechtel, Wimsatt, and Craver), rather explaining *theories* was. The lack of a clear ontological correlate of something like the biological realm, chemical realm, etc. could be seen as an immediate cost of the mechanist ontology I am proposing. And it might be argued that it is uninteresting that biological to chemical causation would be unproblematic on such model, as it simply denies that ‘biological’ and ‘chemical’ are referring terms. This is a potentially serious criticism as scientific realism is supposed to be a non-negotiable assumed good. If an ontology of mechanisms implies instrumentalism about higher level science, I take it as a strong argument that ontology.

However, it is worth noting that nothing about the thesis that there is no referent for the term ‘chemistry’ beyond a loose collection of causal mechanisms chemists study implies anti-realism about chemical properties, entities, or interactions. It may be that neuro-chemistry, bio-chemistry, and physical chemistry, are lumped together for largely contingent (i.e. historical and social) reasons rather than ontological ones. But asserting this does not amount to denying the existence of monoamines, amino acids, and carboxyl functional groups.

I take it that similar things could be said about other higher level sciences. Recall the baseline conception of scientific realism assumed herein—*many of the unobserved theoretical entities and processes posited by contemporary science exist*. To deny that
there is any property of 'being essentially part of biology', any relevant property shared by such diverse things as (1) the depolarization of cell membranes, and (2) the effects of climate change on the migratory patterns of bird species, is not to deny that the causal processes studied in biology departments exist.

A second thing worth noting is that the motivation behind pushing ontological levels as an explanation of macro-scientific realism was to explain (1) why there are many different types of science and (2) make some sense of macro-causal realism (i.e. to stave off reductionism). As long as there are diverse sorts of mechanisms, the first motivation appears met. And if we can avoid micro-determinism, as remains to be seen, the second motivation would be met as well.

Nevertheless, if anti-realism about theoretical domains is thought too costly a price to pay for mechanisms, I can see three other options. The first is to combine a mechanistic outlook with some version of the CCL as writers such William Bechtel have advocated. The second is to take a much more conservative approach regarding the scope of a theoretical domain, as Nancy Cartwright's recent writing suggests we should. The third would be to develop an ontological account of a theoretical field that does not rely on either composition or functional relations, but rather appeals to something like similarity of causal patterns.

The 1\textsuperscript{st} option, integrating mechanisms into the CCL, is the path advocated by William Bechtel, William Wimsatt, and others. There is a kind of naturalness to the suggestion as both the mechanistic accounts of science and the CCL tend to focus on objects and causal relations. As such, it is not uncommon for mechanist advocates to uncritically adopt the talk of levels. Even so, I must note that I possess something of an
intellectual blind spot in my ability to make full sense of the "middle course between realism/instrumentalism" (Bechtel & Craver 6) some mechanist explicitly seek to chart. The tenability of such an 'oil and water' mix is not clear to me. Consider Bechtel and Craver's recent denial of the sort of inter-theoretic causation I have argued herein we must make ontological room for:

"Strictly speaking, our primary objective is to eradicate talk of interlevel causation. The notion of causation cannot remain remotely univocal if we speak of both intralevel and interlevel relationships causally." (Bechtel & Craver, 2, emphasis added).

According to these authors' view, mechanistic interactions, as opposed to genuinely causal interactions, are essentially inter-level. And mechanisms have become a way for these CCL advocates to explain 'away' the putative examples of inter-level causation I have cited—such as the breakdown of proteins by bacteria in the creation of monoamine neurotransmitters. Perhaps the easiest way to spin the thesis is simply that intra-mechanism causation differs from normal causation. Proper causal chains are level specific; mechanistic ones are not. Thus, a neural firing could be represented as below, with the bold arrow representing the genuine intra-level cause and the circle and smaller arrows representing the links in a causal mechanism:

*Wimsatt/Bechtel/Craver-- Levels & Mechanisms*

![Diagram of Mechanism of Neural Firing](image)
Given that this is a variant of the CCL, I will not spend more time arguing against this view here. The arguments in the previous chapter regarding over-determination, as well as the arguments against the CCL in chapter 3, all speak against it.

What is worth noting in the present context, however, is that the apparent cost of the Wimsatt/Bechtel/Craver method of saving realism about some theoretical domains (such as the ‘chemical’) appears to be instrumentalism about other theoretical domains. The reality of chemistry is paid for with instrumentalism about bio-chemical ‘causes’. These latter turn out to really be ‘constitution’ relations, which in turn are categorized as really not causes at all, but rather explanatory devices. To quote Bechtel & Craver again, “inter-level causation is used to describe a perfectly intelligible relationship between an explanans and an explanandum, (but) there is no causation between levels, only a constituency relation” (2).

While some might say that it has been discovered that monoamine treatment can cause a remission in depression, on the current line, this cannot be a strictly causal relation; rather monoamine treatment constitutes a remission in depression. As such, the mechanistic + CCL view appear, at best, a kind of trade-off realism, where empirical claims are regarded in instrumentalist fashion in favor realism about theoretical levels.

A second alternative worth mention in regards to conceptualizing the proper ontological correlates of theories has recently been put forward by Nancy Cartwright. According to Cartwright, the real world correlates of scientific theories are “few and far between” (1997, 292). Cartwright’s view probably lies even further towards anti-realism and away from my ability to clearly comprehend than Bechtel & Craver’s. Cartwright
prefers talk about *nomological machines* rather than mechanisms. While these two notions are similar (Teller’s (2002) argues “nomological machine” is simply an unhelpful rhetorical spin on mechanism), they are potentially different in two respects. Nomological machines (1) typically result from human intervention/intentional setup and (2) are presumed to be relatively rare.

What Cartwright appears to have in mind is a more transformative view of science than the ‘mirror of nature’ view common amongst realists. On Cartwright’s view, theoretical representation is a by-product, rather than an aim, of science. The aim of science is the manipulation of causal systems into tools of control (such as a river dam, or TV remote). These artifacts, according to Cartwright, give rise to thinking that nature is as regular as a TV remote. However, this is an illusion. We have carved out a portion of nature and shielded it from various external complexities and created the regularity of our TV remote. This sort of ‘push-button’ lawfulness is not the norm, according to Cartwright, it is the exception. On Cartwright’s view, the real world correlate of biology, chemistry, physics, etc. would be those bits of reality they allow us to manipulate and control. Thus, the proper domain of neuro-biology would include such things as FMRI machines and psychiatric drugs. The domain of biology would be things like artificial hearts, limbs, and gene therapies. Similarly, the proper ontological correlate of any science will be the tools it allows us to put in nature, rather than the any pre-given natural order.

