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## In Defence of a Scientific Essentialist Account of Natural Law

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In Defence of a Scientific Essentialist Account of Natural Law

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## Abstract

Some argue that the laws of nature are metaphysically necessary (e.g. Ellis, 2001, 2002 and Bird 2007). By endowing the laws with metaphysical necessity it is hoped that a *scientific essentialist* metaphysic will succeed where neo-Humean *contingentist* accounts of natural law failed by, for example, explaining lawful counterfactual support. I argue that the most robust account of the metaphysical necessity of the laws requires that i) kind membership is born essentially and ii) that alien kinds are impossible. Without i) and ii), a scientific essentialist account of laws risks succumbing to many of the same criticisms leveled at the neo-Humean account. I argue that the scientific essentialist can maintain i) and ii) in a principled manner, consistent with their motivations and in line with the strictures of philosophical naturalism. The conjunction of scientific essentialism and ii) implies that all possible worlds are identical with respect to their laws. This result is a positive because it dispels the mystery of metaphysical possibility by assimilating the epistemology of modality to familiar scientific epistemology.

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*[M]odalities in their primary use concern counterfactuals about actual objects, and to reintroduce possibilities is to run counter to the admonition of Russell that we ‘retain our robust sense of reality’.*

– Ruth Barcan Marcus, 1986.

## Part 1

### 1.1) Outline

The account of natural laws as metaphysically necessary because they hold in virtue of essentially dispositional properties is offered as an alternative to the neo-Humean view of laws as thoroughly contingent regularities in the Humean mosaic of loose and separate matters of particular fact. Proponents of this account, which, following Ellis<sup>1</sup>, I shall refer to as scientific essentialism, see it as superior to neo-Humeanism because, unlike that view, it can account for the *necessity* of the laws, the laws' relationship to counterfactuals and the laws' ability to *explain* their instances. I further argue that a metaphysic according to which the laws hold of necessity and in virtue of the essential dispositional properties of natural kinds paves the way for a naturalized account of modality whereby *science* is the primary vehicle of inquiry into real possibility.

In what follows I shall look in more detail at the scientific essentialist metaphysic and its motivation. I seek to defend the resulting account of natural law in the face of some pressing concerns, which threaten to reduce the distance between scientific essentialism and Humeanism to the extent that *both* views succumb to the same problems. I argue that in order to resist these concerns, the scientific essentialist must strengthen her view by denying the possibility of *alien* kinds – hypothetical kinds instantiated nowhere in actuality – and hence by maintaining that all possible worlds are identical with respect to their laws. The broadest respect in which I wish to defend a scientific essentialist account of natural law is to show that it is *naturalistically* acceptable, which in the first instance I shall do by responding to some recent criticisms of scientific essentialism according to which it is

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<sup>1</sup> (2001, 2002)

*unscientific*<sup>2</sup>. And once scientific essentialism is supplemented with the denial of possible alien kinds, I'll argue that the resulting *modal necessitarianism*<sup>3</sup>, has naturalistic appeal since it allows the epistemology of modality to be assimilated to familiar scientific epistemology<sup>4</sup>.

In part 1 I address some criticisms of scientific essentialism, which, according to Khalidi<sup>5</sup>, call into question some of its most fundamental principles. By addressing these issues I hope to elucidate the doctrine of scientific essentialism in more detail and to rebut some preliminary worries that the view is *unscientific*, and unable to maintain the conceptual distinctions it requires. I also address Bigelow's<sup>6</sup> concern with Ellis's formulation of scientific essentialism, according to which individuals can persist through a change in kind membership<sup>7</sup>. Following Bigelow, I argue that essentialism about kind membership is required to maintain proper distance from Humeanism and, furthermore, that an attractive account of *essential properties*<sup>8</sup>, very much in a scientific essentialist spirit, *implies* the essentiality of kind membership.

In part 2 I discuss two related and particularly intractable problems for scientific essentialism. According to one, raised by Lange<sup>9</sup>, scientific essentialism fares no better than Humeanism at explaining the *particular* relation of support in which the laws stand to counterfactuals. This is because the essentialist metaphysic itself cannot account for the particular counterfactual invariance of the roster of natural kinds and hence the particular counterfactual invariance of the set of prevailing laws. The other deep problem, raised in essence by Levin<sup>10</sup>, and further pressed by Khalidi<sup>11</sup>, contends that the essentialist claim to the laws' absolute necessity, which was

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<sup>2</sup> Khalidi (2009)

<sup>3</sup> Schaffer (2006) and Wilson (2012) 's name for the claim that all possible worlds are identical with respect to their laws

<sup>4</sup> Following Wilson (2012)

<sup>5</sup> (2009)

<sup>6</sup> (1999)

<sup>7</sup> Bigelow (1999)

<sup>8</sup> Gorman (2005)

<sup>9</sup> (2004)

<sup>10</sup> (1987)

<sup>11</sup> (2009)

subsequently employed to do *significant* work, lacks substance. The concern is that the essentialist metaphysic cannot rule out the possibility of worlds populated by alien kinds, and hence at which different laws prevail to those of the actual world. Thus, if at some possible world there exists schmass, which is like mass but universally attracted in accordance with an inverse cube law, then it seems wanting to say that gravity is necessarily thus and so. One could point to a possible world with a force somewhat like gravity, but quantified differently, and argue that *in virtue* of this world with an inverse cube law of universal attraction, gravity is not really necessarily thus and so. As Khalidi puts it: “*The possible world that anti-essentialists describe is a mere notational variant of the one that scientific essentialists deem to be impossible.*”<sup>12</sup> I argue that these two problems serve to severely diminish the distance between scientific essentialism and Humeanism and hence that both views risk succumbing to similar criticisms.

It is apparent, however, that these problems have something in common; an appeal to the possibility of kinds and hence laws that are not present at the actual world, thus their resolution would seem to demand the *denial* of such possibilities. In part 3 I discuss the proper context in which to deny the possibility of those things (alien kinds) that give rise to the problems of the previous section.

To just stipulate that there cannot possibly be any alien kinds would be ad hoc; the mere fact that this proposal would serve as a patch to scientific essentialism would be an insufficient recommendation given strong intuitions to the contrary. So I show that the conjunction of three independently plausible theses (the Barcan Formula, Actualism and Essentialism) *implies* the impossibility of alien kinds. But while the assumptions that produce this result are each independently plausible and attractive, the implication that, say, it is not possible that Wittgenstein fathered a child because nothing in actuality is a possible child of his<sup>13</sup>, seems wrong. Advocates of actualism, essentialism and the Barcan Formula have typically posited actually existing *bare possibilia*,

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<sup>12</sup> Khalidi (2009: 92)

<sup>13</sup> Via application of the Barcan Formula.



tokens of which are possible children of Wittgenstein. The postulation of bare possibilities, which, for example, satisfy the consequent of an instance of the Barcan Formula, whose antecedent says that *it is possible that there be a child of Wittgenstein*, seems fruitful insofar as we are interested in validating our intuitions on what is generally possible. Hence, bare possibilities seem to play an important role in arguments for the Barcan Formula as a *metaphysical* principle – which I require in order to yield the *principled* impossibility of alien kinds.

The problem faced upon introducing bare possibilities is that of saying *why* there can be no bare possibilities in virtue of which it is possible that there be schprotons and other alien kinds. Thus I suggest biting the bullet, to an extent, and denying the general possibility that there be a child of Wittgenstein along with the possibility of alien kinds, since I propose denying bare possibilities and retaining a commitment to actualism, essentialism and instances of the Barcan Formula. Following Simchen<sup>14</sup>, I propose instead that it is possible that something(s) *propagated* a child of Wittgenstein. Since, I argue, nothing possibly propagated a schproton, or any other alien kind, it is not possible in any sense that they exist. Hence the possibility of alien kinds is denied in a principled way, absolving scientific essentialism of the concerns of section 2 and yielding the desired *modal necessitarianism*. I finish by offering some general reasons in favour of modal necessitarianism, which emphasize the naturalistic credentials of the view.

## 1.2) Natural Laws as Metaphysically Necessary

Considered most broadly, scientific essentialism is an attempt at a *first philosophy*, a unifying metaphysical picture of reality. My primary concern here, however, will be with the account of natural law thus yielded. At times it will be useful to contrast scientific essentialism with the doctrine of Humean supervenience and the account of natural law (Humean best systems, from

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<sup>14</sup> (2006, 2012)

now on HBS) yielded by *that* pass at a first philosophy. Though there are other accounts of natural law worthy of independent consideration, most notably the *nomic necessitation* account backed by Dretske, Tooley and Armstrong, it would be beyond the scope of this paper to address these other views. Ellis<sup>15</sup> and Bird<sup>16</sup> both provide incisive critiques of nomic necessitation and HBS accounts of law seem to have stood the test of time somewhat better than the nomic necessitation account. HBS laws have also gained considerable contemporary interest due to their role in arguments for deterministic chance<sup>17</sup>: a particularly hot topic in the philosophy of probability at the moment. For these reasons, the scientific essentialist account of law discussed will be most fruitfully contrasted with HBS accounts where needed. Insofar as the scientific essentialist account is able to overcome problems faced by HBS accounts, we will have good reasons to prefer scientific essentialism; better reasons than if scientific essentialism were to outperform, say, nomic necessitation.

Of primary concern to us will be the laws' *necessity* given scientific essentialism. This is a controversial result but also one, it is hoped, that will imbue scientific essentialism with considerable theoretical utility. HBS accounts characterize the laws as thoroughly contingent. This is because, in true Humean spirit, the doctrine of Humean supervenience<sup>18</sup> denies the presence of any necessary connections in nature –everything that can be said about the world supervenes on a fundamentally nonmodal base, which consists just of loose and separate matters of particular fact. Call this fundamental-level amalgamation of distinct matters of fact the *Humean mosaic*. The Humean mosaic may nonetheless exhibit regularities in its particular matters of fact. The laws, on HBS accounts, are then the theorems of the best systematization of these contingent regularities in matters of particular fact. HBS laws are contingent because what regularities there are and hence what constitutes the best systematization of those regularities is a contingent matter. The problems for HBS accounts of natural law shall be

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<sup>15</sup> (2001)

<sup>16</sup> (2007)

<sup>17</sup> E.g. Loewer (2001, 2004), Frigg (2014), Glynn (2010) Schaffer (2007)

<sup>18</sup> E.g. Lewis (1986)

sketched in section 2, where I consider the extent to which scientific essentialism is equipped to do any better. Scientific essentialism, while a supervenience thesis of sorts, yields an account of the laws as metaphysically necessary, because the subvenient base contains irreducible dispositions.

By admitting dispositions into her ontology, the scientific essentialist radically departs from neo-Humeanism and paves the way for an alternative account of natural law, which it is hoped can overcome the problems faced by HBS accounts. Roughly, the scientific essentialist maintains that the laws of nature hold in virtue of the essential dispositional properties of things. Thus, for example, it is necessary that two electrons separated by a distance  $r$  feel a force described by Coulomb's law, for if they did not, they would not be electrons.

Khalidi has contested that “*essentialism encounters some fundamental problems which constitute obstacles to integration with science and a naturalized account of scientific inquiry*”<sup>19</sup>. Thus it shall be instructive to begin by addressing some of Khalidi's concerns, which are recurrent in the literature. In doing so I hope to simultaneously expound in more detail the doctrine of scientific essentialism and go some way towards addressing the specific worry that the view is *unscientific*.

### **1.3) Metaphysical and Semantic Necessity**

The metaphysical/ semantic necessity distinction is central to scientific essentialism. The laws are said to hold of metaphysical necessity, which is implied by the fact that the essences of certain natural kinds include irreducibly dispositional properties. For example, it is metaphysically (or *de re*) necessary that an electron have charge

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<sup>19</sup> (2009)

$(-1.6 \times 10^{-19})$  Coulombs. This necessity holds of the *thing* in question, independently of our conceptual scheme or use of language, or so the essentialist maintains.

To illustrate the distinction between metaphysical and semantic necessity, Ellis compares electrons and bachelors. Ellis argues that failure to know some part of the definition of 'electron' does not amount to a failure to know what an electron is, but failure to know any part of the definition of 'bachelor' *does* amount to a failure to know what a bachelor is<sup>20</sup>. Thus, one may not know that an electron has charge  $(-1.6 \times 10^{-19})$  Coulombs, and yet she may still know what an electron *is*. If, on the other hand, one did not know that a bachelor was unmarried or male, then he would fail to know something that is required to distinguish bachelors from other people, and so would fail to know what a bachelor is. The suggestion here is that it is a mark of semantic, but not metaphysical, necessity that one cannot fail to know any part of the definition of a word for a thing without thereby failing to know what the thing is.

However, it is not obvious that we simply define *any* common terms, including 'bachelor', stipulatively as alluded to. Given the *definition* of 'bachelor' as *unmarried man*, arguably, it is still unclear if, say, the Pope is a bachelor or if a widower is a bachelor. Our knowledge of the *definition* appears incomplete since we fail to categorize some individuals as bachelors or non-bachelors, whom we nonetheless know all the relevant facts about. Conversely, if we did possess an exhaustive definition of 'bachelor', then we could reasonably expect to be able to classify the Pope as either a bachelor or a non-bachelor. Yet, it would be rash to deny that we *know* what a bachelor is, given this ambiguity. This particular way of drawing the metaphysical/semantic necessity distinction fails then because in the case of *bachelors* as well as in that of *electrons*, we can grasp the concept, i.e., *know* what bachelors are, and yet lack exhaustive knowledge of the definition of the corresponding word.

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<sup>20</sup> (2001: 35)

Ellis' emphasis on definitions here would seem to fuel Khalidi's<sup>21</sup> concern that the required distinction between metaphysical and semantic necessity cannot be maintained. I argue, however, that if instead of focusing on knowledge (or lack thereof) of *definitions* we attend to the *methods* by which we acquire knowledge of kinds, the distinction will be perspicuous. Metaphysical and semantic necessities are differently grounded and due to this difference in ground, the means by which we discover necessary properties of one type differ from how we discover those of the other.

Against Ellis, Khalidi offers the example of the word 'circle', where he takes the properties of circles to hold of *semantic* necessity. However, unlike in the case of 'bachelor' it appears that one may know what a circle is, and yet fail to know, for example, the part of its definition that says it is a set of points equidistant from a given point. Hence, we have an apparent counterexample to Ellis's criterion for semantic necessity.

We may agree with Khalidi that one can fail to know certain aspects of the definition of 'circle' without thereby failing to know what a circle is, but as argued we ought not follow Ellis' account of the metaphysical/ semantic necessity divide in terms of knowledge of the definitions of words. On the other hand, contra Khalidi, we may reasonably deny that the necessary features of circles are really instances of semantic necessity. The key, then, to arbitrating in favour of scientific essentialism here, i.e. by making the metaphysical/ semantic necessity divide perspicuous, is in doing some reorientation of the debate. However, it is being *assumed* that there is indeed a distinction between metaphysical and semantic necessity, which some would deny<sup>22</sup>. Thus, when I talk of making the divide perspicuous, I mean to offer a way for the scientific essentialist who already admits metaphysical necessities, to precisify how they differ from 'mere' semantic necessities. It would be beyond the scope of the present inquiry to offer an argument for the distinction that would persuade those who think that all necessity reduces to

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<sup>21</sup> (2009: 87-90)

<sup>22</sup> E.g. Mackie (1974: 560)

semantic necessity, but suffice to note that it is at least standard to distinguish the types of necessity in question<sup>23</sup>.

Ellis's broader point, from which talk of defining terms is a distraction, is that what is true of metaphysical necessity is so independently of us as observers and language users. Metaphysical necessities are out there for us to discover, hence the appropriateness of scientific essentialism as a metaphysic for scientific realism; a world of things with essential, irreducible causal powers, is one that we may reasonably expect to interact with and form knowledge of via scientific methods. What must be emphasized is that metaphysical necessities are discoverable, not by reflection on the social conventions embedding the terms involved, but by close inspection of the *things* denoted<sup>24</sup>.

The word 'bachelor' may not admit of a definition in the crudest internalist sense that Ellis would seem to suggest on occasion. But this fact, and Khalidi's purported counterexample, nonetheless fail to undermine the essentialist's ability to distinguish the ways in which bachelors are necessarily thus and so from the ways in which electrons, say, are necessarily thus and so. The most interesting point to be gleaned from Khalidi's "counterexample" is that the necessary features of circles are discovered in a way more akin to how those of electrons are discovered than those of bachelors. But then we may dispute Khalidi's claim that the essential properties of circles constitute mere semantic necessities because the means by which we come to *know* these features bear no relevant similarities to the means by which we come to know the features of bachelors and other *semantic* necessities.

I argue, then, that in practice the difference between semantic and metaphysical necessity can be discerned by attending to *how* we come to know the necessary features in question: by reflection on social or linguistic convention in the semantic case and via inspection of the *things* denoted in the metaphysical case. Inspection may invoke the scientific method, or even mathematics, when we are interested in the more general features of the

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<sup>23</sup> E.g. Fine (2002)

<sup>24</sup> Ellis makes this point later in his book (2001: 234-237)

thing(s) under consideration. Since science is concerned with how the world is (mathematics in the more abstract, general sense), we may further infer that metaphysical necessities pertain to some objective parts of reality, which echoes Ellis' more pertinent claim that the difference between *de re* and *de dicto* (or metaphysical and semantic) necessity is one of *ground*; the former is grounded in the world, the latter in sociolinguistic convention<sup>25</sup>. Of course, the sceptic about metaphysical necessity will contest our assumption that there are any things existing independently of our conceptual scheme for us to inspect, so the foregoing does not really constitute a suasive argument for metaphysical necessity. Rather, the more modest hope is to persuade one sympathetic to the idea that there are metaphysical necessities distinct from semantic necessities that the scientific essentialist can indeed consistently distinguish between the two.

The sorts of discoveries that *can* be made about particular bachelors, which hold *independently* of social conventions (for example that they like ready meals), will not be *essential* features of the kind bachelor, nor of the individual members of the kind, and so will hold of *no* kind of necessity. Were it discovered that, as it happened, all bachelors liked ready meals, this would not preclude the possibility of some future bachelor who disliked ready meals. On the other hand, were it agreed that partiality to ready meals was an essential feature of bachelors, then this would be a matter of collective agreement, as opposed to revelation delivered via the methods of science. By contrast, discoveries made about electrons and circles, which hold independently of our social conventions, e.g. that electrons have spin  $\frac{1}{2}$  or that the circumference of a circle is equal to  $\pi(\mathbf{diameter})$ , *will*, I argue, reveal themselves to be essential features of the respective kinds, such that all possible electrons or circles will have these features. The point to be emphasized then is that the *metaphysical* necessity with which scientific essentialism is primarily concerned pertains to the (purported) objective parts of the world as opposed to the concepts we employ. It is for this reason that the methods by which we discover metaphysical necessities will differ greatly

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<sup>25</sup> (2001: 37)

from those by which we “discover” semantic necessities and thus the difference between metaphysical and semantic necessity can be clearly drawn.

