ARE ANY KINDS ONTOLOGICALLY FUNDAMENTAL? NATURAL KINDS AND NATURAL LAWS IN E. J. LOWE'S FOUR CATEGORY ONTOLOGY

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Abstract

In this paper I ask whether any natural kinds are ontologically fundamental. In particular I examine E. J. Lowe's view that kinds—substantial universals—form one component of a fundamental four category ontology, and that kinds play a key role in the laws of nature. I contrast this with the view that kinds are supervening entities. According to this view, the existence of kinds depends on the laws and properties there are in a world and the pattern of their instantiation. Correspondingly, laws involving kinds are dependent on laws not involving kinds, but only properties.

1

Are any natural kinds ontologically fundamental? This question may be put in a different way: do we need a category of *kinds*? We use kind terms in a name-like way, and we can count kinds ('there are 92 naturally occurring chemical elements'). But if we look at the fundamental constituents of the states-of-affairs that involve kinds, do we find entities that are the natural kinds?

Whereas David Armstrong takes a reductive attitude towards natural kinds, E. J. Lowe regards kinds as ontologically fundamental. His ontology required four categories, one of which is reserved for the natural kinds—*substantial universals* as he calls them.

In this essay I shall examine Lowe's claim that kinds are fundamental. I conclude that it is unwarranted. We can see that all that we require are universals. Kinds are complex universals, and their existence depends on the more basic universals, laws, and certain contingent facts. Among the basic universals, kinds are not required.

2

Whereas some metaphysicians aim to produce an ontology with two categories (e.g. particulars and universals) and others have ontologies with just one category (e.g. tropes), E.J. Lowe (2006) has an ontology of four categories, in which we have *individual substances* (objects, particulars), *modes* (property/relation instances, tropes) and two species of universal: *attributes* (non-substantial universals, properties/relations) and *substantial universals* (kinds). These are related in a satisfying manner in what Lowe calls 'the ontological square' (see Figure 1).

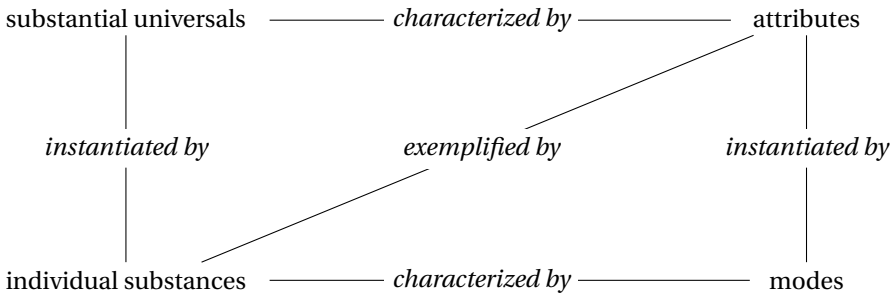

Figure 1: Lowe's Ontological Square with four categories

Consider a polar bear named *Ursula*. According to Lowe, the bear exemplifies the attribute of whiteness. This comes about in two ways. On the one hand there is a particular mode or tope of whiteness, the whiteness of this bear Ursula. Ursula's whiteness mode is an instance of whiteness the attribute, and Ursula is characterized by her whiteness mode. So this manner of Ursula's being white involves the bottom and right hand connections in the ontological square. At the same time Ursula belongs to the kind *Ursus maritimus*. Since it is in the nature of the kind to be white, we can say that *U. maritimus* is characterized by the attribute whiteness. This is parallel to the fact that individual Ursula is characterized by her whiteness mode. The kind (substantial universal) *U. maritimus* is instantiated by the individual Ursula. This is parallel to the fact that the attribute of whiteness is instantiated by the mode that is Ursula's whiteness. This account of Ursula's whiteness involves the left and top sides of the square.[1]

In Lowe's view, when an individual, such as Ursula, instantiates a kind, such as *U. maritimus*, and the kind is characterised by an attribute, such as whiteness, it is *not* entailed that the individual in fact exemplifies the attribute. Rather, the individual is *disposed* to exemplify the attribute. So if we knew only that the top and left hand connections held, we would be able to conclude only that the individual was disposed to manifest the attribute, not that she actually manifests it (Lowe 2006: 16). Furthermore, the top connection, between kind and attribute provides the simplest