On this view, reality possesses more nature than science. The domain of science will be dappled and sporadic. Science looks at some splotchy bits of reality that we can
tinker with, rather than reality in toto. I think we can roughly and fairly represent Cartwright’s view (at least her view circa 1995-2005) as painting a picture as follows:

Now regardless of the particulars of Cartwright’s view, I take it that any similar view that sees the ontological correlates of biology, chemistry, and physics, as carving out small bits of reality will not posit much in the way of vertical structure that ontologically unifies diverse theoretic endeavors. And indeed Cartwright does not. While Cartwright’s view may deliver something like realist correlates of theoretical domains, the other explananda of levels—materialism and emergence—will be potentially put out of reach. Nature, as Cartwright appears to conceive it, is full of diverse properties, objects, and causal capacities. How (or whether) these things may be inter-related is left rather mysterious. As such, a view like hers is likely to be even less satisfactory to the levels advocate than an eliminativist view of theories.

The last option worth exploring I believe holds greater promise for the realist than the first two. It attempts to meet the level-defender’s objection more directly. According to this option we should look for a realist understanding of theories in terms of *similarity amongst mechanisms*—rather than in terms of functional or part-whole relations. On this view, many theories may initially be best viewed as fine grained—such
as Fluid Dynamics, Statistical Mechanics, Evolutionary Psychology, Organizational Behavior, etc.. The domain of such fine-grained theories is assumed to be small classes of similar causal patterns. Large scale theories (Physics, Biology, Psychology, etc.) would then be similar classes of mechanisms. This alternative sees reality as consisting of many overlapping mechanisms that cut across micro-macro divisions. As such, the ontological correlates of theories on this view cannot be arrayed in anything like a vertically ordered hierarchy. Thus the fact that many physical and astro-physical mechanisms involve the earth and sun, need not imply the objects on the earth, i.e. people, are essentially astro-physical parts. Similarly, the fact that light energy from the sun crucially figures in many biological mechanisms, does not imply that the sun is biological object or that other biological mechanisms must stand on the same sort of ontological plateau as the sun. As mechanisms can overlap one another’s objects, the properties of those objects can be recruited as needed to stimulate further systemic interactions. The role of both objects and properties in individuating theories will be oblique; the sun is not essentially a physical, chemical, or biological object. Rather it can participate in many different physical, chemical, and biological mechanisms.

It might be objected that the needed notion of similar causal pattern needed here is too weak or vague. However, the idea of pattern resemblance is already foundational to the notion of mechanism. Mechanisms pick out a fine grained resemblance class of spatio-temporally instantiated causal patterns, such as the different ways a neuron can fire. But this interplay between the electro-chemical and the cellular in neuron firing is bound to have similarities both across species and within an organism. In other words, there are a lot of different, but similar processes that can count as a neuron firing. This
broader similarity class can be seen as carving out a class of bio-chemical mechanisms. The coarser the theory (i.e. biology, or psychology), the coarser we should expect the resemblance relations of the causal patterns and objects that fall within a domain to be. Some mechanisms may lie at the “heart” of a theoretical domain, while others lie at the periphery. Regardless, as long as ‘similar causal pattern’ is allowed as an ontologically respectable relation (and taking mechanisms ontologically serious appears to require such), then such a relation can serve to carve theoretical domains on the current view.

Now even if the domains of theories are understood in these terms, a defender of levels still has a complaint. While such fields may provide a domain of causal patterns for scientists to study, they do not (at least not obviously) provide domains of properties or objects. Mechanisms are made up of objects with causal properties. Nothing about ‘similar causal pattern’ explains the emergence of ontological difference. Thus unlike the PCL and CCL, this proposal cannot rely on its account of theory individuation (pattern similarity) as an account of object or property emergence. If a level-less ontology is to offer a serious challenge to the PCL or CCL, then it must be able to supply an independent account of the emergence that is distinct from, but compatible with, its account of the emergence of theoretical domains.

7.4 Property Emergence and Mechanisms

According to the CCL, the properties of an object, such as myself, are conferred by the sum of its parts in conjunction with the ontologically salient fact that these parts are all now presently composing ME. The view allows that composite objects possess properties in addition to the properties of their parts, but maintains those properties are wholly determined by the properties of the parts of an object. While the view has a
certain reductive flavor, the heart of the view is *compositional realism*. The composition of macro-objects brings new properties and causal capacities into the world. I am 6 ft tall and 165 pounds. The same cannot be said about any of my proper parts. Thus the CCL envisions composition is the ontological wellspring of emergent properties.

According to the PCL, the properties of an object, such as me, are determined by its ‘basic’ physical properties in conjunction with higher-level laws that fix an object’s relation to its environment. The view is more complicated as it is not clear (and PCL advocates do not agree) what ‘basic physical properties’ there are and how many ‘types’ of higher-level laws of nature there are. Regardless, the idea can be illustrated by supposing that there are color ‘types’ of natural laws. There are many factors that need to be present for X to appear colored (i.e. blue) to Y; environmental conditions need to be just right, and Y must possess certain properties and capacities. According to the PCL picture, my possession of the emergent ‘blue-eyed’ property is the result of my possession of a physical property that lawfully fixes my actual and potential color relations to my environment and the properties of things in that environment (such as some person Y to whom I appear ‘blue-eyed’). Thus the PCL advocate sees the different types of natural laws (biological, chemical, mental, social, etc) that fix our extrinsic relations to the world around us source of emergence.

According to the view I want push, the properties of an object, such as myself, are conferred by both by an object’s intrinsic material composition, (as the CCL would have it) as well as by extrinsic relations with the environment (as the PCL would have it). But as often as not, I believe many of our key causal properties are fixed by the mechanisms we are participating in rather than by our material make-up or static laws that govern our
relation to our environment. They are acquired through participation in a finite system of reinforcing causal interactions. The emergence of an object's mechanistic properties will typically be gradual, rather than 'all at once'. It involves more than just the possession of some basic physical property and its relation to a higher-level kind. Mechanistic interactions gradually modify and mold their components by inducing a series of changes through re-enforcing causal interaction.

Consider the property of being a professor. While this may be thought by some an entirely 'unnatural property', I do not think it wise to leave the human material objects out of one's ontological picture. Regardless, 'being a professor' is a property related to the possession and exercise of many causal capacities—determining grades, terrorizing students, impressing the in-laws, getting the university to pay for your health insurance, etc.... Like most jobs it involves coming to fulfill a role in a system (the University) that promotes recurrent patterns of causal interaction (getting students to enroll, graduate, come to class, pay tuition, borrow money, etc.) amongst a particular set of human objects.