As a second line of argument for his required metaphysical/semantic necessity distinction, Ellis suggests that the definition of an electron is corrigible in a way that the definition of a bachelor is not<sup>26</sup>. Counter to this, Khalidi claims that if anything is necessarily true of ‘marriage’ it is so of semantic necessity and yet ‘marriage’ is corrigible as illustrated by the extension of the term to include same-sex union. Hence, it is not clear that what is necessarily true of things whose definition is corrigible is so of metaphysical necessity as opposed to semantic necessity.

However, as we have seen, it is plausible that even the definition of ‘bachelor’ is corrigible or open-ended since we may have to modify or precisify it if we wished to classify, say, the Pope. Thus it seems unlikely that *only* the words for those things that admit of metaphysically necessary features will have corrigible definitions. However, the *means* by which the definition of ‘marriage’ would be augmented is very different to how that of ‘electron’ would be.

If the extension of ‘marriage’ were to be widened to include same sex union<sup>27</sup>, then this could be so for some of the following reasons: it was universally agreed that marriage should be so extended, or someone with sufficient power decreed that it should be so extended, or a discovery was made about the origin of the word – its first use in a religious text or something – which meant that its definition did in fact include same sex union. None of these options bare any relevant similarity to the *means* by which the definition of the electron may be extended; namely by *empirical* discovery of some previously unknown properties of the relevant parts of the world. Hence, any definitional augmentation of words for things that admit of metaphysically necessary properties must be independent of linguistic or other social

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<sup>26</sup> Species concepts may well be corrigible. But the scientific essentialist need not maintain that biological species are natural kinds.

<sup>27</sup> As indeed has happened in many countries around the world.



convention, or indeed of any “discovery” of the word for the thing’s origin or previous application.

I argue, then, that the scientific essentialist can indeed maintain the metaphysical/ semantic necessity distinction, and in a manner that gives a central role to scientific inquiry in uncovering the nature of reality. Though the extent to which we define *any* terms by mere stipulation is unclear, I argue that the distinction can nonetheless be maintained by reference to the *means* by which metaphysical necessities are discovered, namely by scientific inquiry into the relevant constituents of the world. This difference in means of discovery reflects the difference in ground of metaphysical and semantic necessities.

#### **1.4) Individual Essences and Kind Essences**

Ellis admits the possibility that an individual persist through a change in kind membership<sup>28</sup>. However, if individuals’ essential properties are qualified as essential only *qua* those individuals’ membership of a particular kind, then this would appear to be a position that the Humean could agree with, since it would seem to amount to little more than the claim that there are some essential properties of *properties*<sup>29</sup>. It would nevertheless be *possible* for any *individual* to exist with dispositions other than those that it actually has, and thus to be subject to different laws or no laws at all.

In order to gain proper distance from Humeanism and the problems therein, it seems that the scientific essentialist ought to maintain that the individual members of natural kinds bear their kind membership essentially. This would inject the required *de re* modality into the theory and allow for an account of the distinctive relationship between laws and counterfactuals<sup>30</sup>.

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<sup>28</sup> (2001: 237-241)

<sup>29</sup> Bigelow (1999: 47)

<sup>30</sup> Bigelow (1999: 48)

One may be hesitant to adopt this form of essentialism, however, since it appears to conflict with the appearance that something of one kind may *become* something of another kind. Consider the common case of atoms that undergo change in atomic number. An atom may become one greater in atomic number by beta emission, and thus change from being an atom of one element to being an atom of a different element. Many, Ellis included, believe that when this change occurs, the former atom does not just cease to exist and another atom come in to being at exactly the same place as the first. Rather, they wish to say that the former atom has just changed some of its intrinsic properties.

Bigelow however, maintains that such intuitions can be explained away: he argues that the aggregate of subatomic particles constitutive of an instance of a natural kind *viz.* an atom of an element, at least some of which come to constitute an atom of a different element at a later time, is not the same *thing* that it was before, say, the gain of a proton<sup>31</sup>.

There are further independent reasons to adopt essentialism about kind membership, which I shall present now. Ellis's weak essentialist intuition appears primarily motivated by cases involving the kind membership of atoms. Thus, the focus of my arguments will be on showing that, despite appearances to the contrary, there are good reasons to maintain that an individual atom's kind membership is essential to it. These reasons will emphasize the broad cohesion with scientific essentialist motivations of maintaining essentialism about kind membership.

### **1.5) Fine and Gorman on Essential Properties**

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<sup>31</sup> (1999)

According to the modal account of essential properties, just as propositions may be necessarily true, so may individuals necessarily be a certain way. Thus an individual's essence is how it is of necessity.

However, Fine<sup>32</sup> notes some serious flaws in the modal characterization of essence. Fine is concerned with the sufficiency of the condition, since it deems as among a thing's essential properties those which intuitively have nothing to do with that thing, which is inconsistent with our conception of essence. For example, Peter Singer is *necessarily* such that the number seven is prime, and yet seven's being prime appears wholly irrelevant to Singer's identity. So we would like to resist the conclusion that the primeness of seven, among other *necessary* truths, is an essential feature of Peter Singer.

Fine instead proposes that the essential properties of a thing are those that feature in its *real definition*. He argues that *things* can be defined in much the same way as words: just as defining a term results in a sentence, true in virtue of the meaning of that term, giving the essence of an object results in a proposition, which is true in virtue of the identity of the object.<sup>33</sup> Thus, defining a thing is the same as identifying its essential nature. However, Gorman<sup>34</sup> criticizes Fine on the basis that his notion '*the real definition of an individual*', in terms of which we are supposed to understand essence, remains mysterious.

Gorman<sup>35</sup> shares Fine's concerns with the modal characterization, but in addition he argues that it fails to distinguish between properties that, while born necessarily, pertain to the individual's identity with differing degrees. This, and the obscurity of the concept *real definition*, motivates Gorman to develop his alternative account of essence. Gorman's account should be attractive to the scientific essentialist due to its continuity with actual scientific practice in virtue of the central role it allocates science in determining the essences of things. According to Gorman:

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<sup>32</sup> (1994)

<sup>33</sup> Ibid. Pg. 13.

<sup>34</sup> Gorman (2005: 281)

<sup>35</sup> (2005)

“...what makes metaphysics different from other fields of inquiry has something to do with its generality and not with any ability to lay bare a stronger kind of necessity in things than the scientist can capture... [the metaphysician’s] contribution will not involve saying that the physicist’s ideas are beside the point.”<sup>36</sup>

Gorman’s account of essential properties abides by this naturalistic sentiment. Thus it should be of interest to scientific essentialism, which maintains continuity with science by allocating a central role to scientific epistemology; accordingly science is centrally concerned with revealing the essential dispositional properties of things, the resulting necessary laws and thus the *real* constraints on possibility<sup>37</sup>.

Gorman argues for a class of necessary *characteristics* that are not essential, where characteristics are those things that really *characterize* an individual, as opposed to mere features, which include such facts as there being infinitely many primes. According to Gorman a property F of an individual *x* is *essential* to *x* iff: (i) it is characteristic of *x* (ruling out such properties as seven’s being odd) and also (ii) it is not *explained* by any other property that is characteristic of *x*. Thus, if *x* is a hydrogen atom, then *x*’s having one proton is essential to it, since this fact about *x* is explanatorily primary, while *x*’s proneness<sup>38</sup> to bond, though necessary to it, is not essential since it is a fact that is, at least partially, explained by its proton number<sup>39</sup>. Gorman’s view differs to Fine’s in that instead of proceeding from definition to essence, he suggests proceeding from essence to definition; *science* discovers the essence of things and then we go on to define them accordingly. This is an account

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<sup>36</sup> (2005: 287)

<sup>37</sup> See part 3.

<sup>38</sup> Gorman (2005: 282) contrasts “proneness” to bond with mere theoretical ability to bond; inert gasses, for example, are not prone to bond, since they are neutrally charged and have a full outer shell of electrons, but they still *can* bond, in theory.

<sup>39</sup> Fine distinguishes between constitutive and consequential essence where the latter type of essence is a *logical* consequence of the former. Gorman, however, points out that this is not the only way for one feature to be a consequence of another. An atom’s proneness to bond is a consequence of its proton number, but is not strictly implied by its proton number, since the number of electrons must be taken in to account too. Hence, Gorman opts for the language of *explanation* instead, where to say that one feature *explains* another is not to imply that it is *sufficient* for the other.

very much in the scientific essentialist spirit and, as I shall discuss, it implies essentialism about kind membership.

I raise Gorman's criteria of essential properties so as to show that there is a viable account of essence, free of many of the problems faced by the modal account, and amenable to an essentialist metaphysic, which *implies* essentialism about kind membership. Hence I offer an independent reason to reject Ellis' weak essentialist intuition.

One concern with the explanatory characterization of essential properties is that it threatens to render the essentiality of properties subjective if explanatory primacy depends on the interests or abilities of the scientists seeking explanations. However, Gorman maintains that he uses the word 'explanation' in its ontic sense, not in its epistemic sense. The relation of explanation, for example, between the number of protons in a carbon atom and its ability to bond in such and such a way is a real relation that obtains in the world and is independent of any scientist wishing to explain, in the epistemic sense, the bonding behavior of carbon. Science may be *mistaken* in what it judges to be the essential properties of things, due to a mistaken belief about which properties are explanatorily primary. But this does not threaten to render essentiality subjective on this account, since there will still be an objective fact of the matter regarding which properties *are* explanatorily primary, i.e., which properties stand on the appropriate side, and only the appropriate side, of the asymmetrical explanation relation and hence are essential.

Given the problems with the modal characterization of essence and with Fine's invocation of the mysterious notion of *real definition*, I argue that there are good reasons for the scientific essentialist to accept the explanatory characterization, particularly given the distinctly naturalistic character of Gorman's argument. Gorman is clear that essences are revealed by scientific inquiry, which is primarily concerned with uncovering various explanation relations. This may be offered as an interesting elaboration on one of the basic

tenets of scientific essentialism, according to which the essential natures of natural kinds of things are revealed by empirical investigation and that the natural kind structure of the world may serve as the truth maker of our best science. The explanatory characterization of essences is a fruitful subsidiary to scientific essentialism, which provides a reason for the scientific essentialist to accept the essentialism about kind membership that I shall now show that it implies.

### **1.6) Gorman's Criteria and Essentialism About Kind Membership**

In the case of atoms, it may appear that an individual atom's kind is explicable in terms of another characteristic property of that individual, namely, its proton number, in which case the kind that an atom is would not be essential to it, given Gorman's account. However, this is revealed to be incorrect. That an individual,  $x$ , is a member of the kind carbon and that it has atomic number 6 are just two ways of saying the same thing; the latter does not explain the former in the way in which the latter (partially) explains the proneness of an individual  $x$  that is an atom of carbon, to form covalent bonds. Arguably, that an atom has 6 protons *explains* why we would *call* it an atom of carbon because 'has six protons' and 'is a carbon atom' are synonymous. But so long as 'explanation' is understood in its ontic sense, as intended by Gorman, it is clear that there is no true relation of explanation here. Thus, in this case, it is apparent that membership of the kind *carbon* is essential to an individual atom of carbon, since this *characteristic* of the individual cannot be explained by any other of *its* characteristics (see 1.5).

This is not to say that there can be no explanation of the atom in question's coming into existence in the first place by, say, appeal to nuclear processes in stars. Any such explanation would invoke no characteristic of the atom *itself* and so would not undermine the above argument to the effect that what *kind* the atom is, is essential to it. Essential properties of an individual are not wholly unexplained, just inexplicable in terms of any other of that individual's

characteristics. This instance of the essentiality of kind membership is an important result since it is precisely the case of atoms apparently changing kind that led Ellis to his weak essentialist conclusion.

Gorman proposes a theory of essential properties with a distinctly scientific essentialist flavor, which elaborates upon the idea that scientific investigation reveals the essential properties of things. An implication of the explanatory characterization of essence is essentialism about kind membership, since an individual's kind is characteristic of that individual and not explicable in terms of any of the individual's other characteristics. There is, then, available to us a plausible account of essential properties and one very much in keeping with the convictions of scientific essentialism, which *implies* essentialism about kind membership and so constitutes an independent argument in favour of strong essentialism.

### 1.7) Weak Essentialism and the Construction of an Ellis-World

Ellis recognizes that individuals are the bearers of certain properties, essential for their kind membership. However, a distinction is drawn between kind-essences and individual-essences, only the latter, according to Ellis, is essential to the individual *simpliciter*. Ellis maintains that this mere essentialism about kinds (as opposed to essentialism about kind membership) still endows the laws with the required *de re* necessity:

*“The laws of nature that I call causal laws are all necessary de re. The laws in question are straightforward descriptions of the essential properties of the intrinsic dispositional properties which fundamental things must have in virtue of being the kinds of things they are”<sup>40</sup>.*

Though laws of nature do not derive from the *individual* essences of things, Ellis maintains that this is not to say that their necessity is merely *de dicto*.

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<sup>40</sup> (1999: 68)

Consider the causal law that salt dissolves in water. The Ellisian essentialist construal of this law would be as follows:

*For all  $x$  and for all  $y$ , **NECESSARILY** if  $x$  is salt and  $y$  is water, then  $x$  is intrinsically disposed to dissolve in  $y$ .*

As Ellis stresses, the necessity operator in the above formulation is within the scope of the universal quantifier, that is, in the *de re* position.

If the above causal law were formulated in accordance with the essentialism about kind membership (EM), we would have:

*For all  $x$  and for all  $y$ , if  $x$  is salt and  $y$  is water, then **NECESSARILY**  $x$  is intrinsically disposed to dissolve in  $y$ .*

And if we knew that  $a$  was salt and  $b$  water, then we could infer simply: *necessarily  $a$  is intrinsically disposed to dissolve in  $b$* . The implication being that individuals belonging to natural kinds cannot ever change their natures, which Ellis is keen to resist.

Ellis is further moved to resist EM by the belief that his weaker version is better at accounting for the necessity of laws of nature that do not make reference to natural kinds of *objects*. Consider the following example involving the natural kind of *property* gravitational mass.  $M1$  and  $M2$  are two natural kinds; their instances are of mass  $m1$  and  $m2$  respectively. Analogous to the Ellisian construal of salt dissolving in water above, we have:

*For all  $x$ ,  $y$  and  $r$ , **NECESSARILY** if  $x$  is an instance of  $M1$  and  $y$  an instance of  $M2$  then if the distance between  $x$  and  $y$  is  $r$  then  $x$  and  $y$  are intrinsically disposed to move towards each other with acceleration proportional to  $m1$ ,  $m2$  and  $1/r^2$ .*



However, the construal of gravitational attraction in accordance with EM would be:

*For all  $x, y$  and  $r$ , if  $x$  is an instance of  $M1$  and  $y$  an instance of  $M2$  then **NECESSARILY** if the distance between  $x$  and  $y$  is  $r$ , then  $x$  and  $y$  are intrinsically disposed to move towards each other with accelerations proportional to  $m1, m2$  and  $1/r^2$ .*

This latter construal implies that given  $x$  and  $y$  are instances of kinds  $M1$  and  $M2$  respectively, that  $x$  and  $y$  have their particular masses essentially<sup>41</sup>. According to Ellis,  $x$  and  $y$  may happen to belong to natural kinds whose instances are of a particular mass, as in the example, and so have their masses essentially, but it seems clear that they need not, since we could reconstruct the above formalizations for cases where members of  $M1$  and  $M2$  do not have their masses essentially.

However, Ellis's reasoning here depends on the weak essentialist intuition that we have suggested he surrender. So long as we bite the bullet and hold that kind-essence is contained within individual essence, it should just be viewed as an interesting result that sometimes individuals bear their masses essentially. On the other hand, and returning to Gorman, in those cases where all members of a natural kind have the same mass in virtue of their being members of said kind, this property will fall within the class of the necessary accident. Members of the kind in question could not but be the mass that they in fact are and yet we can account for the fact that this feature pertains to the individuals' identities to a lesser degree than other properties that they could not lack because it is explicable in terms of subatomic constitution. Thus we can deny that in such cases as the one of concern to Ellis, the individuals possess their mass essentially and yet we can also account for the fact that they could not be of any other mass. In this case Ellis is apparently preoccupied with the flawed modal characterization of essential properties, which impels him towards his weak essentialist position.

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<sup>41</sup> Ellis (2001: 241), (1999: 69)

It is worth considering at this point whether or not Ellis' weak essentialism nonetheless suffices to provide the desired distance from neo-Humeanism. I argue that does not suffice and hence that the case for essentialism about kind membership is stronger than that which arises just from considerations of how best to characterize essential properties.

The departure from neo-Humeanism is clear insofar as scientific essentialism shows how it is that the laws are dependent upon the constituents of the world. Ellis' picture is of a kind of conditional necessity; the laws are necessary conditional upon the kinds present. But the laws are not necessary simpliciter, nor even conditional upon the *individuals* present. The question is whether or not this species of necessity is equipped to do the work required of it?

Humeanism, it is supposed, allows for the possibility of an aggregate of all of the same *kinds* of things as in the actual world but in accord with different laws of nature or no laws at all. According to an HBS account of laws, what regularities there happen to be in the Humean mosaic, and hence what happens to be the best systematization of those regularities, has nothing to do with the *constituents* of the world and indeed the actual regularities may admit of no unique best systematization. Ellis thus notes that this contingentism allows for the possibility of a *Hume world*. A Hume world consists of all of the same kinds of things as our world and looks the same in all its manifest detail and yet has *no* laws of nature. Any appearance of necessity in the Hume world is purely illusory and is in fact brought about by chance. Ellis cites the possibility of a Hume world in a *reductio* against the Humean account of laws, claiming that this absurdity shows that Humeanism is deficient when it comes to accounting for natural necessity<sup>42</sup>.

My concern, however, is that by allowing that individuals may persist through a change in kind, our world ends up looking something like an

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<sup>42</sup> (2001: 46, 244)

essentialistically acceptable Hume world (an Ellis world?). The distinction between scientific essentialism and Humeanism then looks rather trivial. An Ellis world is one in which the apparently necessary connections between *individuals* and their behaviors are all illusory, since there are no necessary connections between the things (individuals) we observe and the *kinds* of things that they are, and it is only in virtue of the kinds of things that individuals are that they are said to necessarily behave in such and such a way. The problem of natural necessity, which scientific essentialism was issued to solve, then just seems to be pushed one step backwards, since the proposed metaphysic still fails to account for the necessary connections between *individuals*, which, according to Ellis' weak essentialism, may or may not be of the kinds that they in fact are.

In an Ellis world we can account for the truth of certain counterfactuals and necessary connections as they pertain to *kinds*, but we are deprived of saying why such necessities are true of *individuals*, that is, those things within the extension of the kind. For example, Ellis can account for the truth of counterfactuals like, "*if there were two protons separated by a distance  $r$ , then they would repel each other with a force proportional to  $1/r^2$* ", but he could not account for the truth of this counterfactual as it pertained to two *particular* protons. If two specific protons were identified and named, say *a* and *b*, then without essentialism about kind membership we could not account for the truth of, "*if  $a$  and  $b$  were separated by a distance  $r$ , then they would repel each other with a force proportional to  $1/r^2$* ". If there is no necessary connection between the individuals *a* and *b* and their protonhood, then our metaphysic cannot ensure that they will interact in accordance with those laws that pertain to *protons*.