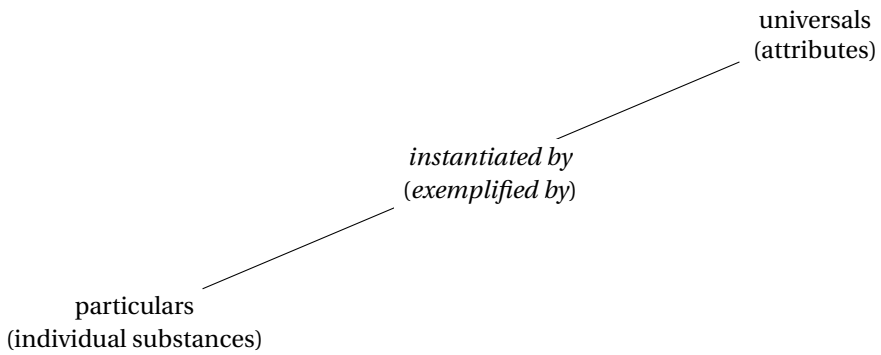

Figure 2: Armstrong's two categories

[1] See Schneider (2009) for a careful articulation of the Ontological Square.

version of the general form of a law of nature. Laws are the characterization of kinds by attributes.

The ontology that has just the bottom left and top right nodes (see Figure 2): particulars/substances and non-substantial universals/attributes, with the single connection (*exemplification* or *instantiation*) is a popular one; it is Armstrong's for example. So an obvious question is: why do we need the additional two categories: modes and substantial universals/kinds, plus the two additional connections between them, *instantiation* and *characterization*? I shall not consider the need for modes. Here, rather, I shall question the need for the category of kinds.

Armstrong (1997: 67) puts the case, for and against, thus:

> The electron is not at present thought of as having any structure and all electrons are though as as identical in nature. Perhaps, then, we should recognize a kind of electronhood?
>
> It would *appear*, however, that a reductive account is available of electronhood. Unlike an ordinary macroscopic object, or even a molecule or atom, the electron is not credited with very many properties. And for properties to make it electron there are required only mass, charge and the absolute value of the spin, properties that are identical in all electrons. When, then, should not electronhood be identified with the property that is the conjunction of these three properties?

3

As we have just seen, Lowe uses the of left hand side of his ontological square in the characterisation of laws of nature. As I summarized the view, laws are the characterization of kinds by attributes. So is it the case that an adequate account of laws requires the existence of kinds?

The involvement of kinds in laws seems to be required by the example given, that *U. maritimus* is white—if that is a law at all. For that does not appear to allow for a simple reduction in the manner that Armstrong suggests for propositions concerning electrons. Lowe gives another example: Kepler's first law, that planets travel in ellipses. Here again it looks as if we are predicating something ('travels in ellipses') of a kind (the kind *planet*) in a manner that does not allow for easy reduction of the latter.

Is Lowe right, that this is what a law is, in its most basic form: the characterization of a kind by an attribute? Counterexamples spring easily to mind. Newton's law of gravitation is one:

$$\mathbf{F} = G\frac{m_1 m_2}{r^2}$$

Here it would appear that no kinds are mentioned, just the masses of two objects, m_1 and m_2, their separation, r, and the force between them, $\mathbf{F}$. Lowe (2006: 158) thinks that this law does conform to the approved pattern, since the law can be understood as characterizing the nature of massive bodies quite generally, just as 'gold dissolves in aqua regia' states a fact about gold:

> It is true that many very different kinds of things can be massive, that is, possess mass—for instance, stars, trees and fish. However, what all these things have in common is that they are composed of matter: each of them is massive thing because each of them is constituted, at any

> given time at which it exists, by a certain mass of matter, albeit by different such masses at different times. Strictly speaking, then, Newton's law of gravitation is a law concerning the nature of masses of matter.