Now according to the PCL picture, acquisition of the property of 'being a professor' simply requires coming to possess a particular physical property that corresponds to a social law and kind. And it entails that ALL of the capacities associated with this property are similarly immediately conferred. A more realistic picture, I submit, is that many of the capacities associated with the property of being of professor are only gradually acquired through prolonged participation in the interactions that define the system. It is only through extensive exposure to, interaction with, and modification by a system's elements (while being a student, grad student, TA, etc) that one's relations
to a systems elements get fixed. Thus the primary wellspring of emergence on the present conception are recurrent causal interactions amongst a system's elements.

### 7.4.1 Object Emergence and Mechanisms.

A level-less account of emergence faces more initial difficulties than the competition as neither the bearers (i.e. macro-objects) nor the bestowers (the laws of nature) of macro-properties get to be assumed. As such, even if mechanisms are a primary way that an object's properties get fixed, the *initial* objects and systems of causal interaction are still need of account. However, the origins of mechanistic systems is a general problem for anyone advocating them as kind of ontological ground for scientific explanation. As such, mechanism advocate, William Wimsatt, (taking inspiration from Herbert Simon’s seminal *The Sciences of the Artificial* (1963)) has written specifically on such and I believe his work can be usefully drawn on at this point. Wimsatt's (1994) proposes that 'causal loops' give rise to emergent mechanisms and I think this idea can do even more ontological work than Wimsatt envisions. It can provide insight on the emergence of natural kinds of *objects* as well as *mechanisms*. This isn't Wimsatt's aim; he relies on levels and composition to provide objects and is worried solely about the question of how mechanisms come about.

Even so, a central problem with the CCL's account of object emergence, I claimed, was that it ignored the extrinsic/environmental relations that need to be in place prior to the existence of (for example) a floor, a nucleus, a neuron firing, or a computer hard drive. The existence of such parts depends upon containing systems—buildings, cells, brains, computers, etc.... Accordingly, I believe (unlike Wimsatt) that emergence of systems is often prior to the emergence of the objects/parts that compose them. This is
one reason that even though I am willing to allow that many of an object’s properties may be conferred by its parts and compositional structure, the simple fact that the parts share an ontological plane with one another can’t be the full story on composition. Too often the ‘higher’ is needed to coordinate the ‘lower’.

Now according to Wimsatt’s view on system emergence, causal interactions can become reinforcing amongst a set of objects/entities to the point where the objects become co-ordinated into a kind of self-perpetuating homeostatic system—a mechanism. To give a simplistic illustration of how this is supposed to work, consider an idealized system containing ‘teeter-totter’ with two bouncing balls perpetually impacting each side, i.e.:

Here we have a ‘causal loop’—the causal input on one side (one ball’s coming down) becomes an output on the other (one ball going up). Extend the example a bit by adding more potentially reinforcing elements, say a couple of pedaled wheels:

By impacting the pegs on the wheels, the plank can now spin the pedaled wheels, with the pedals imparting an additional force to the plank to keep the balls bouncing. Apply
some metaphysical glue, and our idealized perpetual motion machine can now move about like a bicycle.

Now clearly, in a world full of friction and heat dissipation, causal loops are going to require more complexity (and a constant external input of energy). Nevertheless, the example provides a kind of lesson many mechanists miss. Namely, a mechanistic system itself (such as a bike or a child’s train set) can constitute a kind of object itself. If systems can be types of objects then the need for separate accounts of the origins of objects and mechanisms is unnecessary. Now it must be noted that mechanism emergence does not appear sufficient for object emergence, as mechanisms are typically temporally and spatially spread out, while objects exist at particular places and times. However, the fact that mechanistic emergence does not always bring new kinds of objects into the world does not entail that it never can. Much depends, I submit, on the nature of the ingredients at hands. If the initiation of a causal chain amongst a set elements has the potential for forming recurrent patterns (cycles of causal interaction) amongst those elements, then sometimes the properties of those elements can be importantly changed by the nature of the recurrent causal interaction (much as a person can be changed by their job). And I believe this is the way that new macro-objects and kinds can be brought into existence and then later recruited into other mechanistic systems of interaction.

My proposal for seeing how systems can be prior to, and the source of, the emergence of macro-kinds has already been foreshadowed in chapters 2 and 3, and the discussion of the CCL. There I noted that a realist about the macro-objects (cells, solar systems, stock markets, etc.) appears to need some sort of ontological ground for distinguishing between natural kinds of objects and arbitrary objects. And my proposal
here is similar to my suggestion in chapter 2 that arbitrary objects should be seen as the building blocks of natural objects. I submit that arbitrary objects can give rise to the mechanism of their own transformation from arbitrary to natural.

Prior to exposure to an initial causal chain with the potential to become a recurrent pattern, the components of the soon-to-be systems are often arbitrary objects. They are often composites, but their parts possess no essential relation to one another and confer little other than physical contiguity to the ‘whole’. These wholes can enter into causal relations as they exist at particular places and times. They may even be similar enough to some other arbitrary objects as to fall under a loose ‘kind’. But they do not exercise causal powers in regular patterns—their interactions with other objects are varied and sporadic. They lack well defined structure and their properties vary more than natural kinds. Additionally, loose kind (i.e. kind ‘pile of trash’) members are typically defined in terms of instantiated properties rather than causal capacities.

The following examples may help illustrate the sort of process of mechanistic emergence I am proposing.

### 7.4.2 Mechanisms of Emergence in the Natural World

First, consider the formation of planets. The consensus theory (see Lissauer) of planet formation is that such objects emerge from clouds of cosmic dust, a byproduct of late stellar evolution that includes graphite and silicate grains that have typically acquired hydrogen, oxygen, carbon, nitrogen, and sulfur atoms escaped from growing or exploding stars. Such dust can be thought of as the glued piles of trash of the cosmos. Dust grains are thought to grow through a random process of collision with other dust grains into planetesimals as large as 4 miles wide. When a new star begins to form, planetesimals
and smaller bits of dust are pulled into the newly forming stars rotational axis and gravitational pull. Planetesimals begin to gravitationally compete with each other for the smaller dust present in the cloud that forms around the newly formed star.

This process indicates a way that an arbitrary object, a collection of cosmic dust, can be pulled into a looping causal interaction—the more dust that collects, the more the dust will impact and cohere with the growing cosmic dust ball. As it grows, its gravitational pull becomes greater and it grows larger into a kind of object, a planetesimal. A set of planetesimals will begin to exert as gravitational pull not only the dust that surrounds them, but upon one another as well. This interaction (along with solar winds from the newly forming star) helps keep the planetesimals out of the new star's gravitational pull and stabilizes their orbits. The gravitational interaction amongst the soon to be planets, along with their continued accretion of interstellar dust, causes the emergence of planets into stable orbits around the new star. Thus a causal regularity amongst a set of natural objects (i.e. a system of planets) results from a process of causal interactions amongst arbitrary objects (dust bits).