In Part 2 I discuss a similar problem, which arises even if essentialism about kind membership is maintained. The moral being that we must think very carefully about the details of our metaphysic in order to achieve the desired necessity in nature and hence distance from contingentism.

### 1.8) Incidental Properties

In the case of some entities, it is not clear if their properties are borne essentially or accidentally, and it would run counter to the essentialist's realist motivations to offer an account of the divide in terms of context.

Consider the element uranium; we may have two distinct uranium atoms, one of atomic mass 235 and one of atomic mass 238. The question then arises as to whether atomic mass is an essential or an accidental property. Since a uranium atom can be either atomic mass 235 or 238, it seems clear that atomic mass is not an essential property of the kind *uranium*. Atomic mass is, however, an intrinsic causal power, and the equation of intrinsic causal powers with essential properties is one of the central tenets of scientific essentialism. Furthermore, if we consider the things uranium-235 and uranium-238 as kinds in their own right, then atomic mass will be essential to *these* kinds. In the interest of avoiding a contextualized account, according to which atomic mass is an essential property of an individual *qua* element of uranium-238, but an accidental property *qua* element of uranium, Ellis introduces a third category, *incidental properties*, designed to deal with such cases:

*“If a property Q is not essential to a natural kind K, but is essential to a natural species of K, then any member of K that has Q has it incidentally, and is therefore a member of a natural species of K which has Q essentially”<sup>43</sup>.*

Khalidi argues that the introduction of the incidental property category raises a problem for essentialism about kind membership<sup>44</sup> *“if we ask whether incidental properties are had necessarily by their bearers and whether their*

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<sup>43</sup> (2001: 78)

<sup>44</sup> Which I argue a robust scientific essentialist account of natural law requires.

*bearers belong necessarily to the corresponding natural kinds*"<sup>45</sup>. If the essentialist answers 'yes' to the question then it is implied that atomic mass is an essential property. However, atomic mass is clearly not an essential property of the broad kind, uranium, to which the atom belongs, and to defer to the fact that it is an essential property of uranium-238 would be to contextualize the distinction in a way that is to be avoided.

On the other hand, if the answer given to the above question is 'no', that is to say, if the essentialist denies that atomic mass is an essential property of that which bears it, then, according to Khalidi, "*This negates one of the basic planks of the essentialist position, which equates intrinsic causal powers with essential properties*"<sup>46</sup>.

Ellis is clear<sup>47</sup> that incidental properties are definitely not born *accidentally*. Hence, the only real threat of contextualization comes from the fact that the following statements are both true:

- 1) x is a member of the kind uranium that has atomic mass 238 *incidentally*.
- 2) x is a member of the natural species of uranium, U238, that has atomic mass 238 *essentially*.

But Ellis maintains that 1) and 2) are *logically* equivalent. That is, they tell us the same thing, not different things depending upon the context.

Given essentialism about kind membership, Khalidi's concern is that we are confronted with two possible answers to the question of whether or not an atom of uranium-238 could become, say, an atom of uranium-235, thus ceasing to bear the incidental property *atomic mass 238*, and yet continue to be the same atom. Hence, Khalidi argues that the problem of context-dependence arises. But this is not the case. We can maintain, as Ellis does,

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<sup>45</sup> (2009: 94)

<sup>46</sup> Ibid.

<sup>47</sup> (2001: 78)

that the property of having atomic mass 238 is born incidentally, where “incidentally” is defined perfectly objectively as above, and also maintain that there is a fact of the matter regarding what changes the individual in question can persist through.

Identity should not be qualified *qua* anything. Whether or not an individual can maintain its identity through some change is either true or false, not true *qua* such and such but false *qua* whatever else. For example, if Clark Kent<sup>48</sup> decided never again to become superman, or lost his superhuman abilities, or something of the like, we would not ask if he was still the same person and then say “no *qua* Superman but yes *qua* Clark Kent”. Rather, his real personal identity is something that transcends his two egos. We must judge whether this transcendent identity, which nevertheless bears some relation to his various egos, can be maintained given the loss of one ego. Similarly, the identity of an individual atom is not qualified *qua* its membership of the broad kind uranium but also *qua* its membership of the species uranium-238. Rather, membership of these kinds has a bearing on its identity, which ultimately transcends the different categories it falls within. With this in mind, I suggest that we are not so much faced with a dilemma, but with an open choice: do we wish to permit that an individual could maintain its identity through a change in atomic mass, or, more generally, where an individual, *x*, has property *P* due to its membership of a natural species *Q* of a natural kind *K*, could said individual maintain its identity and yet relinquish membership of *Q*?

The two possible answers to Khalidi’s question of whether or not incidental properties are born necessarily are objectively mutually exclusive. One cannot fall back on context dependence to hedge his answer saying “*yes, they are born necessarily in respect a, but also no, they are born accidentally in respect b*”. It is true, as Ellis maintains, that the property “having atomic mass 238” is *incidental* to the *kind* uranium but *essential* to the kind “uranium-238”, but, there is a definite fact of the matter whether or not “having atomic mass 238” is essential to a given *individual*. Upon the introduction of an

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<sup>48</sup> Both “Superman” and “Clark Kent” are actually alter ego’s of the individual born “Kal-El”. But I don’t think that this affects my point.

individual,  $x$ , who is a member of the kind uranium and the species uranium-238, the statements about  $x$ 's bearing property  $P$  incidentally in one respect and essentially in another are *logically equivalent*, as discussed above. Hence, one must choose one of two mutually exclusive answers to the question about the respect in which  $x$  bears  $P$ . Any hint of contextualization is only apparent as the property in question pertains to different *kinds*, not to individuals. And this context dependence collapses to logical equivalence upon the introduction of an individual to whom the property pertains.

So, I argue, that it is not the case, as Khalidi suggests, that when faced with his "dilemma", the essentialist may be tempted to say that natural kinds are maximally specific. Natural kinds can be hierarchical, as Ellis argues, varying in their specificity, with broader kinds encompassing more specific species, which themselves constitute kinds. Yet it will never depend upon context whether or not a certain individual bears a property  $P$  that is characteristic of a species  $Q$  of a broader natural kind  $K$ , essentially. The individual in question will either bear said property essentially or not, but that property will be incidental to the individual *qua* member of the broader kind and essential *qua* member of the species of that kind, but these statements will be logically equivalent, and independent of the issue of whether the property is necessary *for the individual simpliciter*.

We are yet to answer the question of whether individual  $x$  of the kind uranium-238 is essentially a member of the kind uranium-238 and hence essentially of atomic mass 238. One may be deterred from answering the question in the affirmative due to intuitions similar to those that motivated Ellis's weak essentialism. It may be harder to overcome the feeling that an individual atom may increase or decrease its atomic *mass* via loss or gain of neutrons and yet maintain its identity, than to overcome the feeling that an individual could persist through a change in proton number. This, I suggest, is due in no small part to the fact that scientific inquiry into particular atoms is somewhat less concerned with atomic *mass* than it is with atomic *number*, since the set of interactions explicable in terms of atomic number is far greater

than that explicable in terms of atomic mass. Both Gorman and Fine's account of the essential-accidental divide imply that being of interest to scientific inquiry is a hallmark of the essentiality of properties. This implication is most explicit in Gorman when he says that science seeks the essences of things and that we then proceed to define those things via their essences<sup>49</sup>. Essential properties for Gorman are those that cannot be explained by any other properties and hence that serve to explain the largest set of characteristic behaviours of an individual. So it is implied that scientific investigation of an individual is primarily concerned with essential properties since they are the most explanatorily fruitful. The implication is also evident in Fine's concern with the modal account's inability to sieve out those features that intuition would dictate are irrelevant to an individual, let alone essential to it; scientific inquiry into instances of the kind uranium is wholly unconcerned with the fact that there are infinitely many primes.

I have presented some reasons for essentialism about kind membership, but even if one was convinced by this stronger claim, they may nevertheless be reluctant to admit its applicability to the case of an atom *merely* changing its atomic mass. How, then, does Gorman's criteria of essential properties categorize atomic mass? Atomic mass is clearly *characteristic* of an individual atom  $x$ , but is atomic mass *explained* by any other characteristic of  $x$ ? While it would appear that atomic mass is explicable in more basic terms, i.e. by appeal to number of protons and number of neutrons, it is not clear that the property of "being an atom of uranium-238" is any less essential than that of "being an atom of uranium". Like I said earlier, it may appear that "being an atom of uranium", i.e., being a member of the kind uranium, can be explained by the fact that an atom has 92 protons, but this is not the right way to think about it. Having 92 protons not so much *explains* an individual's membership of the kind uranium, as it is another way of articulating its membership of this kind. As Gorman says about an individual  $x$ , that is an atom of hydrogen, "apart from having one proton, the atom just doesn't exist

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<sup>49</sup> (2005: 288)



at all<sup>50</sup>”, similarly for an atom, x, of uranium, apart from having 92 protons *that* atom just doesn’t exist at all.

So, granting that uranium-238 is a kind in its own right (as Ellis does) a similar thing can be said. An individual, x, of uranium-238, cannot have its membership of the kind uranium-238 *explained* by the more basic properties of “having 92 protons” and “having 146 neutrons”, rather the fact that x has this particular subatomic constitution is just another way of saying that it is an atom of uranium-238, which cannot be explained by appeal to any other characteristics of the individual. So we can allow that an individual, x, of uranium-238 belongs essentially to the kind uranium-238. However, atomic mass *simpliciter* is arguably explicable in terms of number of protons and neutrons, since “atomic mass X” would not appear to be synonymous with “natural kind Y” in the same way that “natural kind Z” *I argue* does appear to be synonymous with “having such and such particular composition of subatomic particles”. So, on Gorman’s account, atomic mass would appear to fall within the necessary accident category. But we should not be concerned that atomic mass comes out as accidental, since we do not thus sever the connection between essential properties and intrinsic causal powers of fundamental particles. The intrinsic causal power in question really arises due to the explanatory base of the atomic mass, i.e., the number of protons and neutrons, which I have argued is essential to an individual insofar as it is a redescription of the kind of which the particle is a member. It may seem surprising that any arrangement of protons and neutrons thus constitutes a natural kind, but it ought not, since in actual fact there are limited permutations (as dictated by the laws) of proton number-neutron number combinations and those that do prevail constitute well-defined atoms or isotopes that fulfill the Ellisian criteria for natural kindhood. So Khalidi’s “question” is in fact two questions: 1) is an individual atom x of uranium-238 essentially of the kind uranium-238? And 2) is the individual x essentially of atomic mass 238? Which, according to my argument, may be answered wholly objectively and as follows: 1) Yes 2) No.

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<sup>50</sup> (2005: 285)

### 1.9) Essences, the Special Sciences and Beyond

Khalidi takes issue with Ellis's claim that essences are the concern of just physics and chemistry, and that the 'kinds' of apparent interest to the special sciences are not natural. According to Khalidi, Ellis's conviction is motivated by the fact that the special sciences are concerned with relational, or extrinsic properties whereas physics and chemistry are concerned with intrinsic properties and material constitution.

However, Khalidi argues that if we restrict our attention to EK, the thesis that all members of a natural kind, K, must possess one, or a set, of properties if they are to *belong* to K, then there is no way of denying that special science kinds, as well as highly artificial kinds, are *natural*. On the other hand, Khalidi argues that deference to EM on this matter, the thesis that every individual member of a kind, K, belongs to K in every possible world in which it exists, is not viable, since science is clearly interested in *kinds* not *individuals*. It is further argued that, according to the indistinguishability principle, EM fails to hold for some of the most fundamental particles and hence that it cannot be invoked to deem fundamental physical kinds *natural*, whilst denying special science kinds this status.

Consider the term 'glacier'; it refers to a large body of ice in motion due to the effects of gravity. The kind glacier can reasonably be thought to have the aforementioned properties essentially. Thus the kind *glacier* fulfills the essentialist thesis EK; we cannot deny glacier the status of *natural* kind on the grounds of its failing to concur with EK. What is more, it will not suffice for the essentialist simply to admit that the special sciences *are* centrally concerned with natural kinds after all, because so long as we are concerned only with EK, what counts as a *natural* kind can be extended to the point of trivialization. Consider 'the class of things of mass in excess of 60kg'; this term denotes, in all possible worlds, all and only those things whose mass

exceeds 60kg, thus fulfilling the requirement of EK, since *being in excess of 60kg* is that property which every member of the kind has essentially *qua* a member of that kind.

Special science kinds and artificial kinds will, however, fail to adhere to EM. For a *particular* glacier, it will not be that case that *that* individual is a glacier in every world in which it exists, since that individual may exist in a world that is slightly hotter, and hence as a flowing river instead. Similarly, for any given member, in the actual world, of the class of things whose mass exceeds 60kg, it seems they could exist in a world and yet be of mass other than 60kg. However, Khalidi claims that the essential properties of individuals are of minimal relevance to actual scientific practice. Furthermore, Khalidi argues that since the *indistinguishability principle* implies that fundamental particles, like electrons, cannot be tagged or labeled, no sense can be made of the claim that certain properties are essential to an individual electron. Hence, EM apparently fails for these fundamental natural kinds.

The fact that scientific inquiry is unconcerned with the paradigmatically *metaphysical* question of identity, central to EM, does not mean that such metaphysical considerations cannot feature in the formulation of scientific essentialism. Scientific essentialism is a broad *metaphysic*, and as such, science and practicing scientists will be largely unconcerned with what it has to say, unless they are philosophically curious. But that is not to say that it cannot, in a sense, also be *continuous* with science in virtue of its concurrence with science and the central role given to scientific enquiry for *discovering* the essences of things.

Many of the tenets of scientific essentialism are metaphysical, and so of limited concern to science *per se*, so it is odd that Khalidi argues against one particular feature of the theory on this basis and yet engages in metaphysical debate elsewhere in his critique. *Actual* science is also typically unconcerned with the scientific realism-antirealism debate, since it cannot in itself be used as a vehicle of inquiry into the issue. But this does not mean that this area of

the philosophy of science is irrelevant, or even that it is irrelevant to science. Though scientific essentialism is a metaphysical thesis, the respect in which it can be thought to abide by the strictures of philosophical naturalism is that it emphasizes the role of science as a vehicle of inquiry into the nature of reality and cites in support of its metaphysic the scientific image. Scientific essentialism proposes a metaphysic which is such as to give science an elevated epistemological status, since according to this metaphysic it is *science* which not only gives the best indication as to how things are, but also how things *must be*, since the laws of nature *cannot possibly* be violated.

Much the same line of argument applies to Khalidi's concern with EM and the indistinguishability principle. Just because we cannot *physically* label, tag or track the history of a particular quantum particle this ought not have the final say on what may be said metaphysically about such particles. Besides, the interpretation of quantum mechanical phenomena is a controversial topic (itself steeped in metaphysics!), hence Khalidi's espoused interpretation of the indistinguishability principle and its metaphysical implications must be taken with a pinch of salt so long as our understanding of quantum mechanics is incomplete. Thus, the indistinguishability principle is far from conclusive evidence against the legitimacy of giving a central role to EM.

### **1.10) Conclusions**

For what has been said so far, I conclude that scientific essentialism can maintain the distinctions it requires between metaphysical and semantic necessity and between essence and accident. I have argued that in order to achieve the desired distance from Humeanism, the scientific essentialist ought to maintain that kind membership is born only essentially. Furthermore, an attractive account of essential properties, very much in an essentialist spirit, implies essentialism about kind membership. Indeed it would seem somewhat incongruous to let casual intuition dictate on this point, as Ellis apparently does, when elsewhere arguments for scientific essentialism typically proceed

from considerations of theoretical utility, of which essentialism about kind membership provides its fair share.

## Part 2

### 2.1) Introduction

In this section I shall discuss a pair of closely related and deep-rooted concerns for the scientific essentialist's account of natural law. First, according to Marc Lange<sup>1</sup> the scientific essentialist metaphysic fares no better than neo-Humeanism at explaining the *particular* relation of support in which laws stand to counterfactuals. Second, Levin<sup>2</sup> and Khalidi<sup>3</sup> have maintained that the scientific essentialist's claim to the laws' necessity lacks substance.

These criticisms cut deep, since they reduce the distance between scientific essentialism and Humeanism to the extent that the former risks succumbing to the same criticisms leveled at the Humean view. This in turn threatens to undermine the very motivations for scientific essentialism, which included overcoming the problems faced by alternative accounts of laws<sup>4</sup>. The issues discussed in this section will motivate the supplementation of scientific essentialism with the denial of certain general possibilities. The problems discussed will not arise if it is maintained that it is *impossible* that there be additional things to those that there actually are. The details of this supplementation shall be cashed out in the next section.

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<sup>1</sup> (2004)

<sup>2</sup> (1987)

<sup>3</sup> (2009)

<sup>4</sup> Ellis (2001: 44-47), Bird (2007: 81-90)

## 2.2) Explanation and Counterfactual Support

It is commonly complained that laws as theorems of the best systematization of the regularities in the Humean mosaic, are explanatorily anemic in at least the following respects: i) they cannot explain their instances and ii) they cannot explain the laws' distinctive relationship to counterfactuals<sup>5</sup>. Add to this a further concern that iii) Humean best systems (HBS) laws appear to get the *order of explanation* the wrong way round<sup>6</sup>.

An HBS law is *identical* to some regularity (though not all regularities are HBS laws). However, a regularity cannot explain a particular matter of fact partially constitutive of its subvenient base any more than the picture that emerges from a dot matrix can explain the positioning of a particular dot. Rather, particular matters of fact upon which the laws supervene seem more apt to explain *the law* than the other way round. Thus the well rehearsed objections to Humean regularity theories according to which i) HBS laws cannot explain their instances and iii) HBS accounts get the *order of explanation* the wrong way round, would appear to be two sides of the same coin.

These concerns are also closely related to that according to which HBS accounts make a mystery of the laws' distinctive relationship to counterfactuals, as I shall go on to discuss. Given the interconnectedness of the main problems typically directed at Humean accounts of laws, any alternative account ought to avoid all of these closely related problems or risk falling into a vicious cycle.

Laws are thought to stand in a relation of *support* to counterfactuals. By which we mean, roughly, that the counterfactuals that we take to be true, or at least highly assertable, are so, at least in part, because of the laws of nature. Laws *imply* counterfactuals, it would seem. Little sense could be made of everyday counterfactuals if there were no laws at all. Consider; *'If I were to*

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<sup>5</sup> E.g. Swoyer (1982: 209), Fales (1990: 85–87), Armstrong (1983: 40), Bird (2007: 81–90)

<sup>6</sup> Armstrong (1983), Maudlin (2007: 72)

*drop my pen, it would fall to the ground*', which is (at least) more assertable than *'If I were to drop my pen, war would be declared'*, because there is a law, namely gravity, which supports the former, but there is no law that lends support to the latter. In the absence of laws it would be difficult to say in virtue of what there is a difference between those counterfactuals that are true/assertable and those that are not, so swathes of our counterfactual discourse would be unintelligible. Put more broadly, there seems to be some necessity in nature, which permits inference to what would be the case, because it *must* be the case, under certain pertinent counterfactual suppositions.