One might think that this is stretching the notion of kind or substantive universal, but perhaps this is such an (almost) all embracing kind, that although a kind, it does not attract our attention as such because it is not useful for distinguishing one class of things from another. A more significant problem is that not all laws can be dealt with in this way. Consider Coulomb's law of electrostatic force:

$$\mathbf{F} = -\epsilon_0 \frac{q_1 q_2}{r^2}$$

If Lowe were to treat this analogously to Newton's law of gravitation, then he would have to say that charged bodies form a kind. But that suggestion is implausible. Note that this law governs neutrally charged objects just as much as charged ones. It tells us that the force on a neutrally charged object is zero, and this is not trivial, since is allows for predictions and explanations. For example, a cloud chamber photograph may show the tracks of particles in an electric field: the negatively charged particles curve in one direction, the positively charged objects curve in the opposite direction, and the neutral objects travel in a straight line. The law explains all these behaviours. So the kind governed by Coulomb's laws includes *every* object. Is this kind then, the charged-or-neutral kind, the most inclusive kind of all? That seems odd—what is so special about *charge*? Indeed, returning to Newton's law, in Einstein's reformulation, that too encompasses bodies of zero (rest-)mass (photons are subject to the same law). Hence there is a charged-or-neutral all encompassing kind and there is a massive-or-massless kind, and these are coextensive. This is straining the position. What seems to be clear is that such laws have nothing to do with kinds at all. Rather, these are universal laws (they cover everything, without exception) and concern not the kinds to which entities belong but the properties (mass, charge) that the entities possess.

Thus it is not the case that all laws can be considered as the characterization of kinds by attributes. However, that conclusion does not show that laws form no basis for asserting the existence of kinds. For *some* laws might have this structure, and these might include the examples to which Lowe refers. The problem with saying this is that it leads to the conclusion that there is more than one sort of law of nature. In one the fundamental structure involves kinds, in the other it does not. It is then unclear what makes them both sorts of *law*.

More plausible is the idea that there is just one sort of law and either (a) kinds are not involved in laws at all, or (b) if kinds are involved, then they do not form a fundamental category distinct from the category of universals/attributes. Option (b) ought to include the possibility that kinds form a category distinct form that of universals/attributes but not a fundamental category—facts about kinds, including laws, might supervene on laws involving just universals.

Consider Lowe's example, the law that planets travel in ellipses. In this case there is some doubt over whether 'planet' forms a genuine kind at all. Though, interestingly, it does not matter much where the dividing line for 'planet' falls as far as this law is concerned. For entities smaller than planets obey the ellipse law (comets, asteroids). This suggests that the law does not really concern any kind *planet* at all. And indeed it does not. For Kepler's first law is derivable from Newton's laws of gravitation and motion plus the assumptions: (i) the system has only two bodies, (ii) one

body (the sun) is much more massive than the other (the planet), (iii) the orbit is periodic.[2] The reference to 'planets' in the law makes assumptions (ii) and (iii) true, but what explains the elliptical orbit is not the fact that the object is a planet, but that it is much less massive than the object it is orbiting. As far as this law is concerned, it seems that response (a) is correct, and Armstrong's reductionism is vindicated.

4

Now let us consider the other law mentioned, that *U. maritimus* is white. While this looks less like a traditional law, it does look more promising as a proposition that involves a kind in a way that does not permit the easy elimination that was available for 'planets travel in ellipses'. Nonetheless, the proposal that natural kinds and homeostatic property clusters at least suggests a possible reduction.

According to the homeostatic property cluster view, under certain circumstances a combination of properties can constitute a natural kind (Boyd 1999; Millikan 1999). This occurs when the laws of nature ensure that certain combinations of properties are disposed to be more frequently instantiated than other, nearby combinations of properties. In some cases the laws make those other combinations of properties impossible. So while the the property of having nuclear charge of three times the charge of a proton is instantiated in many entities (lithium atoms), and the property having nuclear charge of four times the charge of a proton is also instantiated in many entities (beryllium atoms), the property of having a nuclear charge of pi times the charge on a proton is not instantiated by any entities. The property of having nuclear charge of three times the charge of a proton can be combined with various properties of nuclear mass, ranging from 6.6 to 19.9 $\times 10^{-27}$kg, but not with any nuclear mass properties greater or less than these limits. Such combinations are excluded by the laws of nuclear physics. In other cases the nearby combinations of properties are not uninstantiated, but are infrequently instantiated. This may be the consequence of homeostatic mechanisms that keep such combinations rare. Certain combinations of weight, length, fur colour, numbers of toes, etc. are commonly instantiated in wood mice. Mice that weigh 25g, are 8cm long, and have brown fur are common. However, a mouse that was 80g, 12cm, and had bright orange fur would be less evolutionarily fit (being less able to breed with other mice, and more vulnerable to predation) and so will be unlikely to have many offspring compared to the more normal mice; hence that combination of properties (along with other murine properties) is likely to infrequently instantiated at best compared to standard combinations of mouse properties.