Another example, though an empirically controversial one from an area in which there is nothing like a 'consensus view', concerns the formation of the first cell membranes (see Zimmer). While much theorizing regarding the origins of the cell concerns the relation between its components, RNA and DNA, some scientists have long pointed out that prior to the origin of such interactions, there must have first been a stable cellular environment for those components to interact with one another. There must be a macro-environment capable of flushing out waste and excess heat, and capable of taking in nutrients to fuel further reactions. These are the functions of the cell membrane.
The most prevalent supposition for the first cell membranes, are bubbles, such as those that form when a wave crashes into the rocks releasing energy and pockets of oxygen and other gases from the hydrogen bonds of the water. The potential emergence of the cell from the bubble also strikes me as another example of the emergence of a natural object from an arbitrary one due to a process of causal looping.

Perhaps one might object that ‘bubbles’ are not properly conceived of as objects at all, arbitrary or otherwise. But the grounds for such an objection are poor. A bubble exists at a particular place and time. It has a contiguous surface with particular causal properties. It has a kind of ‘life span’ in that the continued existence of its surface over some period of time can be seen as individuating it from its environment. Given these properties, I believe bubbles can be granted object status. A potentially more difficult objection to meet, is one that claims they are not arbitrary, but are natural. They certainly populate our environment in a much more regular fashion that ‘trout-nailed-to-turkeys’. This objection is difficult to meet for a couple of different reasons. First, as most 4 year olds will attest, bubbles are bizarrely behaved and virtually unique sorts of objects. Two or more can fuse into one, one can split into many, two can partially share a surface and then separate, one can exist inside another, etc.... Secondly, in chapter 2, the natural vs. arbitrary distinction was primarily fleshed out in terms of an object’s relation to its component parts, for example in terms of aggregative vs. non-aggregative property conferral of the parts. But given the rather unique properties of bubbles, it isn’t clear to me what parts exactly they have. At a minimum, in defense of the idea that they are more arbitrary than natural, one can point out that there is a sense in which they are insensitive to the arrangement of their parts: if you have ten tiny bubbles that fuse into one, the
original arrangement of those tiny bubbles appears largely irrelevant to the identity and properties of the resulting one. Additionally, it is not clear to me what ‘level of reality’ they belong to on either the CCL or PCL view.

Anyway, it is known that a bubble passing through hydrocarbon oil (common in ocean and seas) will have its surface tension strengthened (just like a bubble coated by soap) and possess a longer life than a bubble than passes through less oil. How much hydrocarbon oil it passes through on, for example, a rocky shore, is pretty much random. Even so these bubbles that were so strengthened in pre-biotic oceans gave rise to the possibility of a multi-layer phospholipids (a kind of hydrocarbon) bubble, bubbles within bubbles, that could take water in, and in so doing trap proteins, provide nutrients to those proteins, and allow for the development of proteins that could separate further bubble strengthening phospholipids from other materials in the water. Now it is hypothesized that through a process of primitive reproduction (multi-layer bubbles bursting and their lucky ‘innards’ quickly finding a new bubbles to inhabit) the modern cell is thought to have emerged as protein reactions that had bubble strengthening properties would be able to strengthen their new homes and provide thus provide an environment for the development of more complex protein reactions to take place.

I submit that again what appears to have taken place (or at least possibly could have taken place) is the emergence of a system of natural objects (a cell wall and complex nucleic acids) from more-or-less arbitrary objects (bubbles and chemical bits in the sea) through a looping process of causally reinforcing interaction that gradually changed the properties of the objects involved.
A third sort of example concerns embryonic stem cell differentiation. Stem cells are not great examples of arbitrary objects as they have a specific genetic make-up and a ‘kind-defining’ essence—the capacity to turn into cells in the body. Given that they can be defined in terms of their causal interactions with other biological objects, they can more plausibly be thought of as ‘on the level’, than either dust-bits or bubbles. Even so, they are instructive in 3 respects: (1) they contain the potential to become any cell in the body (a skin cell, a neuron, a liver cell, etc), and as such they are about as ‘type-less’ or ‘kind-less’ a biological object as one is going to encounter, (2) morphology temporally precedes stem cell differentiation—a cell’s relative position in the system has to be determined before it differentiates into a particular cell type (3) the determination of their relative position is causally mediated by extrinsic causal relations.

Very roughly, current research indicates (see Kimball ch. 11, as well NIH report (2006)) that the primary mechanism of cell ‘differentiation’ (i.e. how cells ‘know’ to turn into this or that kind of cell) is achieved by ‘Inductive Signaling’—a chemical signal (a morphogen) is produced by each stem cell that the other stem cells are capable of receiving. The concentration of morphogen signal a stem cell receives ‘informs’ the cell of its relative position in regards to other stem cells and determines what it will do. High amounts of morphogen intake indicate more neighbors and a relatively interior position. Low amounts indicate an exterior position relative to other stem cells in the blastocyst. Low amounts trigger one type of partial cell differentiation, high amounts trigger another. Cells along the periphery develop into embryonic membranes. Inner cells develop into the three germ layers. A second round of inductive signaling determines their relative position in terms of an external, middle, or internal layer of cells. There are many rounds
of cell differentiation that go on before a stem cell reaches its terminal stage. But at
every stage in this development, relative position in the system (interior vs. exterior) is
established before cellular development occurs. Thus, again, the stem cell’s object status
(whether it becomes a liver cell, a heart cell, a neuron, etc.) is determined by a causal
loop (how much of the morphogen signal it receives) and its extrinsic relations to the
system of the blastocyst/incipient fetus.

One last illustration of emergence from systemic interaction concerns the
phenomena of neuronal plasticity (see Ward for a full discussion). When someone suffers
brain trauma, such as stroke, and damage to an area of the brain responsible for motor
function such as the prefrontal cortex, evidence indicates that another area of the brain,
such as the posterior parietal cortex, often gradually acquires the causal capacity and
cognitive duties of the damaged area. As such, certain mental abilities, such as motor
control, rather than being determined by intrinsic properties of neural realizations, are
kinds that emerge according to the needs and causal feedback of a system. Through a
gradual process of causally reinforcing interaction (very roughly, synaptic signals from
one part of the brain being re-routed through another) neurons in a specific area of the
brain acquire new causal capacities and properties.