On an HBS account of natural law, it is unclear how the prevailing laws should support counterfactuals because it is unclear how they are to provide the required necessity. HBS laws are *contingent regularities*, thus there would appear to be no guarantee that the law (gravity, say) that would lend support to the thought that *if I dropped my pen it would fall to the floor* would indeed continue to hold in the counterfactual situation imagined. Thus, an explanation of the laws' support for counterfactuals appears elusive to the regularity theorist because it is far from obvious that laws as contingent regularities *imply* counterfactuals. To illustrate the problem by way of an analogy; it may, for example, be a contingent regularity that everyone in this room is a philosopher, but that would fail to support the counterfactual: *if someone were to enter this room, then they would be a philosopher*, since a history student may stumble into the wrong seminar, or a plumber may come in to fix the radiator, say.

The brute fact of the contingent regularity cannot ensure its own counterfactual invariance by forbidding such occurrences as the next-person-to-enter-the-room's being a non-philosopher, so we cannot be sure that in the counterfactual situation imagined it will continue to be the case that everybody in this room is a philosopher. But of course, the regularity theorist has more to say about *which* regularities will constitute laws<sup>7</sup>.

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<sup>7</sup> E.g. Lewis (1973, 1986, 1994) Loewer (1996)

Unlike in our ‘toy’ example above, the laws will be those regularities that feature as *theorems* of the best systematization of regularities in the Humean mosaic, which achieves an optimal strength-simplicity trade off (where additional theorems/ laws increase strength at the cost of simplicity). But it remains unclear how such details are to provide any explanation of these regularities’ support for counterfactuals, particularly given the apparent mind-dependence of strength-simplicity considerations<sup>8</sup>.

Bird raises a similar concern with respect to HBS laws’ inability to *explain their instances*. The fact that the laws are distinguished from *mere* regularities by some factor X need not be taken to add ontological content to the laws and so need not increase their *explanatory* power (according to Bird, regularities lack the required ontological content to explain their instances<sup>9</sup>). On the other hand, even if it is maintained that X does provide the regularity with additional ontological content, Bird argues: “*That the regularity is an axiom or consequence of the optimal axiomatic system (i.e., has feature X) does nothing to change the fact that it cannot explain its instances*”<sup>10</sup>.

To cite a regularity is to offer a proxy explanation of a particular lawful instance or a proxy account of the laws’ support for counterfactuals. The regularity points the way to an explanation but is no explanation in itself. Unfortunately for the Humean, the additional claim that these regularities are *theorems* of the best system does not fill the explanatory gap. The constitution of the Humean mosaic is a thoroughly contingent matter, which *itself* lacks any explanation, it just *is*, and, crucially, could well be otherwise. So we lack an explanation as to why certain regularities are theorems of the best system and hence why the laws are what they are. Thus, nothing in this metaphysic ensures that the laws hold under precisely the range of counterfactual suppositions that we expect them to hold because nothing ensures the corresponding counterfactual invariance in matters of particular fact. So a law’s being a theorem of the best system does not explain that law’s support

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<sup>8</sup> Armstrong (1983), van Fraassen (1989), Carroll (1990)

<sup>9</sup> (2007:88-89)

<sup>10</sup> (2007: 89)



for counterfactuals. Similarly, that the laws are theorems of the best system does not help them explain their instances, because their instances are matters of particular fact, which rather serve to partially explain *which* regularities ought to constitute *the theorems*.

So the respect in which the concerns canvassed: that HBS laws fail to explain their instances and that they make a mystery of lawful counterfactual support, are related is as follows. Consider the regular interactions of charges, described by Charles-Augustin de Coulomb. Say this regularity has feature X: it is a theorem of the Humean best system and is hence considered a *law*. This feature, X, however, does not endow the law with the ability to explain why two *particular* charges, q1 and q2, feel a force described by Coulomb's law. This is because nothing in the information that the regularity obtains, or that it has feature X, makes it the case that q1 and q2 *must* interact in accordance with Coulomb's law; q1 and q2 may interact differently, or not at all, given Humean supervenience and an HBS account of laws. Sure, in such a case Coulomb's law would not be a law, but it is this *contingency* of HBS laws, in virtue of their dependence on their contingent instances (matters of particular fact), which deprives them of the ability to explain those instances and which makes lawful counterfactual support a mystery; because there is nothing to ensure the prevalence of the law in question in any given counterfactual scenario.

What we would seem to require of our feature, X, such that lawful support of counterfactuals is intelligible and lawful instances admit of an explanation, is that it endow those regularities that would be laws with an appropriate degree of counterfactual invariance and that it offer a *principled* account of this invariance. Contrast this requirement with Lewis<sup>11</sup>, who builds the laws' particular counterfactual invariance into the counterfactual by stipulating that invariance in his counterfactual semantics, which is to evade this meaningful request for an explanation<sup>12</sup>. If, however, feature X provided a principled account of regularity R's particular counterfactual invariance and hence its

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<sup>11</sup> (1973, 1979)

<sup>12</sup> See also Bird (2007: 48)

status as a *law*, then an explanation of the instances of R by appeal to the invariance and the reason for this invariance of the law that *implies* these instances, will be forthcoming. Furthermore, R will support the relevant counterfactuals because it will be assured that R will hold in other relevant possible worlds. It is thus the modal character of explanation, i.e., the idea that to explain something involves, to some degree, showing why it *must* be the case, that relates the issue of explaining lawful instances to that of accounting for lawful counterfactual support.

The fact that these two problems for HBS laws are so connected, I argue, shows that we should not seek to reduce or deflate the modal character of the laws. HBS accounts go wrong in the first instance by trying to respect Hume's dictum that there is no necessity in nature and hence that the laws are contingent. An account of natural law can only respect this contention at the cost of severing the link between laws and counterfactuals and between laws and explanation.

The scientific essentialist hopes to endow the laws with the requisite explanatory ability and to account for lawful support for counterfactuals by appeal to their central tenet that the laws hold in virtue of irreducible dispositional properties and are thus necessary. It is this necessity, then, and the account thereof, which specifies the exact counterfactual invariance of the scientific essentialist's laws. Strictly speaking, the law itself, considered merely as a regularity, does not do the explaining, but the scientific essentialist metaphysic underpinning the lawful regularities does<sup>13</sup>, or so it is hoped<sup>14</sup>.

The foregoing was a very brief treatment of a broad topic. It may be argued, for example, that HBS laws explain by *unifying*, since their status as theorems of the *best* system is dependent upon the *overall* pattern of regularities in the Humean mosaic<sup>15</sup>. It seems doubtful, however, that this strategy would prove

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<sup>13</sup> Bird (2007: 89-90)

<sup>14</sup> Lange disputes this. See below.

<sup>15</sup> E.g. Loewer (1996)

fruitful, since interconnectedness of contingent regularities would still fail to endow the resulting laws with the required counterfactual invariance, which, as argued, is of central importance to the issues of explaining lawful instances and accounting for lawful counterfactual support. My main aim in the foregoing, however, was to show that the respects in which it is argued that laws as contingent regularities are explanatorily anemic are very closely related. Thus, an alternative account of natural law ought not succumb to *any* of these deficiencies, which appear poised to viciously feed into one another.

### 2.3) Scientific Essentialism and Lawful Counterfactual Support

In this section I shall examine those features of a scientific essentialist metaphysic that it is hoped will account for the relationship between laws and counterfactuals. It will be argued, however, that the metaphysic fails to do the work required of it in some crucial respects. My criticism builds on that of Marc Lange<sup>16</sup> by showing how failure to account for lawful support of a class of particularly idiosyncratic counterfactuals has ramifications for an account for the laws' support for more commonplace counterfactuals too.

In response to the criticism of regularity accounts according to which HBS laws make a mystery of lawful counterfactual support, the regularity theorist typically maintains that similarity of laws carries some special weight in determining *closeness* of possible worlds<sup>17</sup>. But this, it has been complained, is ad hoc and unprincipled<sup>18</sup>. If Lange's concern goes through, however, the scientific essentialist would appear to have to resort to similarly ad hoc stipulation herself. Despite this, Lange thinks that scientific essentialism may nonetheless prove superior in other respects. But given the interconnectedness of the laws' ability to explain their instances and support counterfactuals, as argued above, I suggest that Lange's concern is somewhat more pressing than

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<sup>16</sup> (2004)

<sup>17</sup> Following Lewis (1973, 1979)

<sup>18</sup> Ellis (2001: 271)

he lets on. We should be concerned if an account of laws fails in *any* of the respects that proved troublesome for HBS laws.

The development of a scientific essentialist metaphysic is motivated by a desire to provide an account of natural law that *can* explain instances of general laws, which gets the order of explanation the right way around and which *can* explain the laws' distinctive relationship to counterfactuals. An account of laws as *holding in virtue of* essentially and irreducibly dispositional properties is hoped to be sufficient for the task at hand.

There is some subtle disagreement within the literature over how central a role natural kinds ought to be given in an account of the laws of nature. Natural kinds feature prominently in Ellis' metaphysic<sup>19</sup> while Bird seems to derive an account of laws with reference only to natural *properties*, and Bird *denies* that all natural properties are natural kinds and vice versa<sup>20</sup>. Lange specifically targets Ellis with his criticism, thus in articulating his concern I will lapse in to assuming the Ellisian view at times. However, in the interest of thoroughness, once the problem is on the table it will be useful to explicitly consider it in relation to the subtly different account of natural law provided by Bird (section 2.5).

A scientific essentialist account of natural law, articulated as neutrally between Bird and Ellis as possible, roughly amounts to the claim that the laws of nature hold in virtue of irreducibly dispositional properties and hence that the laws are metaphysically necessary. Bird rejects the idea that natural properties form a kind, since, he argues, the property negative charge, for example, does not form a class of things, it just *is* the property. Furthermore, the class of negatively charged *things*, including electrons, raindrops and balloons, is too diverse to form a kind<sup>21</sup>. The role of natural kinds is thus diminished on Bird's account because laws pertaining to natural kinds, electrons, say, obtain most fundamentally in virtue of the *properties* of those

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<sup>19</sup> (2002: 85)

<sup>20</sup> (2007: 208)

<sup>21</sup> Ibid.

electrons. Ellis, on the other hand, posits a hierarchical ontology of natural kinds encompassing natural kinds of properties and processes as well as natural kinds of substances, which he requires for his distinctive *physical realism*<sup>22</sup>.

Either way, it is hoped that a metaphysic according to which the laws hold in virtue of irreducibly dispositional properties (whether or not these properties also constitute kinds) will be such that an explanation of the laws' support for counterfactuals will be forthcoming.

Lange offers the following as an example of a counterfactual the lawful support for which *can* be explained by the scientific essentialist metaphysic:

- i) *If there had been an electron at spatiotemporal location L, then a negatively charged body would have been present at L.*

Lange concedes that an explanation is available for the support that the law *all electrons are negatively charged* lends to i). Bird, however, denies that *all electrons are negatively charged* is itself any kind of nomic fact<sup>23</sup>. Bird's claim is that while it is part of the essence of an electron that it is negatively charged, this is not a law of nature, just as it is no law of nature that water is H<sub>2</sub>O – water just is H<sub>2</sub>O. According to Bird, any *laws* pertaining to electrons will be derivative of the electron's essential properties – charge, mass, spin etc.

Given the controversial nature of i) it will be more instructive to consider how the laws yielded by scientific essentialism support counterfactuals like:

- ii) *If individuals, a and b, of negative charges, q1 and q2 respectively, were separated by distance r, then they would experience a repulsive force proportional to the product of the magnitudes of their charges and inversely proportional to r<sup>2</sup>.*

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<sup>22</sup> (2001, 2002, 2005a)

<sup>23</sup> Bird (2007: 208)

As it happens, the less trivial nature of ii) as compared with i) means that the explanation of lawful support for ii) purportedly offered by scientific essentialism will be brought into doubt by Lange's criticism. Thus, in what follows it will serve our interests to keep ii) in mind so we may appreciate the broader implications of Lange's otherwise seemingly narrow criticism.

Now let's see how this metaphysic is supposed to yield an explanation of the relationship between laws and counterfactuals, using ii) as our test case.

According to scientific essentialism, the dispositional property, charge, among others, cannot be reduced to a categorical property. So the behaviour of charged things cannot be explained by some categorical property of the thing in conjunction with a law of nature, which is the sort of metaphysic that gives rise to the view that laws are contingent. Rather, the dispositional property *charge* is taken to be fundamental and such that Coulomb's law holds *in virtue* of this property. Thus, any world at which Coulomb's law prevails is a world at which charge is instantiated and vice versa. At no world is there a counterexample to Coulomb's law, i.e. there is no possible world in which charge is instantiated but where charges are not disposed to interact in accordance with Coulomb's law. In this sense, scientific essentialism implies the metaphysical necessity of the laws<sup>24</sup>. And of more relevance to our purposes, it is this metaphysical underpinning of the laws that specifies their counterfactual invariance. As we shall see, however, the laws would seem to be invariant under a wider range of counterfactual scenarios than even this metaphysic is able to account for.

The antecedent of ii) stipulates two instantiated charges, q1 and q2. It is thus guaranteed, given scientific essentialism, that whatever else may be the case in the counterfactual scenario, Coulomb's law prevails because charge is instantiated. According to Coulomb's law, the force between charges is proportional to the magnitude of those charges and inversely proportional to

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<sup>24</sup> E.g. Bird (2007: 48-50)

the square of the distance between them, thus, *ceteris paribus*, the consequent of ii) is assured. Though a failure to build in relevant *ceteris paribus* clauses to the counterfactual *may* result in its falsity, it is argued against Humean regularity accounts that even with an appropriate amount of *ceteris paribus* qualification, conditionals like ii) may still be false because the HBS law's relationship to the counterfactual remains mysterious<sup>25</sup>.

Scientific essentialism endows the laws with metaphysical necessity in such a way as to ensure their invariance under an important range of counterfactual suppositions. Specifically, it assures the prevalence, in counterfactual scenarios, of those laws that hold in virtue of kinds or properties posited in the counterfactual antecedent. This, it is argued, is the sense in which scientific essentialism can account for the relation of support that holds between laws and counterfactuals. Hence it is suggested that scientific essentialism appropriately cashes out that property, X, in virtue of which a regularity is elevated to the status of law, such that lawful counterfactual support admits of an explanation.

What this metaphysic cannot do, according to Lange, is provide an account of the laws' support for such counterfactuals as

iii) *If two negative charges, q1 and q2, were separated by distance r, then atoms would still have been composed of protons and not schprotons*<sup>26</sup>.

iii) is highly assertable, if not *true*. But, according to Lange, there seems to be no specifically scientific essentialist explanation of why it should hold; absent is an explanation of the support between the laws and *this kind of* counterfactual. No specifically *essentialist* explanation is forthcoming as to why the roster of natural kinds should be invariant under the range of

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<sup>25</sup> Ellis (1999), Bigelow (1999: 50). Bigelow urges Ellis to explicitly embrace a *constitution* thesis, according to which conditionals constitute dispositional properties, as opposed to being merely entailed by them, since even the Humean could accept the latter by building enough into the *ceteris paribus* qualification (1999: 51-52).

<sup>26</sup> Which are like protons except half their mass.

counterfactual suppositions that it in fact is. Analogously, the regularity theorist would like to assert ii), but as discussed, HBS laws and the underlying Humean metaphysic would appear to lack the means to provide an explanation of *why* the law appealed to in support of ii) should remain invariant under the counterfactual supposition in question and hence of the HBS law's support for ii).

Of course, the essentialist can say that atoms are essentially composed of protons, not schprotons. But this just pushes the concern back a step; how can the scientific essentialist account for the truth of: *if two negative charges,  $q_1$  and  $q_2$ , were separated by distance  $r$ , then there would have still been atoms and not schmatoms*, where schmatoms are like atoms except for being composed of schprotons instead of protons. The general concern is this; scientific essentialism is unable to account for the counterfactual invariance of the kinds of things and properties that there are and hence of the prevailing laws. No counterfactual antecedent can posit anything in virtue of which it is a law that the roster of kinds is what it *actually* is, and yet the roster of kinds would seem to enjoy considerable counterfactual invariance. Scientific essentialism cannot, then, explain the *particular* relation of support in which the laws stand to counterfactuals and hence why counterfactuals like iii) should hold.

One may respond that it is unfair to demand that scientific essentialism be able to account for the laws' support of such eccentric counterfactuals as iii). However, the complaint has ramifications beyond this particularly niche respect in which scientific essentialism would appear explanatorily wanting. It is probable that Lange's criticism it is capable of bringing into doubt the ability of scientific essentialism to explain lawful support of counterfactuals like ii) and others common in scientific reasoning, since that there are protons and no schprotons is something held fixed when evaluating more common counterfactuals, like ii). If, however, a world did contain schprotons instead of protons, who knows what that world would end up like, or if it would be a world in which the consequent of ii) follows from the antecedent?



The scientific essentialist metaphysic is a holistic picture of interdependent fundamental entities and laws, which it is argued is more faithful to the modern scientific image of fine-tuned<sup>27</sup> laws and a dynamic ontology described by quantum mechanics<sup>28</sup>. My concern, then, is that a world with schprotons may not even be a world in which Coulomb's law is a law. Fixing the roster of kinds and hence laws is no mere *ceteris paribus* qualification, a requirement which may be embraced (see 2.4 below). I take *ceteris paribus* qualifications to rule out the hampering of the prevailing-law-in-question's characteristic manifestations in such a way that its support for the counterfactual is not reaped, as opposed to simply ensuring the prevalence of the law, which is a job for our *metaphysic*. It seems plausible, given scientific essentialist sympathies, that worlds with alien kinds and laws might not even *possibly* admit the law posited by our counterfactual antecedent. If this is right, then the scientific essentialist metaphysic cannot even explain why the law appealed to is consistent with, and hence prevalent at, the world in which our counterfactual is evaluated, and this is precisely what it was invoked to do.

Lange considers a response according to which the specific roster of natural kinds at a world obtains in virtue of the natural kind the world is *considered as a whole*. But not only does this attempt to find *something* in virtue of which it is a law that there are the kinds that there are seem futilely ad hoc, it still requires some assurance that the counterfactual antecedent directs us only to *worlds like ours*, which would appear to be an intolerable mere evasion of the problem of counterfactuals. As Lange puts it, when I say '*if two charges had been separated by a distance  $r$ , they would have felt a force...*' I do not mean, '*if two charges had been separated by a distance  $r$  and the world had been of the same kind it actually is...*' Similarly, when I say '*if I had struck the*

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<sup>27</sup> I use 'fine-tuned' in a non-technical sense for the idea that any change in fundamental physical laws, e.g. gravity, the strong nuclear force, etc., would likely lead to a drastically different universe. Or, to change these laws and maintain a universe that superficially resembled our universe would require the alteration of a whole host of other laws to compensate.