Now consider *ranges* of properties in combination, e.g. 20–35g and 7–12cm and ... (similarly for other murine properties). We could regard this collection of properties as the natural kind *Apodemus sylvaticus*. Of course, other combinations of ranges (25–40g and 8–13cm and ...) might also claim to be the collection of properties that is the kind. This question is the same as that which we face when we consider which collection of particles is some particular person or object; the metaphysics of vagueness has various competing answers to that question. That problem does not itself require us to deny that the object is indeed the sum of its parts, even though there is vagueness surrounding which parts those are. Likewise we can re-

[2] We need assumption (iii) since parabolic and hyperbolic paths are also solutions to Newton's equations in a two body system.

gard the kind as the sum of its constituting properties, even though it is vague which properties those are.

We could regard the combination or sum of properties as belonging to a new category of entities (as briefly suggested above). More plausibly it belongs to the same category as the entities of which it is composed, just as complex particulars are particulars as well as the particulars of which they are composed. Since the properties in question are universals (Lowe's attributes), we should therefore think of a natural kind as certain sort of complex universal. But even if natural kinds were members of a *sui generis* category, their existence would not be fundamental but would be dependent—dependent on the (non-substantial, i.e. non-kind) universals, the laws, and possibly certain contingent features of the world. Either way, we can see that what kinds there are in a world does not require the existence of natural kinds as fundamental entities. As it stands, this argument may not convince Lowe, since he holds that the laws themselves involve kinds. But as we have already seen, this is implausible for fundamental laws.

5

Lowe claims that his ontology has an advantage over Armstrong's when it comes to our understanding of the laws of nature. We have seen that there is no special reason to think that laws need to be understood in terms of substantial universals as opposed to attributes. Lowe's view might nonetheless be favoured if it can avoid the metaphysical problems that beset Armstrong's view.

Armstrong holds that laws should be understood as second order relations between first order universals (attributes). The second order relation is symbolised by 'N' (for necessitation'). So 'N(F,G)' symbolises the law that Fs are Gs. Armstrong tells us that:

(I) N(F,G) entails $\forall x(Fx \rightarrow Gx)$

The *inference problem* (van Fraassen 1989: 38–9) for Armstrong is to explain how it is that N achieves this. There are other second order relations among universals that do not have this property. So what is it about N that means that when two universals are related by N there is also a universal generalisation holding between them?

Lowe believes that his account avoids this problem, since it does not invoke the general second order relation N or anything like it. Rather, as we have seen, laws involve the characterisation of a substantial kind, S, by an attribute, A:

(II) A(S)

Unlike Armstrong, Lowe (2006: 131) does not think that laws entail universal generalizations; so it is not the case that A(S) entails $\forall x(Sx \rightarrow Ax)$. Rather, as mentioned above, the law does entail that each member of the kind in question is disposed in a certain way. The law that polar bears are white entails that polar bears are disposed to be white; this law is not falsified by the fact that some polar bears can appear pale green (on account of algae growing in their fur). The law that planets travel in ellipses entails that planets are disposed to travel in ellipses; this law is not falsified by the anomalous orbit of Uranus, disturbed by the gravitational pull of Neptune. And so it is true that:

(III) A(S) entails $\forall x(Sx \rightarrow$ x is disposed to be A)

However, it is unclear that Lowe's view really does avoid the problems associated with Armstrong's view. First, it is not quite correct to say that Lowe's view does do without second order properties and relations. Consider the law given above. S is universal and so is A. Since A is a universal characterizing a universal, it must be a second order universal. Lowe might claim that this is not right, since S is a substantial universal and A is an attribute, whereas in Armstrong's law N and F and G are all universals of the same category. But that seems to me to be a terminological difference. Armstrong could claim, on the ground that it is second order, that N is of a different category from F and G, and so say the same as Lowe.