This picture of the mental is compatible in respects with both causal-role
functionalism and the identity theory (it is not unique in this respect, as David Lewis sees
his causal-role functionalism and reductionism fully compatible—as noted before,
functionalism is varied doctrine). However, functionalists assert the causal powers of a
material realizer precede the assignment of type (this follows from the assumed
independence of functional types and their realizations), software does not fundamentally
alter hardware. But the fact that neurons and brain areas obtain new causal powers upon brain re-organization indicates that the links between causal capacities, types, and material realizations is not as most functionalists conceive it. Rather the individuation of type, the acquisition properties, and the determination of causal powers, all occur simultaneously as the newly recruited motor function area of the brain causally interacts with, and reinforced by, the rest of the brain. It also indicates the capacities of the brain are not as many reductionist envision it as the causal capacities of brain areas is not intrinsic to their make-up, but is sensitive the organization of the whole. To use the computer analogy again, it as if half of the hard-drive slowly turned into video card. A previously arbitrary collection of neurons emerges as a new neuro-biological type of entity (a new primary motor control area).

In each of these cases a new natural object comes into being (a planet, a cell membrane, a liver cell, the primary motor control area of the brain) only after a system of ingredients (dust, bubbles, stem cells, neurons) are placed into a system of causally re-enforcing interaction with other elements, i.e. into a mechanistic system. If it is granted that each of these examples concerns a kind of emergence of a natural kind of object, then the need to assume levels of natural laws (as per the PCL) or natural objects (as per the CCL) is unnecessary to account for the existence of such. Mechanistic causal looping can do the job.

This view of emergence, unlike either the PCL or the CCL, can also give some insight into why a particular kind object and set of properties can appear essentially related to those other objects and properties. Namely, such objects and properties could
have played a role in their individuation by causally interacting with them a mechanistic system.

Recall that one problem of the CCL was explaining level branching—why is it that the combination of some chemical parts result in biological entities, and others result in geologic entities. Both are composed out of similar parts ‘one level down’, and the ‘parts-one-level-down’ relation is supposed to determine everything about an object according to the CCL. But it can’t explain why some emergents go to the biological level, while others are sent elsewhere. The PCL faces a similar problem. Some disjunctions give rise to higher-level properties picked out by a law, others do not (i.e. trout-or-turkey). Both models struggle to account for the essential relatedness emergents beyond mysteriously positing. If, however, the emergence of macro-objects and properties is due to an object’s causal interactions with other objects, then the relatedness of the set is more natural. They may have helped birth one another.

If Wimsatt’s notion of mechanism emergence and causal feed-back loops is ontologically plausible, then emergent systems are common in the natural world. My suggestion is that the emergence of the properties and kinds out of which such system are built can stem from the organization of the system itself. Thus to fulfill the 2nd motivation behind the levels hypothesis, i.e. giving an account of the emergence, a mechanism centered ontology needs nothing more than it needs to account for mechanisms: the notion of a causally reinforcing and evolving system of interaction (and perhaps some interstellar piles of trash). The assumption of compositional levels, or disjunctive properties and levels of natural laws, is not needed.
7.5 Mechanisms, Materialism, & The Vertical Axis of Reality

So far I have argued that a mechanism centered ontology can avoid causal over-determination along the horizontal axis of reality by obviating the necessity of level specific laws. I have also argued that this is not an essential threat to motivation 2 of the levels hypothesis, realism about macro-science, as macro-science can be seen as essentially concerned with families of similar causal mechanisms that range over different object types. I have also argued that emergence (motivation 3 of the levels-hypothesis) may be accounted for in terms of causally reinforcing patterns of systemic interaction. The question now turns to whether a mechanism-centered ontology can make good on the materialist claims (motivation 1) of levels hypotheses while avoiding systematic over-determination along a vertical/synchronous axis of reality.

The mechanist approach to scientific explanation (with the possible exception of Cartwright and her claim regarding the intentional character of most mechanisms) is essentially a materialist approach. This is probably clearest in the advocacy of the CCL by authors such as Bechtel and Wimsatt. Regardless, nothing about my spin on mechanisms is intended to imply the existence of any non-material parts, properties, or objects. While it is not precisely clear to me what such things might be, I take it that a property that can exist independent of a material bearer (an ‘out-of-body’ mentality), or object that could not be causally effected by normal material objects (a deity or spirit), or a part that cannot be causally interacted with (an epiphenomena, as some claim consciousness is), would all qualify as failures of materialism.

Objects, at least those larger than sub-atomic particles, I assume are typically composites rather than ‘simples’—they possess intrinsic sub-atomic (atomic, molecular, and often larger) micro-parts and structure. Unlike the CCL, however, on the current
view the properties and causal powers of an object are not solely determined by its composition. Also, unlike the CCL, no assumption is made that the parts of objects within a theoretical domain, such as biology, need be essentially causally related to one another 'one-level down'. Causation does not have to be mediated by micro-steps downward. The objects in a biological mechanism may have chemical, physical, biological, biochemical, neurophysical, etc., parts (though the classification of parts as chemical (for example) has to be presumed to be more or less 'rough' on the current view, and largely dependent upon the sorts of mechanisms in which such 'parts' figure most often).

Much of this should not be terribly controversial. However, my understanding of the ontological cost of materialism is controversial. As I said at the beginning of the chapter, levels imply micro-supervenience. If the problem of over-determination is to be avoided, micro-supervenience must be abandoned. The macro must be seen as sometimes determining the micro. This differs from the view of many contemporary philosophers, not only PCL and CCL advocates. While we agree that a commitment to materialism entails a commitment to a vertical dimension of determination (if everything is made material stuff, then a change in a thing requires a material change), the vast majority (if not all) of contemporary philosophers who have written on these themes do not question the vertical dimension of determination is unidirectional—traveling solely from the micro to macro. Some (see Sturgeon 1999, as well as Humphreys (1997 & 1999)) have questioned whether the 'quantum level' (i.e. the sub-atomic) is an appropriate micro supervenience "base", due to the weirdness of certain interpretations of quantum theory; but no one I know of has pressed the issue the above the quantum level (which is
peculiar, given that the ontological payoff of moving the supervenience base to the molecular 'level' is far from clear). Similarly, some contemporary self-proclaimed emergentists (see Chalmers) have questioned the materialist assumption that there is a vertical dimension of determination. But none have openly questioned the *unidirectionality* of the determination relation.

Part of the reason for the uniformity on this issue, I suspect, is tacit acceptance level hypothesis. Neither the PCL, nor the CCL, can deny the supervenience of the macro upon the micro, and the fundamentality of the micro-physical, without contradicting their own approaches to emergence and the ontological underpinning of levels. Without a base level of properties and a uniform vertical relation across levels, the PCL lacks the disjunction relation to build up a hierarchy of higher-order properties. Similarly, without the fundamental determination of an object by its micro constituents, the CCL lacks account of the emergent inter-level relationship. Thus CCL and PCL advocates have little interest in questioning the micro-supervenience assumption. It is only by dropping the received notions of levels of reality that the possibility of consistently denying part-whole determination while affirming materialism opens up.