<sup>28</sup> Ellis (2001: 52)

*match, then it would have lit*', I do not mean '*if I had struck the match **and kept it dry**, it would have lit*'. The challenge is to say *why* the match would still have been dry and *why* the world would have been of the same *kind* (in Ellis's metaphysically loaded sense of *kind*) as ours in fact is<sup>29</sup>. We cannot build such facts into the antecedent, which would be to evade this meaningful challenge to the notion of counterfactual support. Indeed such stipulation on the part of the essentialist would appear vulnerable to the very concern leveled at the regularity theorist, according to which it is unprincipled to stipulate that large-scale sameness of regularity in matters of particular fact (laws) ought carry some special weight in determining similarity between worlds for the purposes of counterfactual evaluation.

In their replies to Lange, Ellis (2005) and Handfield (2005) both suggest that sameness of natural kinds *will* contribute significantly to similarity between worlds. On a Stalnaker-Lewis account, when evaluating counterfactuals at the actual world we should look to the closest possible world to the actual one in which the antecedent is realized and see if the consequent holds. The present suggestion, then, is that worlds comprising natural kinds, schprotons etc., not found at our world, are *further away* from the actual world than worlds comprising only those kinds present at the actual world. This justifies our keeping the roster of kinds fixed under a *wide range* of counterfactual suppositions, namely that range of suppositions which directs us to worlds within some set of worlds that are relevantly similar to ours. However, that sameness of kinds and hence sameness of prevailing laws contributes significantly to similarity again does not seem to be something that can *itself* be explained by the essentialist dictum that laws hold in virtue of natural kinds/ dispositional properties. No specifically essentialist metaphysic is required to explain why worlds with the same natural kinds or properties are closer than those with different kinds or properties. To just build a stipulation on similarity ordering into the essentialist metaphysic would be as ad hoc as the essentialist accuses the Humean of being.

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<sup>29</sup> Lange (2004: 231)

One may feel inclined to push harder the obvious response; that it is just asking too much of *any* metaphysic that it be able to account for lawful support of counterfactuals like iii). But as it happens, the preceding concern seems closely related to another leveled at scientific essentialism. Khalidi<sup>30</sup>, following Levin<sup>31</sup>, contends that the metaphysical necessity of the laws according to scientific essentialism lacks substance so long there is a plethora of possible worlds, with different natural kinds and hence *laws* to those found at the actual world. Consideration of these issues will lead me to prescribe the denial of alien kinds as a supplement to scientific essentialism. The details of this proposal shall be explored in the next part, but first I want to consider the Lange concern from the perspective of Bird's account of natural law, which does not explicitly reference natural kinds.

#### 2.4) Dispositions and Laws

Whereas on Ellis' account natural kinds are given a central role: "*the laws of nature are explications of the essential properties of the natural kinds*"<sup>32</sup>, it is not obvious that they play *any* role on Bird's account. Elsewhere Bird tentatively advocates realism about natural kinds, pointing to the difficulties that arise in the attempted reduction of sentences with *prima facie* reference to natural kinds<sup>33</sup>. But natural kinds play a reduced role on Bird's account of *natural law* given his view that they are something like clusters of sparse properties; properties which are not themselves natural kinds, and that it is these *properties* in virtue of which the laws hold. Since Lange's concern is articulated with reference to natural kinds it will be instructive to consider it from Bird's perspective, with an apparently diminished role for natural kinds, before considering it in relation to the issue raised by Levin and Khalidi.

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<sup>30</sup> (2009)

<sup>31</sup> (1987)

<sup>32</sup> Ellis (2002: 85). This is a result of Ellis' more inclusive notion of natural kinds.

<sup>33</sup> Bird (2012)

According to Bird's *dispositional essentialism* no two worlds could be identical with respect to instantiated properties and yet differ with respect to the prevailing laws. Bird thus derives the natural laws not from natural kinds that are essentially characterized by their dispositional properties, as Ellis does, but from the dispositional properties *themselves*.

Prior to the derivation of the laws from dispositional essentialism, we may consider a *potency*<sup>34</sup> P with its dispositional essence. Let P stand for *negative electric charge*. The bearer, *x*, of P is disposed to give some characteristic manifestation **m** (acceleration) in response to characteristic stimulus **s** (moving to within close proximity of a distinct charged object). Bird posits a relation of necessary equivalence between dispositions and certain characteristic counterfactual conditionals<sup>35</sup> such that a dispositional property will imply the truth, in all possible worlds, of a class of conditionals, given the appropriate *ceteris paribus* qualifications.

Thus, the ascription of a dispositional property, say P, to an individual *x* implies that necessarily (*if x were to acquire stimulus s in circumstances c then x would yield m*)<sup>36</sup>. Where **c** comprises the relevant *ceteris paribus* conditions such that the disposition is not hampered<sup>37</sup>. The possibility of finks and antidotes that would prevent dispositions from displaying their characteristic manifestations, and hence the potentially infinite conjunction that could comprise **c**, posed a serious problem for the Humean's attempted *analysis* of dispositions in terms of counterfactuals. But the dispositional essentialist is not trying to analyse dispositions away. The result that dispositions cannot be completely analysed in terms of conditionals is embraced then, and it suffices for Bird's purposes simply to invoke conditionals to characterize those irreducible dispositions that constitute the ontological bedrock. What is more, since the laws hold in virtue of dispositions, those finks and antidotes that must be excluded correspond to the *ceteris paribus* clauses in otherwise

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<sup>34</sup> Essentially dispositional property (2007: 45)

<sup>35</sup> (2007: 43)

<sup>36</sup> (2007: 45)

<sup>37</sup> (2007: 60)

universal law statements and thus the dispositional essentialist can account for the *ceteris paribus* nature of the laws<sup>38</sup>.

The laws may be derived from dispositional essentialism and shown to hold of metaphysical necessity as follows. Take any individual  $x$  that bears potency  $P$ . The conditional characterization of  $P$  allows us to infer that if  $x$  were to acquire stimulus  $s$  in circumstances  $c$  then  $x$  would yield manifestation  $m$ . Since  $x$  is arbitrary we may generalize such that *for all*  $x$ , if  $x$  bears  $P$  and if  $x$  were to acquire stimulus  $s$  in circumstances  $c$  then  $x$  would yield manifestation  $m$ . We now have a universal statement that is not accidental and so is lawful. Furthermore, since potencies have their dispositional essences in all possible worlds, the lawful generalization holds in all possible worlds, that is, of *metaphysical necessity*<sup>39</sup>.

## 2.5) Dispositional Essentialism and Counterfactual Support

How, then, does Bird's account of natural law, with reference only to potencies, fare in the face of Lange's concern, phrased in terms of natural kinds? Recall the counterfactual

- ii) *If two individuals,  $a$  and  $b$ , of negative charges,  $q_1$  and  $q_2$  respectively, were separated by distance  $r$ , then they would experience a repulsive force proportional to the product of the magnitudes of their charges and inversely proportional to  $r^2$ .*

Bird's account of laws as derivable from the dispositional essences of properties allows us to account for the laws' support for ii); it allows us to explain *why* in the counterfactual situation considered the relevant laws would a) be invariant and b) given their prevalence, *ceteris paribus*, ensure the truth of the conditional. The potency, *charge*, is such that if two individuals,  $x$  and

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<sup>38</sup> (2007: 60)

<sup>39</sup> Bird (2007: 46, 48)

$y$ , were each to have this property and come in to close proximity of each other (acquire stimulus  $s$ ), they would feel a force described by Coulomb's law (yield manifestation  $m$ ). Charge is *essentially* such that distinct charged objects interact in accordance with Coulomb's law, i.e., charge has its dispositional essence in all possible worlds. Since  $x$  and  $y$  are arbitrary, we can generalize and say that if *any* two charged individuals, including  $a$  and  $b$  as posited by the antecedent of ii), were to come in to close proximity of each other (acquire stimulus  $s$ ), they would feel a force described by Coulomb's law (yield manifestation  $m$ ). And it is in this way that the general law lends support to the counterfactual. The fact that the antecedent posits two individuals with the property *charge* ensures that the general law prevails in the counterfactual situation because it prevails if and only if the property is instantiated.

Now reconsider iii):

*If two negative charges,  $q_1$  and  $q_2$ , were separated by distance  $r$ , then atoms would still have been composed of protons and not schprotons.*

Again, dispositional essentialism supposedly explains why the antecedent of iii) directs us to a world in which Coulomb's law holds, because according to that view charge is essentially such that distinct charges interact in accordance with Coulomb's law. Hence any world in which charge is instantiated is one in which Coulomb's law prevails. But dispositional essentialism cannot *itself* explain why iii) ought to be evaluated at a world with the same roster of natural kinds as ours, i.e., a world in which there are no schprotons.

The point can be made more perspicuous if instead of stipulating that schprotons are half the mass of protons we stipulate instead that they are positively *schmcharged* as opposed to being *charged*. Where schmcharge is like charge except that schmoulomb's law holds in virtue of schmcharge. Schmoulomb's law is like Coulomb's law except it is inverse *cubically*

quantified, such that the force between schmcharges decreases with the inverse cube of the distance between schmcharged individuals. The point, then, is that a dispositional essentialist account of laws cannot explain why the roster of kinds nor *potencies* is invariant under the counterfactual antecedent of iii). That the antecedent directs us towards a world with charge and hence where Coulomb's law prevails is consistent with that world also being such that schmcharge is instantiated and hence such that schmoulomb's law prevails. Schmoulomb's law is no counterexample to the necessity of Coulomb's law since it holds in virtue of schmcharge, not charge. Thus Lange's point remains; there is no specifically dispositional essentialist explanation of the laws' support for counterfactuals like iii). In order to account for the truth of iii), the dispositional essentialist will have to resort to stipulation of some similarity ordering between worlds, which *itself* cannot be justified by appeal to the fact that laws hold in virtue of essentially dispositional properties.

## 2.6) More on Counterfactual Support

The inability of scientific essentialism to explain the counterfactual invariance of those *very things* in virtue of which the laws hold is concerning. It implies an inability to explain the counterfactual invariance of the conjunction of the prevailing laws. The counterfactual invariance of the laws in this broadest sense, I argue, is required to account for the relation of support in which any given law stands to those counterfactuals we would take it to imply (section 2.3 above).

That laws support counterfactuals, whereas non-lawful regularities do not, is a platitude. Scientific essentialism promised to succeed where regularity theories failed by *explaining* this support. But any such explanation would seem to, at least partially, depend upon the absence of any alien laws in counterfactual scenarios.

The problem can be characterized epistemically by showing how *justification* of our beliefs delivered by science depends upon the fact that laws support counterfactuals. Stated thusly, the present concern undermines scientific essentialism's motivation by calling into question its relevance to actual scientific practice and contesting its claim to suitability as a metaphysic for scientific realism.

Ellis proclaims scientific essentialism's aptness as a metaphysic for scientific realism, arguing that it describes how the world must be in order for our best scientific theories to be true; he thus maintains that it accords with actual scientific practice better than the alternatives. According to Ellis, given the kind of world that science is revealing to us; one whose fundamental nature is *holistically* described by quantum mechanics, a '*dynamic ontology*' is required. Such ontology requires that we assume "*that there are fundamental processes of various kinds that are not just sequences of instantaneous point events whose identities are independent of the processes in which they are involved*"<sup>40</sup>. So, contra the Humean world view of loose and separate matters of particular fact; a view that failed to explain lawful support of counterfactuals, and given the kind of world that science is revealing to us, we are to picture the kinds of things that there are as causally connected via the laws that hold in virtue of their essential dispositional properties. The essentialist metaphysic is motivated by a desire to acknowledge the causal interdependence of events that science reveals and hence to ground the justification for beliefs that science provides. Contrast this with the Humean metaphysic; science may tell us that light will follow a curved path around massive objects, but the belief that this *will* happen is in no way supported by a metaphysic according to which all there is, is a vast mosaic of loose and separate matters of particular fact. However, if belief in the counterfactuals implied by causal connectedness cannot in fact be justified by appeal to the essentialist metaphysic, then it is far from obvious that scientific essentialism is really any better placed than Humeanism to provide a metaphysic that

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<sup>40</sup> Ellis (2001: 52)



explains the justification we have for belief in the predictive and explanatory powers of our best science.

As argued above (2.3), I am concerned that scientific essentialism's inability to explain lawful support for those counterfactuals whose truth requires the counterfactual invariance of the roster of kinds implies an inability to explain lawful support even of everyday counterfactuals, whose consequents do not explicitly postulate an absence of alien kinds. Insofar as these 'everyday' counterfactuals are implied by science, the result is that essentialism fares no better than Humeanism when it comes to explaining the justificatory warrant that science provides for our beliefs. Our *prima facie* justification for belief in many counterfactuals derives, I submit, from the belief that the prevailing laws are invariant under a wide range of counterfactual suppositions. But, as we have seen, the scientific essentialist metaphysic *itself* cannot explain why the worlds at which we evaluate counterfactual antecedents should be ones that do not differ from the actual world with respect to kinds present and hence the prevailing laws.

We would like our scientific essentialist metaphysic to *justify* a belief in **C**: *if two individuals, a and b, of charges q1 and q2 respectively were close to each other, then they would feel a force described by Coulomb's law*, by explaining lawful *support* of **C**. But, in light of the foregoing considerations, we may question what exactly our justification for believing **C** has to do with a scientific essentialist metaphysic? The fact that our metaphysic says nothing about what kinds and properties and hence *laws* may be present in other possible worlds appears to deprive it of the ability to provide proper justificatory grounds for belief in **C**.

Our justification for believing **C** derives in part from our imagining a world like ours with respect to the roster of natural laws, in which the effects of Coulomb's law are well documented and corroborated. But if nothing in our metaphysic ensures that the roster of natural laws will in fact be the same under counterfactual suppositions, then *as far as our metaphysic is concerned*

the world,  $wI$ , at which **C** is evaluated may well have some additional, very peculiar, prevailing laws, which are such as to make it false that the two individual charges in close proximity feel a force as described by Coulomb's law. Intuition cannot be held as a reliable guide to the goings on in such cases. Besides the possibility that Coulomb's law may be *inconsistent* with the laws of  $wI$ , a world with different prevailing laws may be such that, although charge is instantiated, interactions in accordance with Coulomb's law are consistently hampered, such that counterfactuals like **C** are always false. Maybe in such a world charge is *finkish*, or antidotes to the dispositional property *charge* abound to the extent that no amount of *ceteris paribus* clauses would suffice to ensure the truth of the conditional. The problem is that the essentialist metaphysic *itself* is lacking because a major justifying factor for our belief in **C**, I have argued, is the further belief that in the counterfactual situation the set of laws is the same as at the actual world. And whatever justifies *this* belief, intuitions on a similarity ordering or the like, is *not* grounded in the scientific essentialist metaphysic.

## 2.7) Absolute Necessity

It appears then that the essentialist metaphysic struggles to explain the laws' particular support for counterfactuals. This implies that the essentialist metaphysic itself cannot provide a full justificatory ground for our belief in counterfactuals, which in turn threatens to undermine its motivation.

That Lange's concern cannot simply be dismissed as placing too stringent a requirement on an account of natural law should be becoming evident from the fact that it threatens to undermine an essentialist explanation of lawful support even for *everyday* counterfactuals, common in scientific discourse. But there is another, closely related, concern, which I argue ought push the scientific essentialist to adopt *modal necessitarianism*<sup>41</sup>, as a result of denying

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<sup>41</sup> Schaffer (2005) and Wilson (2012)'s name for the view that all possible worlds are identical with respect to their laws.

the general possibility of any kinds or properties not present at our world. Further, independent, reasons in favour of modal necessitarianism shall be presented in part 3.

Levin (1987) and Khalidi (2009) maintain that there is no substance to the scientific essentialist's claim that the laws are necessary<sup>42</sup>. While essentialism implies the lack of a counterexample in any possible world to charges interacting in accordance with Coulomb's law, it says nothing about the possible behaviour of *schmcharged* objects.

Taking a few steps back for a moment, the dialectic between the necessitarian and the contingentist goes something like this. The necessitarian maintains that the laws of nature are necessarily thus and so; that in all worlds in which those things to which the laws pertain are instantiated, the laws prevail and are quantified as they are at the actual world. The contingentist, on the other hand, maintains that the laws may fail to hold, even in worlds in which those things to which they pertain in the actual world are instantiated and a given law may be differently quantified across different worlds. The contingentist will typically claim that she can conceive of the force between charges being proportional to the inverse *cube* of the distance between them, or that she can conceive of a situation in which no law governs charge and hence that Coulomb's law is metaphysically contingent. A typical necessitarian retort will be to challenge the contingentist assumption that it is indeed *charge* that is picked out in the other possible world. The intuition, according to the necessitarian, if anything tells in favour of its being possible that *some property* be governed by an inverse cubically quantified law. For reasons similar to those that Kripke offers in favour of, e.g., gold's necessarily having atomic number 79, the scientific essentialist maintains that charge is necessarily such that distinct charges interact in accordance with Coulomb's law, to merely assume that there are charges in another possible world that interact in accordance with an inverse cubically quantified law will be to beg

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<sup>42</sup> Levin comes to this conclusion after imagining how Kripke's arguments for the necessary a posteriori may be extended to the domain of natural laws. But the point applies to the scientific essentialism presently discussed, as Khalidi shows.

the question against the essentialist. Fine acknowledges this point, with the example of mass, when he says:

*“For how can we be sure that the hypothetical situation in which an inverse cube law is envisaged to hold is one in which the bodies genuinely have mass? Perhaps they have some other property somewhat like mass, call it schmass, which conforms to an inverse cube law.”*<sup>43</sup>

However, Even if the contingentist is pressured to rephrase her objection in terms of schmcharge and schmoulomb’s law, it is far from clear that the criticism loses any of its intended bite. Indeed the mere terminological dispute does little to challenge the anti-essentialist claim. As Khalidi puts it:

*“The possible world that anti-essentialists describe is a mere notational variant of the one that scientific essentialists deem to be impossible.”*<sup>44</sup>

For the same reasons as those discussed by Lange in the context of counterfactual support, it now becomes apparent that the essentialist is ill equipped to deny the possibility of a qualitatively identical possible world to that which the contingentist claims constitutes a counterexample to the laws’ necessity. The essentialist has no means of denying the possibility of schmcharges interacting in accordance with schmoulomb’s law, because nothing in the essentialist metaphysic rules out the possibility of schmcharged objects.

Ellis contends that the anti-essentialist lacks good reasons for thinking that there could possibly be some property *schmcharge* such that schmcharged objects are disposed to interact in accordance with *schmoulomb’s law*<sup>45</sup>. Indeed, Ellis argues that one’s belief in such a possibility must stem from the

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<sup>43</sup> (2002)

<sup>44</sup> (2009: 92)

<sup>45</sup> In part 3 I argue that much more can be said in favour of this broad sentiment.

belief that Coulomb's law and other laws of nature are contingent and so, he maintains, the contingentist begs the question against the scientific essentialist in this respect<sup>46</sup>. But as has been emphasized, scientific essentialism *itself* cannot tell against the possibility of alien kinds and properties like schprotons and schmcharge and so cannot tell against the possibility of alien laws. Thus no anti-essentialist assumption must be made and so no question begging must be employed in order to argue that there is a possible world in which schmoulomb's law governs schmcharged objects. Indeed, elsewhere Ellis concedes that there *might* be worlds in which there are dispositional properties of other kinds,<sup>47</sup> an admission that completely undermines the above retort. So as it stands we lack any good reasons for denying the possible worlds that the contingentist stipulates. And the fact that these worlds are mere notational variants of those that the essentialist deems impossible, would appear to deprive the essentialist claim that the laws are absolutely necessary of the required substance.