The Lowean law above is only the simplest form of a law. Consider 'water dissolves salt'. We might symbolize this: D(W,S). As just argued, D, the dissolving relation, should be considered a second order universal; and in this case, it is a second order relation. Lowe (2006: 143–4) denies this on the ground that D can also relate particular objects, in instances of the law. So when some particular volume of water is dissolving some particular lump of salt (or is disposed to) then that relation is also D. But that does not seem quite correct to me. For particulars are not characterized by attributes; they are characterised by modes, and D is not a mode. Lowe does say that particulars *exemplify* attributes. But since characterization and exemplification are different connections between entities, it is a fallacy of equivocation (regarding the expression 'stand in') to say that both universals and particulars can stand in the relation D.

Lowe does emphasise another difference between his view and Armstrong's, that Armstrong employs one *general* relation N, whereas Lowe thinks that there is no general law-making relation. Rather, each law involves a specific attribute that suffices for a law when it characterizes a substantial universal. While this is an important difference, and one where my own sympathies lie with Lowe, it is worth noting that something like Lowe's view may be reconstructed using Armstrong's materials. Consider the Armstrong law above, N(F,G), and now abstract the property F, leaving N(_,G). The latter can be regarded as a second order property which in combination with a first order universal delivers a law. For example, consider Lowe's 'planets travel in elliptical orbits'. Armstrong would construe thus as N(planet, travels in elliptical orbits). Now think of this as the (second order) attribute N(_, travels in elliptical orbits) characterising the universal *planet*. This is just the form that Lowe ascribes to laws, except that in this case the attribute property is complex.

So Lowe's account of laws can be reconstructed in Armstrong's terms, differing only in that where Lowe has a simple attribute, Armstrong has a complex universal which in every case involves N plus some particular first order universal. Now let us ask the question, what is it about Lowe's understanding of laws that avoids the inference problem for Armstrong? The comparison between the views shows that where Lowe has a simple attribute, Armstrong has a complex one. But that should make no difference to the issue of how each is able to entail facts about particulars. If there is a mystery about how N can make (I) true, there must be a corresponding mystery about how A makes (III) true. The fact that N is a general component of laws in Armstrong's account, while A is a specific universal does not make any difference to this problem; indeed, as seen, Armstrong can create a specific universal that is the analogue of Lowe's. Equally, responses on behalf of one view will be available to the other. For example, one might argue that it is part of the essence of A that (III) is

true. If that is an adequate answer for Lowe, then Armstrong can say that it is part of the essence of N that (I) is true.[3]

The conclusion of this section is that Lowe's account of laws does not provide a metaphysics that avoids the inference problem for Armstrong, and so doe not give us an independent, metaphysical reason for adopting a category of kinds.

6

E. J. Lowe's four categories do provide a satisfying ontology. Yet I believe that it is over-inflated. It does not need the category of substantial universals (natural kinds). Lowe thinks that they are needed to account for the laws of nature. But that does not seem right because many laws of nature, including the fundamental ones, do not make any mention of kinds. And in other cases where laws do appear to concern kinds, we can see that what is really doing the work is a law that governs non-kind universals. In such cases it looks as if a simple reduction of kinds to combinations of universals is available along the lines proposed by Armstrong. Not all kinds can be dealt with so easily, for example those in biology. Nonetheless, the strategy can be extended, by considering kinds as homeostatic property clusters. Although Boyd does not see the latter in ontological terms, we can construe them as sums of properties, just as complex particulars are the sums of their component parts. This approach does not eliminate kinds, but shows that they are a special class of complex universal. Finally I considered the thought that while a fundamental and distinct category of kinds might not be strictly necessary to account for the claims of science, it might be required in order to avoid the metaphysical problems facing a sparser ontology. I have argued that analogous metaphysical problems in accounting for the relationship of laws to particulars beset Lowe's four category ontology as much as Armstrong's two category ontology.

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[3]Such a response might well be Armstrong's best option. But it does undermine his quasi-Humean rejection of essences of this sort and denial of metaphysically necessary connections between distinct existences. See Bird (2005).