Even so, levels undoubtedly aren't the only source of the presumption that the small determines the large. As the quote from Steven Weinberg in chapter 2, noted, there are certainly many physicists that believe the small=fundamental and determinative (though there are also others, such as Nobel prize winning physicist Robert Laughlin (see his 2005), who specifically reject this idea). Additionally, the presumed equivalence of materialism and micro-determination may well go back to the ancient roots of contemporary materialism, i.e. Atomism. And the notion has even entered the popular
mindset as “Star Trek” transporters and their ability to create molecule for molecule duplicates is often used as an example by Jaegwon Kim of the plausibility of the micro-supervenience.

Regardless, the only way to avoid the problem of over-determination is to allow horizontal/causal determination to work in unison with the vertical. To see this, consider a putative macro-process like the one in the diagram below, where the ‘S’ level is assumed to be a ‘base’ micro level where the ‘real’ horizontal and micro-macro determination reside. The higher lines represent “faux-macro causation” of medium and higher levels

\[
\begin{array}{c}
H \\
M \\
S
\end{array}
\quad \text{No- Overdetermination}
\]

\[
T_1
\]

On this view there is no over-determination. The base is responsible for both horizontal (causal) determination and vertical (micro-macro) properties and events. Over-determination can only occur where there is divergence between the horizontal and vertical. When, for example, causal determination is seen as happening in the ‘mid-range’, but micro-macro determination comes from below.

\[
\begin{array}{c}
H \\
M \\
S
\end{array}
\quad \text{Over-determined (by S and M)}
\]
When they are rooted in the same object/causal nexus over-determination is not a problem.

While granting that macro-causal eliminativism (as pushed by David Lewis, and recently Kim) regarding horizontal determination avoids the problem of over-determination, the point I now wish to advance is that there is nothing that should prevent this same style of explanation working in macro domains. As long as horizontal and vertical determination work in concert, no over-determination problem can arise. The following picture eliminates over-determination just as well as the first.

```
H

M No-Overdetermination

S
```

This solution will not work for a levels advocate, particularly a CCL advocate who see every object as wholly determined by its vertical micro structure. However, as it is not part of my view that objecthood/emergence is determined by part/whole relation, I claim that my view is not similarly committed to the thesis of part-whole determination. The CCL claims all of an object’s properties depend upon its composition. But absent a commitment to this idea, I see nothing in the ontological view on offer that commits it to locating all powers of vertical determination in the micro. As I have claimed horizontal determination can come from ‘above’ or ‘below’ on the mechanist view, I now claim that vertical determination can similarly come from above or below.

Suppose I ingest some tranquilizer that promotes the release of GABA in the brain. Intuitively it looks like we can have a causal intervention in the ‘middle range’ that can synchronically determine such macro processes as heart rate, metabolism, and
respiration. (It is perhaps worth noting that the characterization of a tranquilizer as purely a ‘chemical’ object would be a bit misleading as without a glucose or protein mediated carrier, the relevant chemical cannot pass through cells of the ‘blood-brain’ barrier.) Through its effects on these macro-processes, a GABA-agonist can determine the behavior of every micro-physical bit (such as the oxygen molecules we breathe in and out) that can plausibly be said to be part of the human body. Thus, let C represent the ingestion of the drug, N the gaba-releasing affects on the central nervous system, B the body, and P my constituent fermions. Then my suggestion regarding horizontal and vertical determination can be represented in the following way:

\[
\begin{align*}
\text{C} & \quad \rightarrow \quad \text{N} \\
\downarrow & \quad \quad \downarrow \\
\text{B} & \quad \rightarrow \quad \text{P}
\end{align*}
\]

While such a picture of the macro’s ability to synchronically determine the micro does do away with the problem of systematic over-determination ‘from below’, the question may remain in many materialists’ minds whether the synchronic determination of parts by the whole is consistent with materialism. It is common to find blanket statements by philosophers that “(s)cience tells us we ought to formulate microstructural theories of objects and their properties” (emphasis added, Kim 96, 1993). Typically no further argument is given.

However, contrary to the typical assumption of the ‘empirical givenness’ of micro-determination, there are many different sorts of examples that speak against the empirical givenness of micro-supervenience. Additionally, I believe there are no
compelling a priori reasons to accept that the rejection of micro-supervenience is inconsistent with materialism either. The next two sections will attempt to defend these claims. If I am successful, then I submit that the solution to avoiding the over-determination (while maintaining materialism) is straightforward—reject micro-supervenience.

7.5.1 Micro-Supervenience is *Not* Empirically Given.

The first set of examples that speak against the empirical givenness of micro-supervenience are simply the sorts of examples canvassed above, such as stem cell differentiation, where an individual’s role is determined by its place in its macro-environment rather than by its micro-properties. Causing something to turn into a liver cell, for example, appears to bring about a change in that thing’s micro-components. Thus to the extent that it is accepted that systems can give rise component properties and objects, it should also be accepted that the macro can determine the micro.

A second set of examples that speak against micro-supervenience concerns the employment of certain abstract models in disciplines as diverse as Economics and Physics that can be used to predict the behavior of the micro. Such models often are constructed by making assumptions about aggregate behavior that cannot be derived from facts about individual components of a system. As such, it appears that there must be something beside facts about the micro that is determining the behavior of the micro.

For example, in Economics the aggregate demand curve cannot be seen as a simple function that sums the desires of individuals for a particular good. Such a picture of aggregate demand would place no restrictions on lengths people might go to acquire a
good as it does not take into consideration the tradeoffs (if I buy X, I can’t buy Y) different individuals must consider. As such, to derive the aggregate demand curve the ‘macro’ has to be treated as one big individual whose desire for a particular good will decrease as price increases. However, while we know such assumptions work in representing aggregate behavior, we also know (due to things like ‘snob appeal’—i.e. people like more expensive goods) that such facts are not determined by individual preferences. Rather they are determined by such macro properties such as limitations in total money supply.

Similarly, in Physics the ergodic assumption required in statistical mechanics to derive energy from heat, involves an assumption that not only does not involve microfacts, it contradicts them. It requires the micro to cycle through every possible distribution of the space defined by the macro-system over the course of time. If this actually happened a zero-energy state from which the system would never move would occur. This does not happen to real world gases, however. As such, whatever determines the correspondence between kinetic energy and heat can’t simply be the behavior the micro-particles considered in isolation.