On the one hand we can imagine the contingentist pointing to a world in which individuals with a property very much like charge are disposed to interact in accordance with a law very much like Coulomb's law, except that this law is inverse *cubically* quantified. In virtue of this possibility the contingentist may claim to have provided a counterexample to the necessity of Coulomb's law's being thus and so. While on the other hand the essentialist simply denies the pertinence of this possibility to his claim that Coulomb's law is necessary. But arguably it is difficult to see what else it could *mean* for Coulomb's law to be contingent than for there to be a world like the one pointed out by the contingentist. The best the essentialist can do here is to agree to disagree with respect to what is *meant* by the laws' modal status. But then there is nothing to arbitrate between the differing modal semantics of the contingentist and the essentialist. Indeed it would appear that one could adopt the essentialist metaphysic and yet allow that the laws are contingent in virtue of the prevalence of worlds with alien kinds and laws just slightly different to those at the actual world. But then scientific essentialism runs the risk of

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<sup>46</sup> Ellis (2001: 257)

<sup>47</sup> Ellis (2001: 48)

doing little more than taking a meandering metaphysical detour only to arrive back at a position without the desired distance from Humeanism and thus presented with the familiar problems engendered by that view.

The issue can be considered in light of a line of argument in favour of counterpart semantics for *de re* modalities. Against Lewisian counterpart semantics and in favour of transworld identity, Kripke questioned the relevance of Humphrey's counterparts to the issue of whether or not *our* Humphrey could have won the election<sup>48</sup>. Kripke wishes to maintain that it is possible that Humphrey won only in virtue of *his* winning at some other possible world; whereas whether or not some similar man in another possible world won is irrelevant to what is possible for *Humphrey*. Counter to this, one may reason as follows. Just as an architect may show what is possible for a house, say the feasibility of a loft conversion, by building a scale model, so may we say what is possible for individuals at the actual world by reference to what is true of their counterparts at other possible worlds. It seems reasonable to maintain that certain structural similarities between the scale model and the actual building make it true that the house could sustain a loft conversion. So contra Kripke, what *is* true of individual *b* who is distinct from individual *a*, could nonetheless be relevant to *a* in some way, namely insofar as we are concerned with *a*'s modal properties. Analogously, it seems reasonable to maintain, that what is possible for individuals at the actual world is so in virtue of how their counterparts are at other possible worlds<sup>49</sup>. But if what is possible for the house is so in virtue of how the scale model actually is and if Humphrey *could* have become president in virtue of his counterpart's being president at some nearby possible world, then plausibly Coulomb's law *could* have been differently quantified, i.e. it is *contingently* thus and so, in virtue of some relevantly similar law, which *is* differently quantified at some other possible world.

The Kripkean retort available to the essentialist in this contention would of course involve denying the relevance of some distinct law at another possible

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<sup>48</sup> Kripke (1972/1980)

<sup>49</sup> Lewis (1968)

world to what is possible of an actual law at our world. Or saying that an inverse cubically quantified law, schmoulomb's law governing schmcharge, bears *no* relevant similarity to Coulomb's law, so it is not the case that Coulomb's law is only contingently thus and so in virtue of how schmoulomb's law *is*. Similarly, the essentialist may be unmoved by the contingentist pointing out a possible world that is a 'mere' notational variant of one that she claims is impossible, for the essentialist could argue that there is no 'mere' about it. But then we have a stalemate. To some it will seem that a plethora of possible worlds with prevailing laws slightly different to those at the actual world will deprive the essentialist's claim that the laws are necessary of substance, while others will deny any relevance of these possible laws to the modal status of the actual laws. But brief consideration of why the essentialist would wish to include amongst the wares of her argument by display the absolute necessity of the laws should convince us that a stalemate on this issue is undesirable.

As discussed, much of the motivation for developing a scientific essentialist metaphysic and account of natural law comes from documenting the problems with the alternative Humean account<sup>50</sup>. With these problems in mind, the viability of scientific essentialism is increased to the extent that it distances itself from the Humean alternative. It would be most unfortunate, then, to point out all of the problems for the Humean metaphysic only for the proposed alternative to turn out to be similarly susceptible to these problems, whilst taking a somewhat meandering metaphysical detour. Thus, the result that the laws are metaphysically necessary is an attractive feature because it serves to distance scientific essentialism from Humeanism. The distance between the opposing views is lessened to the extent that the essentialist claim that the laws are metaphysically necessary lacks substance. And insofar as this distance is diminished, it becomes more likely that scientific essentialism will succumb to the criticisms leveled at Humeanism. Thus, from the perspective of the scientific essentialist, if her view cannot arbitrate, and if there is no other way of arbitrating between different sides of the stalemate outlined

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<sup>50</sup> And to a lesser extent the nomic necessitation view of Armstrong.

above, then her argument by display is weakened. However, in what follows I shall argue that there is indeed a means of arbitrating this stalemate in favour of essentialism.

## **Part 3**

### **3.1) Introduction**

In this part I urge the scientific essentialist to supplement her view by denying the possibility of alien kinds. The possibility of alien kinds is integral to the concerns of the previous section, so if there are no such possibilities then these concerns do not arise. As it stands this proposal is vague. In what follows I shall offer a principled context in which to deny these troublesome general possibilities. Furthermore, I shall argue that the scientific essentialist is particularly well placed to embrace this context and hence that my proposal is no mere ad hoc patch that could be just as easily applied to the leaky Humean picture. I conclude with some general remarks in support of the resulting necessitarianism.

### **3.2) What is Really Possible?**

In light of the forgoing considerations I urge the scientific essentialist to acknowledge the damaging implications of *merely* possible alien kinds for her view, and to maintain that, despite appearances to the contrary, there are no such possibilities.

It need not be conceded that the alien kinds and resultant laws appealed to by Lange, Levin and Khalidi are metaphysical possibilities. What is more, the denial of such possibilities need not be motivated *merely* by a desire to block



objections to scientific essentialism. There are some good independent considerations that tell against the possibility of schprotons and their ilk, which I shall go on to discuss in some detail. But most generally, I suggest that the haste with which some are keen to admit all sorts of exotic possibilities stems from an outdated view of *conceivability* as a reliable guide to possibility and hence of possibility as *cheap*. But this conception of possibility is one that we need not accept. And indeed there are good reasons to reject it. For example, Ruth Barcan Marcus maintains that:

*“Modalities in their primary use concern counterfactuals about actual objects, and to reintroduce possibilities is to run counter to the admonition of Russell that we ‘retain our robust sense of reality’”*<sup>1</sup>.

A plausible interpretation of Marcus here, and one very much in a scientific essentialist spirit, garners that philosophical interest in modality should be concerned with the way the *actual* things could be differently configured.

Given scientific essentialism, we may come to know the way things could or could not be via *science*, which is centrally concerned with uncovering the essences of the most fundamental constituents of reality. From this, we can infer the universal laws, and it is in *this respect* that we should be concerned with matters modal, since it is these laws that *really* tell us how things could or could not possibly be and which guide our counterfactual judgements.

Thus, real possibilities are constrained by how the actual things could possibly be and our modal discourse can be thought to be true or false in virtue of what is *really* possible for actual things, as opposed to what we can *imagine* to be the case.

Adherence to the Russellian admonition (with respect to modality) that we retain a robust sense of reality<sup>2</sup> should come naturally to the scientific essentialist, according to whom the actual things are of central importance to what is really possible in virtue of their essential and irreducible dispositional

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<sup>1</sup> Marcus (1995). Also see Russell (1919:152).

<sup>2</sup> See Russell (1919), Simchen (2006, 2013).

properties<sup>3</sup>. The scientific essentialist will accordingly *deny*, e.g., that there is a possible world in which two electrons feel a repulsive force that is inversely proportional to the *cube* of the distance between them. The reasoning behind this makes no appeal to what is or is not *imaginable*; rather it is the *essence* of electrons, which prohibits any such possibility. Thus the scientific essentialist should resist sweeping assertions of possibility with no *witness* in what is possible for some tangible part of actuality, since her actuality provides the most principled restriction on possibility.

So modality *de re* is to be given primacy over modality *de dicto* in the order of metaphysical explanation, with the implication that possibility in general depends upon what is possible for the actual things. This then provides justification for denying the general possibility of alien kinds, because these purported “possibilities” have no *witness* in actuality, robustly construed – *nothing* is a possible schproton. Marcus also suggests, in the passage above, that when we think of possibility as cheap, and thus as having nothing to do with the way the actual things are, we must resort to talk about *mere possibilia* in order to ground such possibilities, which is to engender commitment to peculiar metaphysical postulates with no relation to a robust reality<sup>4</sup>. Thus, if commitment to metaphysical entities makes us uncomfortable, then we may deny the possibility of schprotons and other alien kinds in the interest of resisting an appeal to mere possibilia.

By contrast, certain non-actual *relational* kinds, for example, such as the possibility that I own a car, will not be ruled out by these strictures, nor will they demand recourse to mere possibilia, since any of the *actual* cars may stand in as a possible car of mine<sup>5</sup>. So to reiterate, it is suggested that the constituents of the actual world sustain real possibilities and insofar as a purported possibility is not so sustained, it constitutes no possibility at all. We

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<sup>3</sup> Compare this to the Humean who denies that there is any necessity in nature and maintains that everything is, at bottom, categorical.

<sup>4</sup> Ellis (2001: 40) makes a similar point, according to which if we deny that natural necessities exist in the actual world then short of denying natural necessity altogether, we must find a basis for them in some *other* reality.

<sup>5</sup> Well, a Porsche may not even be a *possible* car of mine!

thus have a reason to deny the possibility of alien kinds: because these purported possibilities are not sustained by actuality, and science, concerned as it is with the actual world and its constituents, is given a central standing in the epistemology of modality.

I argue, then, that the spirit of scientific essentialism warrants a commitment to instances of *the Barcan Formula* (BF):  $\diamond\exists xAx \rightarrow \exists x\diamond Ax$ <sup>6</sup> as a metaphysical principle, interpreted such as to imply the *impossibility* of alien kinds. In what follows I shall develop this idea with more rigor by presenting some logical and metaphysical considerations in favour of a commitment to instances of (BF) and by discussing the fullest context in which (BF) may imply the impossibility of alien kinds. Insofar as these considerations are independently plausible, the scientific essentialist will have a principled context in which to deny those possibilities that proved problematic for her view. But first I shall give a provisional sketch of how the impossibility of alien kinds is to overcome the concerns of the previous section.

### 3.3) A Response to Lange, Levin and Khalidi

Recall Lange's concern was that scientific essentialism could not account for the particular relation of support in which the laws stood to counterfactuals because it could not *itself* explain why it is true that *if there had been an electron at spatiotemporal location L, atomic nuclei would still have contained protons and not schprotons*. But the current proposal (of which the above is just a brief sketch, the remainder of this essay shall comprise the details) is, contrary to Lange's assumption, that there are no metaphysically possible worlds at which there are schprotons, or any other alien kinds for that matter.

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<sup>6</sup> In words: *if it is possible that something satisfy a condition, A, then something possibly satisfies A.*

The general possibility of schprotons, say, has nothing to do with possible configurations of the actual things, and so may reasonably be denied in the interest of avoiding an appeal to exotic mere possibilia and hence losing grip on a robust sense of reality in matters modal. Hence, *if there were an electron at L* atomic nuclei would not have contained schprotons because it is not possible that there be such things as shprotons. No question arises as to why the counterfactual antecedent should point us to worlds without schprotons because *all* worlds lack schprotons. So there really is no burden of explanation on the scientific essentialist because there is nothing to explain.

According to scientific essentialism, the laws hold *in virtue* of the essential dispositional properties of natural kinds. So if there is no possibility in which there are natural kinds other than those that there actually are<sup>7</sup>, then there is no possibility in which there are any laws other than those that there actually are. The current proposal addresses the concern of Levin and Khalidi by doing away with the possibility of laws different from those in actuality, in virtue of which it would seem that the laws are really only contingently thus and so. The scientific essentialist ontology implies that the laws admit of no counter examples, which in conjunction with the impossibility of alien kinds implies the absolute necessity of the laws.

In what follows I shall explore in detail the context in which to deny the possibility of alien kinds. This will involve looking at arguments for The Barcan Formula as a metaphysical principle and candidate semantics that would underpin such commitment. Once these details are in place I shall be able to address more fully the question of how the proposed principled denial of alien kinds is to address the concerns of Lange, Levin and Khalidi.

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<sup>7</sup> Presumably some instantiated alien *property* would constitute an alien kind. Thus the argument can be framed with reference to natural/alien kinds and remain relevant to Bird's account of natural law with its emphasis on properties over of kinds. Bird nonetheless thinks it likely that properties will lawfully be instantiated in particular clusters, with precise boundaries at the fundamental level, and that this lawful pattern of coinstantiated properties will correspond to a natural kind ontology (2007: 208).

### 3.4) The Proper Context of Necessitarianism

Prior to any detailed semantic considerations, the conjunction of three highly attractive theses: actualism, essentialism and The Barcan Formula, would seem to imply the impossibility of alien kinds and thus would appear to constitute a principled context in which to deny their possibility.

The Barcan Formula is derivable from the simplest, most sensible axiomatization of quantified modal logic<sup>8</sup> and was first introduced as a schema by Ruth Barcan Marcus<sup>9</sup>. Essentialism is just the familiar (given our broader concerns) and plausible view that there are some properties of some things that those things could not possibly lack. Actualism is the view that *everything is actual*, where the scope of *everything* is completely unrestricted. Thus actualism amounts to the claim that there is no division of existence into modes, contrary to *possibilism*, according to which the mode of existence of some things is that of actually existing whereas others exist, but merely possibly. Given good metaphysical and logical reasons for a commitment to instances of the Barcan Formula<sup>10</sup>, the intuitive appeal of actualism, and a prior commitment to essentialism, the scientific essentialist would appear to have a good context in which to deny the possibility of alien kinds.

Consider the Barcan Formula:

$$(BF) \diamond \exists xAx \rightarrow \exists x \diamond Ax$$

Letting *A* stand for ‘is a schproton’, then in words (BF) says: *if schprotons are possible then something is a possible schproton*. In this instance the consequent of (BF) asserts the existence of something with the modal property of *being a possible schproton*.

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<sup>8</sup> Linsky and Zalta (1994), Williamson (1998)

<sup>9</sup> Marcus (1946)

<sup>10</sup> There are of course controversies surrounding the Barcan Formula, which I discuss below.

When *nothing* satisfies a condition,  $\phi$ , which cannot be satisfied contingently, commitment to the relevant instance of (BF), in conjunction with actualism implies the general *impossibility* of a  $\phi$ . Since *kind membership* cannot be born contingently<sup>11</sup>, (BF) implies the impossibility of any kinds of thing other than those that there *actually* are. Hence, assuming there are in fact no schprotons and given that schprotonhood cannot be born contingently, it is not the case that there exists a possible schproton – any possible schproton would have to be an actual schproton, contrary to our original stipulation that there are no schprotons. Thus, from (BF) and *Modus Tollens* we can infer that it is not the case that there could have been schprotons, because nothing satisfies the consequent of (BF) in this instance.

In conjunction with scientific essentialism, the impossibility of alien kinds implies the impossibility of any laws other than those present at our world, and this, I argue, is needed to counter the concerns of the previous section.

There are, however, conditions besides natural kind membership, which cannot be satisfied contingently. An example is the condition *being a child of Wittgenstein*. Wittgenstein fathered no children and nothing is a possible child of his because if it were then it would be an actual child of his, given the essentiality of origin<sup>12</sup>. So in this case a commitment to the relevant instance of (BF) implies that it is *impossible* that Wittgenstein fathered a child because nothing is a possible child of his.

But surely Wittgenstein *could* have fathered a child. This general possibility would then seem to require the rejection of one of (BF), actualism or essentialism. The possibilist can maintain that although nothing in the actual world is a possible child of Wittgenstein, he may nonetheless have fathered a child at some other possible world, and that this *merely possible* child satisfies the consequent of (BF). The actualist, by contrast, has no recourse to mere possibilia, which has led some to try and invalidate (BF)<sup>13</sup> or else reconceive

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<sup>11</sup> See part 1 above.

<sup>12</sup> Kripke (1972/ 1980)

<sup>13</sup> E.g. Kripke (1963)

our modal semantics such that it does not commit us to the existence of mere possibilia<sup>14</sup>.

Putting controversies aside momentarily, for now it will suffice to notice the relationship between actualism, essentialism and (BF) on the one hand and the denial of alien kinds on the other. A full survey of the reasons why one would want to be an actualist as opposed to a possibilist would be beyond the scope of this essay, but the result that alien kinds are *impossible*, given (BF) and essentialism, can be shown without explicit reference to actualism or possibilism<sup>15</sup>, which is indicative of how commonplace and plausible the characteristically ‘actualist’ assumptions required for the result are.

Furthermore, the scientific essentialist’s endowment of her ontological bedrock with primitive modalities in the form of dispositional properties was motivated by a distain for ‘reductive’ accounts of modality, which engender commitment to entities *outside* of actuality<sup>16</sup>. And given the subject of this paper, no independent discussion of essentialism is required – primarily I want to argue that the *scientific essentialist* can offer a principled denial of alien kinds, which can reasonably involve appeal to characteristically scientific essentialist sentiments. However, I shall discuss the plausibility of commitment to instances of (BF) and, crucially, its purported counterexamples shortly.

My intention is to offer this context – actualism, essentialism and (BF) – to supplement scientific essentialism and then to explore the details of how it will serve to bolster the view. This context can be thought of as being offered in response to the question: *besides providing a patch to scientific essentialism, why would anyone want to deny the possibility of, say, schprotons?* To which I respond, *a commitment to three independently plausible theses implies such denial*. The point is that the scientific essentialist’s denial of alien kinds need not be seen as a knee-jerk or ad hoc response to the criticisms of the previous section. Rather, those criticisms can

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<sup>14</sup> Linsky and Zalta (1994, 1996), Williamson (1998)

<sup>15</sup> E.g. Williamson (1998)

<sup>16</sup> E.g. Lewis (1986)

be seen as motivating the essentialist to think seriously about embedding her view within a highly plausible logical-metaphysical context. Once this context is fully elucidated, I shall offer some broad reasons as to why the scientific essentialist should find it more accommodating than, say, the Humean and conclude with some general remarks about the attractiveness of the resulting *modal necessitarianism*<sup>17</sup>.

In what follows I shall present a survey of the reasons, logical and metaphysical, in favour of commitment to instances of (BF). I shall then consider how the different interpretations of a commitment to instances of (BF) that preserve actualism and essentialism found in Linsky and Zalta<sup>18</sup> and Williamson<sup>19</sup>, on the one hand, and Simchen<sup>20</sup> on the other, bear on the current proposal; that alien kinds and laws are *impossible*. I shall then move on to discuss how these interpretations relate to our current interest in supplementing scientific essentialism.