A third set of considerations that speak against the empirical givenness of micro-supervenience concerns the roles macro-variables play in virtually all applied equations. Consider that what defines a harmonic oscillator is any system whose behavior can be modeled by an equation of a certain form. But such equations will require a constant, such as the spring constant, that relativizes the predicted values of the equation to macro-variables of the system under consideration. Consider the equation governing surface re-adsorption:
Here we have a rate constant $k$, for the ‘stickiness’ of the substrate/adsorbate system under consideration (one sensitive to the 2-dimensional surface area of contact) as well as relativization, $C$, to phase (a property of concentrated matter). If physics can countenance such macro-determining properties as surface stickiness, then I see no reason that physicalism cannot either.

A fourth consideration again comes by way of consideration of physics, namely the fact that physics presently implies different forces at work in the micro and macro world. In the micro-world electro-magnetic force appears to most of the work. However, these are not the forces that appear crucial to the behavior of things at the astronomical scale. At the astronomical scale (i.e. the super-macro) gravitational force appears to be the primary mover. Nobody has much of any idea (or at least evidence) concerning how to reconcile gravity with the behavior of sub-atomic particles at the micro-scale. Gravitational force appears to fall out entirely. At the micro-scale, the gravitational force of the protons and neutrons ought to either attract electrons or imply they have infinite energy, neither of which is true. Given this, it appears this difference, it appears that where a particular object is at the macro scale, is not something micro-determined. Rather, it is determined by gravitational force.

As a last broad swipe against the notion micro-determination, consider our apparent ability manipulate the micro-world by means of, for example, a particle accelerator such as the Tevatron. At 4 miles long, this hardly-micro magnetic ring allows us to propel protons to nearly the speed of light. Such speeds are not ‘natural’ for a proton on earth. The sequenced collection of oscillating magnetic fields that
continuously propel the particle forward are not something that a proton is going to encounter outside of the highly contrived environment. Rather the cause of its eventual speeding up toward the speed of light appears to be the setup of its macro-environment, the 4-mile circular tube, by us. Whether one considers us, or the tube, the ‘cause’, it appears that both are macro relative to the proton [additionally, I think the electromagnetic fields (as well as most other vector valued properties) that propel the proton are probably best thought of as macro as well – but there are admittedly complications concerning the best way to conceptualize 2nd rank tensor fields that I do not believe are necessary to go into to make my point]. Given that we appear able to radically alter the typical behavior of micro-particles, and that we are macro-entities, I believe the idea that all determination flows from micro-regularities is again undermined by empirical practice and thus far from ‘empirically’ given.

7.5.2 Further Arguments Against Micro-supervenience

As the empirical case against macro-determination appears less than conclusive, one might imagine that there are strong pre-theoretical reasons/a priori arguments that can be mustered in favor of micro-supervenience. But as with the empirical case, actual arguments supporting micro-supervenience are difficult to find. The typical intuitive picture offered in support of micro-supervenience can be found in a previously referenced quote from David Lewis concerning a picture and the collection of micro-dots that make it up:

the picture and the properties reduce entirely to the arrangement of light and dark pixels. They are nothing over and above the pixels. They make nothing true that is not made true already by the pixels. They could go unmentioned in a complete inventory of what there is. (Lewis 292).
The intuition about the picture and its supervenience on the dots can be made more explicit in various ways (as there are many, many, ways to characterize supervenience). Kim prefers talk of micro and macro properties and formulations of supervenience that can potentially cover both mind/body and micro/macro cases. Thus on the Kimian view, micro-supervenience claims that for any object X, there can be no macro change in X without a micro change in X, (Kim 1993, 70). Philip Petit (1994) puts the thesis in terms of duplicates, supposing two macro-duplicates cannot differ without a micro difference.

However, all the characterizations above suffer from a similar equivocation regarding macro-objects and their parts. The problem is perhaps more evident in the formulations of Kim and Petit. Both views require a macro-object has to explicitly be identified (object X, or its duplicate), and then a set of micro-parts can determined from the macro-object's identification. Without first identifying the whole, the relevant subvenient base cannot be identified. But this draws the notion of micro-supervenience into question right from the start. These formal characterizations seem to necessitate that there is at least one thing about the micro determined by the macro—namely membership in a relevant subvenience set. Note that this is not the case with mind/body supervenience. There, two families of properties of a bearer can be assumed (mental and physical) without essential reference to each other.

However, when one assumes an object and then defines a set of micro-parts or properties in terms of it, the risk is run that the claims of Petit and Kim simply amount to the circular idea that the members of particular set (call it A) of micro-parts cannot change without some change in the members of that set (A). While certainly true, this hardly seems like much of a metaphysical thesis or argument. Rather it is simply a
principle of individuation. An example may help illustrate the nature of my complaint and worry. Suppose we have a line (call it L) composed of three parts (call them A, B, C):

Object L

A

B

C

Now considering object L in isolation, the notion that it is wholly dependent upon and determined by its parts—A, B, C—can seem plausible. Wherever A, B, C go, object L is sure to follow. Change the shape of a part, and you will change the shape of L.

The problem is that the formulations of micro-supervenience canvassed above appear to entail that any change in L must occur through a change in A, B, or C (because no independent characterization of the macro-object is given). But this appears false, or at least question begging. If L is like most objects, (toasters, proteins, kidneys, computers, etc...) then L will have a set of persistent conditions by which we judge whether or not it still exists or has been destroyed. But if L it goes through any process of growth (say M + N get added to L), then L change without any corresponding change in A, B, or C.
I suppose someone might reply here that part C has gone through change as it is now contiguous with M. But it still would seem that the addition of N must be accounted a change in L without a change in A+B+C.

Alternatively, suppose that M+N is an ax blade, distinct from L. Even if we allow that L has no new parts, the fact that it now constitutes an ‘axe handle’, while before it may have been just a club or walking stick, would appear to indicate it now has new causal powers and capacities without a change in A, B, or C. Thus again it looks like a change in L can be effected without changing any of its intrinsic parts (A, B, C).

As such it appears that if we consider objects as persisting and changing through time, as capable of growth and alteration, then there will be many changes that can come about in an object that are not result of change in its parts before the growth or alteration. The only reason that the determination, for example, of a picture by its pixel dots seems to be an intuitively obvious truth, I submit is that it conjures up the idea of a static image. However, if we allow that the picture can change (for example, if we add a background to it and other pictures around it) then the idea that it is just the sum of sum specified set of dots becomes less plausible.

The micro-supervenience intuition pumps, such as Lewis’ picture-dot example, tacitly dismiss the macro-realist assertion that macro-objects have independent persistence conditions that explain why the macro can stay the same while the micro changes. Famously, most of the cellular components of a human being die over the course of seven years, yet we do not see this as entailing that the biological objects they compose, i.e. us, have only have seven year life spans. But if we take the micro-
supervenience assumption seriously, i.e. the properties of a biological whole are determined by its parts, and all of those parts ceased to exist, shouldn’t the whole cease to exist as well?

A different sort of case may also help weaken the micro-supervenience assumption. Consider a cellular automata simulation. Perhaps the most famous example of such is Christopher Langton’s ‘Game of Life’ (discussed by Dan Dennett in his (1991)). Langton’s ‘game’ consists of grid, some of the squares are ‘on’/filled, the rest are ‘off’/empty, and the simulation proceeds through a series ‘turns’. Given an initial distribution of ‘on’ squares, a simple algorithm determines whether a cell either turns on or off for a given turn:

**Langton’s ‘Law of Life’:**

Each cell counts how many of its 8 neighbors is on, if the answer is two, the cell stays in its present state (ON or OFF) through the next turn. If the answer is 3, the cell is ON, under all other conditions the cell is OFF for the next turn.

To see how this works, consider the 5 x 3 grid below, with the 3 black dots forming a vertical row of ‘ON” cells. The cells at the ends of this line have only one neighbor ON (i.e. the middle dot), thus they will be off for the next turn. The OFF cells on either side of the middle dot, as they have 3 on neighbors, will turn ON for the next turn. All other cells will remain OFF.
After turn 1, the state below (turn 2) will result. When we consider what will happen on turn 3, we see that the grid will actually revert to its previous state, the ON dots at the ends will turn OFF, and the OFF cells on either side of the middle dot will turn ON.

If left alone, the 'end' dots of this 3 dot system will continue to shift back and forth between the vertical and horizontal axis indefinitely. Different initial arrays produce different patterns. Given a starting position like the one below (also known as a "glider gun") the two larger figures in the middle of the screen will 'spit' dots toward one another. When the dots collide, what is known as a 'glider' is formed and it will amble
off the screen to the lower right. The rest of the dots return to this initial start-up position and begin the process anew.

*Glider gun*

Now many may suppose that these cellular automata provide the perfect intuitive illustration of micro-supervenience. The behavior of the figures in the picture above, is after all, determined by the behavior of their constituent dots.

However, any support for micro-supervenience inferred from cellular automata I believe is short-sighted. Langton’s cellular automata can actually help illustrate what is wrong with micro-supervenience position. Consider the causal influences on the behavior of the component dots in the first example cited above:

The behavior of each of these dots must ‘look’ to *each of 8 squares* the colored lines above pass through to determine its behavior. In other words, the behavior of the line composed by these three dots is not determined by properties intrinsic to the line (or the
components dots). Rather the behaviors of both the dots and the line are determined by the total surrounding environment. Thus the idea that the line is determined purely by something intrinsic to it, rather than its environment, is false in this example.

Furthermore, consider the "law" of Langton's life game: "Each cell counts how many of its 8 neighbors is on, if the answer is two, the cell stays in its present state through the next turn. If the answer is three, the cell is ON." Not only is the behavior of the components determined by extrinsic relations, the crucial causal variable looked for in the environment is a kind of macro-object—a two-dot-object or a three-dot-object. If the behavior of the dots in Langton's example can be determined by their relations to the environment and the presence of macro-objects, then it should not be so difficult to believe that the behavior of a micro-components can't also be similar determined.

A last thing to point out about intuitive arguments in favor micro-supervenience is that "Star-trek" transporters and similar sorts of examples involving duplicates cheat. Molecules are macro in comparison to atoms, electrons, and sub-nuclear entities (as well as any potential sub-sub nuclear particles and so on). A molecule for molecule duplicate of me that determines all of my properties would have to determine my atomic, sub-atomic, and potentially sub-sub atomic properties as well. In other words, all of these examples always assume macro-supervenience as they are explicitly related.

Now there seems little doubt that the tellers of such tales, if pressed on this, would admit that a duplication process that supported micro-supervenience would have to come couched in a tale about even smaller entities--electrons, quarks, and perhaps sub-quarks if such there be. But the problem with this admission is that the explicit examples the users are employing, support the opposite of the conclusion they want to push (i.e.
micro-supervenience). However, if the examples were stated in terms of such things as quarks, then the thought experiment is likely to have less force as the entities in question are less well understood. What would happen if we could duplicate such things in a one-for-one way (which appears quite impossible as many come in pairs, and the individuation of something even as intuitively graspable as a single electron is far from a simple matter, and Heisenberg’s uncertainty principle likely prevents the possibility that all of the required information about such micro-particles could ever be had) is far from clear.

As such, I submit these sorts of examples simply illicitly play on a corpuscularian intellectual heritage that is precisely at issue. If these sorts of examples were stated in terms that actually supported their conclusion, the weakness of the intuitions involved would be more evident.

The considerations above lead me to conclude that the a priori arguments in favor of micro-supervenience ultimately fare no better than the claim that micro-supervenience is an empirical given. The only reason I can see for maintaining micro-supervenience in the face of such weak motivations and serious ontological complications is the hidden hold of the conceptual blinders of levels-talk. While levels may need micro-supervenience, the doctrine is separable from materialism, which need not assert the ontological priority of either macro or micro objects.

7.6 Leaving Levels Behind

An early section of this chapter was called “learning from levels’ mistakes” and if the present chapter (and project) accomplishes nothing else, my hope is that it illustrates the sorts of ontological possibilities that open up—such as the rejection of micro-
supervenience--once natural objects and properties are no longer seen as essentially level bound. Intractable mysteries may become avenues for developing novel analyses.

I have attempted to illustrate that the levels hypothesis need not be seen as the only way to achieve the explanatory goals that motivate it, but that these goals can also be achieved by a mechanism centered ontology that avoids the over-determination problem that the levels-hypothesis appears to bring, essentially, in its wake. If this is accepted then the last criticism I have to offer against the levels hypothesis is simply that it need not be, as its supporters may too often assume, the only game in town for a macro-realist. Not only do levels bring unique problems in their wake, they are not the best explanation of the admittedly difficult ontological issues they try to speak to.

In defense of levels, I do believe that the attempt to coherently picture different dimensions of determination while fitting diverse scientific phenomena into a single ontological scheme is a worthwhile endeavor. If science cannot provide a unified picture of reality, then instrumentalism and skepticism about its claims are likely to follow. It is because of this that I took up Kim’s challenge to try to make as much sense of the various notions of levels of reality as I could. Perhaps others may be able to do a better job in their defense. However, in the absence of such a defense, and upon a thorough examination, I conclude that there are likely better ontological schemes available, such as the one sketched here, to achieve the otherwise admirable goals of the levels of reality hypothesis.
Bibliography


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