### 3.5) The Logical Case for the Barcan Formula

Linsky and Zalta (1994) and Williamson (1998) advocate logical systems (SQML and LPC=S5, respectively) that result from the addition of modal operators to first order logic in arguably the simplest, most straightforward manner. From the resulting axiomatization of the “simplest and strongest sensible quantified modal logic”<sup>21</sup> the Barcan Formula and its converse are derivable as theorems governing the interaction between the quantifiers and the modal operators. Thus one popular argument for (BF) proceeds by emphasizing the theoretical virtues of a logical system from which it is derivable.

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<sup>17</sup> According to which all worlds are identical with respect to their laws; Schaffer (2005), Wilson (2012)

<sup>18</sup> (1994)

<sup>19</sup> (1998)

<sup>20</sup> (2006, 2013)

<sup>21</sup> Williamson (1998)



However, concerns were raised by apparent counterexamples to (BF) or the threat that it posed to actualism – these problems are really two sides of the same coin. Whether one frames the concern as a threat to actualism or as the presence of counterexamples to (BF) depends on what is held fixed. Thus Williamson, unwilling to engage directly in what he sees to be a highly confused debate between possibilists and actualists resulting from the *weasel* word ‘exists’<sup>22</sup>, apparently assumes what some may dub ‘actualism’ because he does not think a meaningful distinction can be drawn between ‘being actual’ and ‘existing’. Hence for Williamson the concern raised by the possibility that Wittgenstein fathered a child is that this poses a counterexample to (BF), which is a theorem of an elegant and powerful logical system. Linksy and Zalta, on the other hand, are concerned with rendering the simplest quantified modal logic (SQML) metaphysically neutral between possibilism and actualism. Thus their emphasis is on the threat that (BF) poses to actualism, given such possibilities as Wittgenstein fathering a child and the apparent ease with which possibilism accounts for these possibilities and validates (BF). Either way, (BF), and hence the otherwise theoretically virtuous quantified modal logic of which it is a theorem, appear under threat.

In light of these concerns, the project of invalidating the Barcan Formula gained interest. It was hoped that quantified modal logic could be axiomatized such that (BF), along with other actualistically objectionable theorems of SQML, were not derivable and that this could be represented semantically. Kripke’s innovation with respect to the semantics was the introduction of *variable domains*. By assigning each world of a model its own domain, Kripke was able to *semantically* invalidate (BF). So while it may be possible that Wittgenstein fathered a child:  $\diamond \exists x Ax$ , it can nonetheless be false, on a variable domains semantics, that anything, where ‘anything’ is relativized to some world of the model, is a possible child of Wittgenstein:  $\sim(\exists x \diamond Ax)$ .

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<sup>22</sup> Ibid.

The modal operator ‘ $\diamond$ ’ ranges over worlds, whereas the existential quantifier ‘ $\exists$ ’ ranges over individuals, with its scope is *relativized* to worlds. That is to say, with respect to the existential quantifier, the domain of quantification varies from world to world, which supposedly captures the intuition that *what there is*, is a contingent matter. The modal operators, on the other hand, quantify over possible worlds and the scope of *this* quantification can be maximal, or restricted via the invocation of an accessibility function. Thus it may be true at some world, call it  $w$ , that Wittgenstein *could* have fathered a child because in some world, call it  $v$ , accessible<sup>23</sup> from  $w$  Wittgenstein is not childless. This is what is meant by  $\diamond\exists xAx$ . However, it is false at  $w$  that anything is a possible child of Wittgenstein. The possible child of Wittgenstein at  $v$  is outside the range of the quantifier ‘ $\exists$ ’ in ‘ $\exists x\diamond Ax$ ’, which ranges only over individuals at  $w$ , hence this instance of  $\exists x\diamond Ax$  is false and (BF) is *semantically* invalidated by this counterexample, among others.

Kripke was now tasked with blocking the derivation of (BF) from the axioms of quantified modal logic to ensure the soundness of his system, which he does by rejecting the following instance of the rule of universal instantiation:

$\forall 1: \forall xAx \rightarrow Ay$

But as it happens, without  $\forall 1$  the axiomatization of quantified modal logic becomes considerably harder and the expressive power of the language is compromised. Suffice it to say that invalidating (BF) comes at a high cost to the theoretical utility of the system. Thus Williamson complains: “*such complications are a warning sign of philosophical error*”<sup>24</sup>. But this sentiment embeds a controversial stance. It is by no means immediately obvious that elegance or expressive power of a purely formal system need be taken to indicate (approximate) truth; different formal systems may be employed for different computational purposes.

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<sup>23</sup> It doesn’t matter for present purposes whether or not all worlds are accessible from all others.

<sup>24</sup> (1998: 262)

However, there are reasons besides the cumbersome nature of its axiomatization for rejecting Kripke's quantified modal logic. Bearing in mind that the motivation for adopting Kripke's semantics, which invalidate (BF), came from the observation that some instances of (BF) appear to demand mere *possibilia*, a sense of dissatisfaction lingers with the counterexamples to (BF) that Kripke models provide. But what is it about the details of the above counterexample that fails to spark our enthusiasm? According to Williamson<sup>25</sup> the problem is that the very statement of the counterexample to (BF) requires quantification over individuals not in the domain of the distinguished member of the set of worlds with which we are concerned:

*“On the relativized domains approach, the meta-linguistic statement that (BF) has false instances implies that something in the domain of some world is not in the domain of the actual world. But the latter is true only if the domain of ‘something’ in the metalanguage is not restricted to the domain of the actual world”<sup>26</sup>.*

Williamson continues to argue that since the restriction on quantifiers in the object language *must not* apply to quantifiers in the metalanguage, that restriction looks arbitrary.

Thus, we can frame the debate as follows. Since (BF) would *appear* to demand *possibilia*, it is arguably in our interests as *actualists* to invalidate (BF). Kripke semantics invalidate (BF) but are committed to *possibilia* elsewhere. Thus we should not embrace Kripke's semantic invalidation of (BF), because that semantics does not absolve us of a commitment to *possibilia*, which was the whole reason for wanting to invalidate (BF) in the first place. Kripke's formal system, which blocks the derivation of (BF), is cumbersome and its semantic underpinning *still* requires *possibilia*. We thus lack grounds besides the intuitive force of the informal counterexamples to give up (BF). Furthermore, if we are of the Williamsonian mindset that elegance and expressive power of formal systems should be read as an

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<sup>25</sup> Ibid.

<sup>26</sup> (1998: 263)

indication of *truth*, then the fact that those systems from which (BF) is derivable have these desirable features may be cited in a positive argument for (BF).

This concludes my brief sketch of the case for the Barcan Formula from logical considerations, but it is inconclusive insofar as we are interested in the metaphysical import of (BF). Purported problem cases for (BF) would still appear to retain their intuitive force despite it being shown that Kripke semantics cannot underpin them. In what follows I shall discuss the metaphysical repercussions of reconciling instances of (BF) with such possibilities as Wittgenstein fathering a child.

### 3.6) (BF) as a Metaphysical Principle

Of more relevance to our current concerns than the purely logical considerations in favour of (BF), or at least *counter* its proposed logical invalidity, would be the *metaphysical* thesis that possibility in general cannot float free from what is possible for the particular things. A mere commitment to instances of the schema  $\diamond\exists xAx \rightarrow \exists x\diamond Ax$  on logical grounds does not have unambiguous metaphysical import. More must be said about how, metaphysically, we are to interpret (BF) if it is to provide the required context for the denial of possible alien kinds.

Following Marcus when she says: “*Modalities in their primary use concern counterfactuals about actual objects*”<sup>27</sup> and keeping in mind the interpretation of Marcus’ dictum offered at the start of this section, it would not seem unreasonable to maintain that possibility in general ought to be constrained by what is possible for the actual things. And in our post-Kripkean philosophical landscape (particularly the region encompassing the *scientific* extension of essentialism currently under scrutiny) the actual things seem capable of imposing a fair amount of constraint in this respect. If, for example, I say

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<sup>27</sup> Ibid

“*there could have been talking donkeys*”, you may reasonably disagree with me, since it has become apparent that the class of sentences expressing necessary truths is not coextensive with those true in virtue of the meanings of their non-logical terms. Hence, the sentences that state genuine possibilities are not *all* those that do not express a *logical* contradiction, some *logically* consistent sentences nonetheless express metaphysical impossibilities, such as ‘water is XYZ’. With this in mind, your reasoning may proceed along the following lines: it is not possible for any of the *actual* donkeys that *they* could talk and neither is it possible for any of the non-donkeys that they could be donkeys, let alone talking ones. Therefore, it is not possible after all that there be talking donkeys. Your response can be viewed as a demand for some principled basis for our modal assertions; a requirement that possibilities obtain in virtue of something. And insofar as that *something* is a part of our ‘robust reality<sup>28</sup>’ we also have an explanation of *why* we should care about modality in the first place – because it concerns familiar, everyday things apt for investigation by scientific methods.

What is more, on this account, the *epistemology* of modality may be assimilated by familiar scientific epistemology, since it is *scientific inquiry*, as opposed to speculative metaphysics, that is best placed to discern the essences of things in the world and hence the constraints on possibility. This line of thought gives primacy to modality *de re* because it is maintained that the obtaining of a *de dicto* possibility can be *explained* by reference to what is possible for some *particular* thing or other. What is more, the Barcan Formula construed thusly as a bridge principle between modality *de dicto* and modality *de re*<sup>29</sup>, gives expression to this primacy of *de re* modality in the order of metaphysical explanation. Hence, insofar as we are persuaded by the presently espoused interpretation of Marcus’ quote above we appear to have good reason to adopt (BF) as a *metaphysical* principle<sup>30</sup>.

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<sup>28</sup> See Russell (1919)

<sup>29</sup> See also Simchen (2013)

<sup>30</sup> Simchen (2013) offers a similar line of reasoning.

By arguing that all possibilities must have some ‘witness’ in actuality, we seek to shift the explanatory burden onto he who thinks that possibility abounds. One resounding influence of Quine through Lewis is the idea that possibility is *cheap*, if you like, and necessity expensive. But this results from scepticism about the cogency of essentialism<sup>31</sup> and an adherence to Humean supervenience, respectively. However, with the plausibility of essentialism widely accepted and the scientific essentialist metaphysic offering an attractive alternative to Humean supervenience, it would seem appropriate to shift the burden of explanation on to the contingentist to explain in virtue of *what* his plethora of fanciful possibilities obtain.

I have discussed broad metaphysical considerations and formal logical considerations in favour of a commitment to instances of (BF). But we have yet to tackle head on the *prima facie* counterexamples to (BF), which would appear to be the main sticking point for anyone wishing to maintain the presently advocated metaphysical import in (BF). I suggested that it would not be unreasonable to deny the general possibility of talking donkeys by arguing from considerations of the impossibility *for* any particular thing that *it* be a talking donkey. The plausibility of this reasoning, which I am suggesting is enshrined in (BF), appears to cause a problem if we return to the example of Wittgenstein’s child. Whereas to deny the general possibility of talking donkeys would not appear wholly unreasonable, to deny that Wittgenstein could possibly have fathered a child does seem wrong. So long as we are interested in, at least minimally, respecting our intuitions on matters modal, something will have to be said about the appearance of this general possibility (and others<sup>32</sup>) that would appear to constitute a counterexample to (BF).

### 3.7) Proxy Actualism

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<sup>31</sup> E.g., Quine (1953)

<sup>32</sup> For example, the possibility that there be an *additional* carbon atom.

The most prominent response to this problem can be found in the work of Linksy and Zalta (1994) and Williamson (1998) (independently, apparently). Their solution to the issue of reconciling (BF) with actualism and essentialism involves introducing a category comprising what Linksy and Zalta call *contingently nonconcretia*. According to this view, which I shall call proxy actualism, and contrary to what had previously been assumed, the property *concreteness* need not be borne by an actually concrete individual in every world in which that individual exists and essential properties are reconceived of as those that an individual bears in every possible world *in which it is concrete*.

The proxy actualist accepts the general possibility that, e.g., Wittgenstein fathered a child, among other *prima facie* problematic general possibilities for (BF). Furthermore, they accept that none of the *concrete* things could possibly have been a child of Wittgenstein but they nonetheless *deny* that nothing in actuality, *concrete or nonconcrete*, satisfies the consequent of this instance of (BF). Embracing the implication from (BF) and the possibility that Wittgenstein fathered a child, they maintain that Wittgenstein's possible child is just that: a contingently nonconcrete possible child of Wittgenstein, something that is such that *if* it were concrete, it would be a child of Wittgenstein. Contingently nonconcretia play a role analogous to the possibilist's *mere possibilia*, except that they *actually* exist, and the quantifiers of the language (SQML/ LPC=S5) range over *all* individuals concrete and nonconcrete. Nonconcretia, much like abstract objects<sup>33</sup> (numbers, sets, etc.) occupy no spatiotemporal location, hence Williamson concludes:

“...there are no counterexamples to (BF), only counterexamples to the different claim that if there could have been something in space and time that was such and such (e.g. fathered by Wittgenstein), then there is something in space and time that could have been such and such.”<sup>34</sup>

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<sup>33</sup> Williamson (2013) distinguishes between the abstract and the contingently nonconcrete.

<sup>34</sup> (1998: 266)

The majority of the arguments in favour of proxy actualism begin with actualism as non-negotiable and centre on extolling the virtues of a logical system of which the Barcan Formula is a theorem whilst highlighting theoretical shortcomings of those systems that would invalidate it. These arguments were touched on above in my discussion of the logical considerations in favour of (BF). Thus it is argued that the introduction of contingently nonconcretia is justified because it allows us to retain the theoretical utility of the simplest quantified modal logic and accompanying fixed domain semantics without recourse to mere possibilia, which offend actualist sensibilities.

Proxy actualism is interesting for our current purposes since it provides a way of rebutting counterexamples, such as the possibility that Wittgenstein fathered a child, to the context; actualism, essentialism and (BF), which it has been suggested will make for a principled denial of possible alien kinds. But this context has been altered by the introduction of contingently nonconcretia. So next I shall turn my attention to the question of how, if at all, we may deny the possibility of alien kinds given proxy actualism.

### **3.8) Contingently Nonconcrete Alien Kinds?**

I have been arguing that the denial of possible alien kinds would bolster a scientific essentialist account of natural law by blocking the objections discussed in section 2. To the extent that proxy actualism strengthens the case for (BF) as a metaphysical principle it may appear apt to feature in an argument for the *context* that I require to deny the possibility of alien kinds. Indeed, proxy actualism provides a way of rebutting *prima facie* counterexamples to (BF) as a metaphysical principle and so appears to serve our broader purpose in *this* respect. However, the introduction of *contingently nonconcretia* would seem to provide a means of rebutting counterexamples to



(BF)<sup>35</sup> only at the cost of depriving (BF), actualism and essentialism of the ability to strictly imply the impossibility of schprotons *et al.*

So long as we retain the classical and intuitive notion of essential properties as those possessed by an individual in every world in which it exists and retain a *robust sense of reality*<sup>36</sup>, the conjunction of (BF), actualism and essentialism implies the impossibility of alien kinds. However, with the introduction of the proxy actualist's *vestigis*, which can satisfy the consequent of (BF) in problematic cases and the accompanying reconception of *essential properties* as those born by an individual in every world in which it is *concrete*, the impossibility of alien kinds no longer follows plainly from our context. Proxy actualism, though it preserves (BF), actualism and essentialism, does not eliminate the possibility of alien kinds, since it allows for the possibility of actually existing contingently nonconcrete entities that would satisfy the consequent of an instance of (BF) whose antecedent says that there could have been schprotons. So, given proxy actualism, is there a way to consistently allow for possible children of Wittgenstein whilst disallowing possible alien kinds?

Maybe, again following Marcus<sup>37</sup>, and in the interest of heeding Russell's caution, we could argue that since modality in its primary use concerns the possible configurations of actual things, robustly construed, we have no reason to think that there could possibly be, say, schprotons and so no need to postulate contingently nonconcrete schprotons or any other possible alien kinds. Thus, it may be argued with respect to Wittgenstein possibly fathering a child versus the possibility of schprotons that the former, and not the latter, possibility pertains to a part of robust reality. The former pertains to Wittgenstein and says that *he* could have stood in the *fatherhood* relation, the postulation of a contingently nonconcrete possible child of his is then warranted. However, the possibility that there be schprotons says nothing

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<sup>35</sup> *As a metaphysical principle*: when I refer to (BF) I mean *as a metaphysical principle* in the sense argued for according to which modality *de re* takes primacy over modality *de dicto* in the order of metaphysical explanation.

<sup>36</sup> Mere possibilia and contingently nonconcretia run counter to this requirement.

<sup>37</sup> (1995)

about what is possible for anything so tangible and so there is no demand to introduce possible schprotons.

However, the very introduction of contingently nonconcretia constitutes an abandonment of a Russellian robust sense of reality in matters modal. Hence, arguments throughout this section to the effect that possibility in general ought to be constrained by how the actual things may be configured cannot consistently be invoked to argue that there could be no contingently nonconcrete thing that is possibly a schproton, whilst admitting contingently nonconcretia elsewhere. To say that, with respect to modality, primary concern with how the actual things *could* be, should lead us to the belief that it is not possible in general that there be schprotons and hence that nothing is a contingently nonconcrete possible schproton would be inconsistent with admitting contingently nonconcretia to validate *other* instances of (BF). This is because to admit contingently nonconcretia epitomizes the abandonment of a robust sense of reality in matters modal and so we cannot consistently appeal to this Russellian admonition to determine *how many* contingently nonconcrete things there are, unless the answer was *none*.

I can think of one other possible strategy for reaping the benefits of proxy actualism's support for (BF) as a metaphysical principle by admitting possible children of Wittgenstein whilst simultaneously denying possible schprotons etc. The possibility that Wittgenstein fathered a child was posed as a counterexample to (BF) as a metaphysical principle. In order to properly constitute a counterexample, it should be widely agreed that it really is possible that Wittgenstein fathered a child. Indeed this *prima facie* counterexample to (BF) seems highly plausible, so let's assume for now that it holds up and hence that the introduction of a contingently nonconcrete possible child of Wittgenstein is warranted. What is less obvious than the possibility that Wittgenstein fathered a child is the possibility that there be schprotons. Thus, if we disagree that schprotons are a possibility then we have no recourse to the postulation of contingently nonconcrete *possible* schprotons.

In common with the previous suggestion, this involves admitting some apparent general possibilities and denying others. Unsurprisingly, the possibilities we will deny will be those that require possible alien kinds. But instead of appealing to the idea that general possibility must nonetheless be constrained by actuality, robustly construed, this would be a *straightforward* appeal to intuition, without any broader supporting principles that would risk conflicting elsewhere with the concept of contingently nonconcretia. Strong modal intuitions drove the postulation of a contingently nonconcrete possible child of Wittgenstein, but it is likely that there is no such intuitive force present that should impel us towards postulating the existence of possible schprotons. Proxy actualism doesn't itself imply that there are possible schprotons; it simply provides a framework from within which to validate statements of general possibility to this effect. It still remains unclear what the intuitive consensus is on the possibility of schprotons, and thus what work our would-be semantics has to do here.

This latter strategy seems an odd one. The whole point of promoting a commitment to (BF) as a metaphysical principle was to provide an *independent* reason for denying the possibility of alien kinds, lest the proposal look like a mere ad hoc appendage to scientific essentialism. But if the extoled context no longer has the implication that we require, as would seem to be the case when proxy actualism is adopted, then we are back to unprincipled mere stipulation or arguments from intuition in order to maintain the impossibility of alien kinds.

### **3.9) Possible Propagation**

While the formal arguments forwarded by Linsky and Zalta and Williamson for a commitment to instances of (BF) help us to the extent that we at least require the formal *validity* of (BF), ultimately our present interests are frustrated by the full metaphysical import of proxy actualism. Thus, armed

with compelling formal arguments from theoretical utility, and the *broad* metaphysical reasons in favour of (BF) from considerations of the primacy of modality *de re* in the order of metaphysical explanation, we should nonetheless resist the introduction of contingently nonconcretia. As argued, this postulate would run counter to our desire to *ground* modality in reality, *robustly* construed, and thus to allow for the assimilation of the epistemology of modality to scientific epistemology. Contingently nonconcretia, unlike concrete tokens of kinds, are not the sort of thing that we can find out about via *science*, and hence could not feature in a naturalized account of laws and modality<sup>38</sup>.

With the rejection of proxy actualism, we are challenged to provide an alternative response to counterexamples to (BF). I have argued that there are good reasons to adhere to instances of the schema, according to which if possibly something satisfies a condition  $\phi$ , then something possibly satisfies  $\phi$ , and to interpret this as giving expression to the primacy of modality *de re* in the order of metaphysical explanation. But the highly plausible claim (among others) that it is possible that Wittgenstein fathered a child would seem to constitute a counterexample to this principle. Nothing is a possible child of Wittgenstein, thus (BF) and *Modus Tollens* imply that it is not possible that there be a child of Wittgenstein.

In the face of *prima facie* counterexamples to (BF), following Simchen<sup>39</sup>, I suggest that instead of denying the *seeming* absence of any possible  $\phi$ s, as the proxy actualists do, we instead embrace appearances and the implication from (BF) and hence deny the general possibility *that* something  $\phi$ s. So, in the above case, we would deny the general possibility *that* there be a child of Wittgenstein, because it is not possible *for* anything to be a child of Wittgenstein. The apparent possibility that Wittgenstein fathered a child can then be explained, not by appeal to the possibility that there be a child of his, which does not obtain, but by the real possibility that something, or things

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<sup>38</sup> See also Simchen (2006) fn 11, for an independent philosophical concern with Proxy Actualism's treatment of *concreteness*.

<sup>39</sup> (2006, 2012)

jointly, *became* or *propagated* a child of his. Purported counterexamples to (BF) are then rebutted by diagnosing the appearance of possibility that something *satisfy*  $\phi$ , in problematic cases, as confusing the real possibility for something(s) to *propagate* a  $\phi$ , with the spurious possibility for something to *satisfy*  $\phi$ . Thus, while it is true that some genetic material of the past could have propagated a child of Wittgenstein, it is not the case that this material, or anything else, *is* a possible child of Wittgenstein. Analogously, an acorn is not a possible oak tree, but it does have the potential to *become* an oak tree, i.e., it is a possible propagator of an oak tree.

The Barcan Formula is then followed with respect to possible propagation. Thus, if it is possible that something(s) propagate a  $\phi$ , then something(s) possibly propagate a  $\phi$ . The sense in which it is possible that Wittgenstein fathered a child, then, is that it is possible that something(s) propagated a child of his and hence it is possible for some actual things, i.e. his genetic material, that they propagated a child of his. The possibility that there be, say, an additional carbon atom also typically posed a problem for (BF). But on the current account this is possible in the sense that it is possible for some thing(s) to propagate an additional carbon atom. And this is not to say that anything could have propagated some additional matter, just that the matter that there is could be reconfigured so as to give rise to an additional carbon atom, as indeed occurs in stars.

The invocation of unactualised potentialities in this way should appeal to the scientific essentialist who is ready to admit irreducible dispositions into her ontology. There is no requirement that these possible propagators of  $\phi$ s ever realise their potential just as there is no requirement that genuine dispositional properties ever manifest their dispositions, or that they be fully *analyzable* in terms of conditionals. Potentialities, like dispositions, may be viewed as part of the modal bedrock of our broad picture. The bullet that the scientific essentialist bites is that of admitting *irreducible* modalities into her ontology, which pays its dues by absolving us of any requirement to ground natural

necessity somehow *outside* of actuality, whatever that may mean<sup>40</sup>. Thus the presence of potential propagators of  $\phi$ s, need not commit us to the existence of merely possible  $\phi$ s, just as, on the current view, the presence of dispositional properties does not commit us to merely possible worlds in which the disposition manifests<sup>41</sup>. The general idea is that by admitting irreducible modalities into our ontology<sup>42</sup>, as the scientific essentialist already does elsewhere, possible propagators of  $\phi$ s demand no recourse to shadowy possible  $\phi$ s, that can claim no right to residence in robust reality.

But is it possible that anything *propagate* a schproton? It certainly would not *seem* as if there are any possible propagators of schprotons. Consider the continuing presence of actual carbon atoms and human children; this would appear to constitute good evidence for the existence of possible propagators of carbon atoms and of children, some of which realise their potential as possible propagators, giving rise to the atoms and children we observe. Children and atoms at least raise the probability of there being such propagators, since it seems more likely that these things are *propagated*, in a sense, that that they spontaneously and immediately come into existence out of nothing. And indeed it does turn out to be the case that there are possible propagators of children and of carbon atoms in the form of subatomic particles and human genetic material. Thus, The presence of actual schprotons would be good evidence for there being possible *propagators* of schprotons. On the other hand, a good explanation for the absence of schprotons, then, is that our world with its particular laws is not such that schprotons are possible, in any sense, and hence that there are no possible propagators of schprotons<sup>43</sup>.

To respond that there may be possible propagators of schprotons *at other worlds* would be to ignore the forgoing argument against the possibility of

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<sup>40</sup> Ellis (2001: 40)

<sup>41</sup> See Simchen (2012: 390-391) for formal argument to the conclusion that a commitment to possible propagators of  $\phi$  *does not* entail commitment to possible  $\phi$ s.

<sup>42</sup> See e.g. Williamson (2000: 204); Williamson challenges the preconception that the modal must somehow be grounded in or reducible to the nonmodal. He makes this point with respect to irreducibly modal properties of contingently nonconcretia, but there is no reason not to thus extend the point so as to maintain that concretia too can have modal properties that are not grounded in nonmodal properties. See also Bird (2007) for defense of dispositional monism, according to which *all* properties are dispositional.

<sup>43</sup> Bird (2001) argues that what substances there are depends on what laws there are.

alien kinds. Just as we require some principled basis in actuality to sustain the general possibility of schprotons, so would we require some principled basis in actuality to sustain the general possibility of possible propagators of schprotons. So the foregoing arguments against the general possibility of schprotons can be extended to apply to the general possibility of possible propagators of schprotons<sup>44</sup>.

Schprotons, like all *alien* kinds, are the product of philosophical imagination; there is no empirical evidence to suggest their possible existence. We may be able to imagine schprotons, but in the interest of respecting naturalism, it is reasonable to give minimal weight to intuition or imaginings when considering *what* there is or could be. Indeed, science would seem to tell *against* there being possible propagators of schprotons because the actual world just does not seem to be such that it could possibly yield this imagined kind<sup>45</sup>. So why think that there are propagators of schprotons any more than we would think it *really* possible that straw could be spun into gold in the patent absence of any really possible straw-spinner setup that would turn the straw *into* gold? The burden should be on the contingentist to identify such propagators. Until then, it seems reasonable to maintain that there are no such things.

If there are no (possible) possible propagators of schprotons (or any other alien kinds), which I suggest is eminently plausible, then the current proposal suits our needs where proxy actualism failed; it allows us to account for the apparent possibility that Wittgenstein fathered a child, whilst consistently denying the possibility of schprotons.

### 3.10) Modal Necessitarianism

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<sup>44</sup> Though the qualification with this line of argument, as with the arguments above, is that this is something that the scientific essentialist could at least consistently maintain – some scientific essentialist sympathies are assumed.

<sup>45</sup> Ibid.

Broad considerations of the nature of modality, constrained by a desire to heed the admonition of Russell that we retain a robust sense of reality, have provided good reasons in favour of a commitment to instances of (BF) as a metaphysical principle. Furthermore, the formal validity of (BF) follows from a simple yet powerful system of quantified modal logic and alternative systems, which invalidate (BF), are somewhat unwieldy and their semantic underpinning of counterexamples to (BF) proved unconvincing. Thus we have good independent reasons, consistent with the motivations of scientific essentialism, to deny the possibility of alien kinds, since this is implied by the resulting commitment to, and favoured interpretation of, (BF).

The scientific essentialist is particularly well placed to embrace the espoused necessitarianism. The Humean, for example, would likely deny that *modalities in their primary use concern counterfactuals about actual objects*<sup>46</sup>, since for them what constitutes the actual world and how its constituents happen to be is of no special relevance, due to the assumed lack of necessary connections between distinct existences and hence irrelevance of what is actual to what is possible. Thus, the forgoing arguments for necessitarianism assume scientific essentialist sympathies, but this does nothing to diminish the point that the *scientific essentialist* can offer a *principled* denial of possible alien kinds. This suggestion is no mere ad hoc appendage; rather it follows from independently plausible considerations consistent with prior motivations for scientific essentialism. For example, we required a metaphysic capable of underwriting the laws' support for counterfactuals, and which reflected the interconnectedness of the fundamental reality that science is revealing<sup>47</sup>. This involved postulating essential, irreducibly dispositional properties. This *essentialism*, coupled with

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<sup>46</sup> Marcus (1995). We also read in Marcus (1971: 69) the following: “*Being gold or being a human are not accidental... No metaphysical mysteries. Such essences are dispositional properties of a very special kind: if an object had such a property and ceased to have it, it would have ceased to exist or it would have changed into something else*”. This endorsement of essentialism would seem to directly feed the thought that “*modalities in their primary use concern counterfactuals about actual objects*”, since we must consult the things themselves in order to properly tell how things (in general) could possibly be.

<sup>47</sup> Ellis (2001: 52)



(and motivated by) a reluctance to admit mere possibilia<sup>48</sup> and a commitment to (BF), implies the impossibility of alien kinds. So to the extent that *necessitarianism* is attractive, scientific essentialism should be more attractive than Humeanism, since the former, but not the latter, can consistently embrace necessitarianism in a non-ad hoc manner.

The concerns of section 2 served to diminish the distance between scientific essentialism and Humeanism and hence to expose scientific essentialism to the recurrent criticisms leveled at Humeanism. While the scientific essentialist can maintain the required distance from and hence avoid the criticisms of Humeanism by denying the possibility of alien kinds, the Humean could not consistently embrace modal necessitarianism. Besides not being able to consistently embrace the idea that *modalities in their primary use concern counterfactuals about actual objects*, for the aforementioned reasons, the Humean metaphysic seems intimately connected with an abandonment of a robust sense of reality in matters modal. Unless the Humean flatly denies the reality of modality in *any* sense whatsoever, the purely *categorical* mosaic of the actual world would demand reference to something *outside* of actuality to give meaning to our modal discourse. Insofar as the invocation of *mere possibilia* constitutes a failure to heed the Russellian admonition, a requirement to maintain a robust sense of reality cannot consistently be invoked to argue for the interpretation of (BF) that is required in order to deny possible alien kinds in a principled fashion.

Following Schaffer<sup>49</sup> and Wilson<sup>50</sup>, I refer to the view that all possible worlds are identical with respect to their laws as *modal necessitarianism*. Modal necessitarianism is implied by the conjunction of the scientific essentialist metaphysic with the impossibility of alien kinds, and blocks the concerns of the previous section. Modal necessitarianism has its defenders, such as Wilson, who<sup>51</sup> in response to Schaffer's<sup>52</sup> critique of the view, argues that it is

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<sup>48</sup> That the Humean picture seemed to demand such metaphysical commitments was among the motivations for the alternative scientific essentialist picture.

<sup>49</sup> (2005)

<sup>50</sup> (2012)

<sup>51</sup> Ibid

at least consistent<sup>53</sup> and indeed appears to have desirable results in the domain of modal epistemology.

If, as has been orthodox, we think of those possible worlds with the same laws of nature as the actual world as a proper subset of all possible worlds, then we may reasonably demand an explanation as to *why* this subset should be of more concern to us than any other. To stipulate that sameness of laws carries particular weight in determining similarity between worlds for the sake of evaluating counterfactuals is to provide no such explanation; it is simply to pass the buck on this matter. What remains is the question of *why* sameness of laws should carry the weight it does in determining similarity and hence in our counterfactual judgments. Why should *natural necessity* and the corresponding subset of worlds be of any more interest to us than, say, the subset corresponding to *goldfish necessity*? The contingentist may answer by citing certain pragmatic reasons for a particular interest in natural necessity. Natural necessity is certainly broader than goldfish necessity, the latter being a proper subset of the former, and natural necessity corresponds to the full breadth of humanity's scientific and hence practical interests (we'd like to subsume our interests in goldfish and nuclear fusion, say, under some more inclusive set). But we may still question *why* our interests align in this way? Why is scientific inquiry (and hence our interest) particularly concerned with this set of worlds? To which the modal necessitarian can respond that this set is the set of *all* possible worlds; science is concerned with possibility *simpliciter*.

Furthermore, an explanatory regress in the scientific domain may lead to a law proposition, for which we may request a *further* explanation. Any strategy that the contingentist may employ to meet this explanatory demand will compromise the ideological parsimony of their account, lest they just leave the laws unexplained. The modal necessitarian, on the other hand, has a response ready, striking in its elegance and which in no way serves to further

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<sup>52</sup> Ibid

<sup>53</sup> Bird (2004, 2007) also tentatively defends the view, which he calls *strong necessitarianism with instantiation*.

ideologically encumber their view, namely that the laws are the same in *all possible worlds*. Hence we are concerned with those worlds in which the laws are the same as ours because they are the only *genuinely* possible worlds, and the fact that any given law is how it is may be explained by appeal to the necessity of that law, it *has* to be and it *has* to be thus and so. No appeal to pragmatics or intuitions on the truth-values of counterfactuals<sup>54</sup> must be made in order to provide these necessitarian explanations, which follow simply from the single proposition, which characterizes the view; that all possible worlds are identical with respect to their laws.

For the contingentist, modal epistemology amounts to little more than the proffering of intuitions. The modal necessitarian, on the other hand, denies any pertinent conceivability-possibility link. Contra Schaffer<sup>55</sup>, this does not engender modal scepticism, since modal epistemology is assimilated to *scientific* epistemology. Physics is concerned with the most fundamental constituents of reality, their dispositional essences and hence *the laws* that emanate from them. Since it is maintained that the laws are metaphysically necessary and hence that metaphysical possibilities must be consistent with the laws, it is *physics*, not the imagination, which is our vessel of enquiry into what is metaphysically possible.

I have argued that the scientific essentialist can consistently and in a principled manner deny the possibility of alien kinds by way of a response to the criticisms canvassed in section 2. Furthermore, the resulting modal necessitarianism also has independent appeal<sup>56</sup>, which cannot be consistently reaped by the Humean. But a strange result looms. For all that has been said thus far about scientific essentialism, the impossibility of alien kinds and the requirement that all worlds are identical with respect to their laws it is implied that kinds exist *necessarily*. Furthermore, no platonic conception of kinds, such that they may exist uninstantiated would serve our purposes, for much the same reason that our position could not consistently embrace proxy

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<sup>54</sup> E.g. Lewis (1973, 1979)

<sup>55</sup> (2005: 26)

<sup>56</sup> And is consistent, see Bird (2004, 2007) and Wilson (2012)

actualism. So it must be maintained that kinds are instantiated in all possible worlds. This result is acknowledged by both Wilson and Bird<sup>57</sup> and the general gist of Bird's response is to maintain that it is only the force of intuition that could tell against such a thing, and the sway of intuition took a back seat in this line of inquiry a long time ago. According to Bird, intuition tells no more against strong necessitarianism with instantiation than it does against the simple metaphysical necessity of the laws that arises even without the necessary instantiation of kinds. Thus the suggestion would seem to be that if there are significant theoretical benefits to the necessary instantiation of kinds, then the mere charge that this is counterintuitive should have no sway.

### 3.11) Conclusion

I have argued that the most resilient formulation of scientific essentialism includes the following claims: i) the individual members of natural kinds bear their kind membership *essentially* and ii) alien kinds are impossible. Add this to the core principle that natural kinds are essentially characterized by irreducibly dispositional properties, from which the universal laws of nature may be derived, and we obtain the result that all possible worlds are identical with respect to their laws. I thus offer the preceding as an account of the metaphysical details and motivations for modal necessitarianism, which builds on the ideas of Bird<sup>58</sup> and Wilson<sup>59</sup>.

Arguments for the impossibility of alien kinds appeared equally to imply the impossibility of things required for eventualities that we would like to maintain *are* possible. For example, my arguments implied the impossibility of a child of Wittgenstein, which in turn implied that it was not possible that Wittgenstein fathered a child. Much of the argument for the impossibility of alien kinds was motivated by a desire to heed Russell's admonition that we retain a robust sense of reality. Furthermore, the essentialist metaphysic

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<sup>57</sup> In his discussion of *Strong Necessitarianism* (2004, 2007)

<sup>58</sup> (2007: 50-59)

<sup>59</sup> (2012)

appears to allow us to give meaning to our modal discourse whilst also respecting Russell in this respect. Thus, in lieu of any mere or bare possibilia, which would run counter to the Russellian admonition and the broader motivations of scientific essentialism, I appealed to Simchen's idea of possible propagation<sup>60</sup> to rebut purported counterexamples to the espoused interpretation of the Barcan Formula.

For all that has been said it follows that natural kinds are necessary existents. If one finds this too big a bullet to bite, then the forgoing will likely be viewed as an elaborate reductio of scientific essentialism, or, if it is a bolstering of anything it will be of those criticisms of scientific essentialism canvassed in section 2. However, the necessity of kinds and resulting modal necessitarianism constitutes no *logical* contradiction, so we have no reductio in the strictest sense. Furthermore, our arguments for necessitarianism were rooted in the prior motivations for and particularities of the scientific essentialist metaphysic. So the counterintuitive nature of necessitarianism ought only bolster the criticisms of section 2 if one lacks sympathy for the aims or methods of scientific essentialism already. Anyone disinterested in endowing actuality with the necessity required to give meaning to our everyday as well as scientific discourse and thus in avoiding recourse to entities *outside* of actuality, is unlikely to find suasive much of what has been said. But for anyone concerned by the shortcomings of, say, Humeanism about laws and modality more generally, the preceding discussion may be seen as unifying, to some extent, a live alternative that is free of the problems engendered by contingentist views of laws.

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