A Problem for Natural-Kind Essentialism and Formal Causes

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Abstract:

A combination of formal causation and natural-kind essentialism has good prospects. After all, natural-kind essentialists are under pressure to accept that natural kinds ground or formally cause the properties that characterize them. However, natural-kind essentialists are committed to the claim that natural kinds essentially depend on the properties that characterize them, such as the property of unit negative charge in the case of the electron kind. We argue that, given plausible assumptions about grounding and dependence, these claims clash. After presenting the problem, we consider and criticize ways in which natural-kind essentialists could try to avoid it.

Key Words: Natural Kinds, Essentialism, Formal Causation, Grounding, Essential Dependence

Contemporary defenders of ontologies of natural kinds or 'substance kinds' have normally tried to assign them a unifying role in the explanation of the properties or attributes of an object. Natural kinds like 'Electron' or 'Horse' supposedly determine the properties that we deem essential for electrons or horses. The properties considered essential for an electron—its unit negative charge, its mass of 0.511 MeV/c^2, and its quantum spin of ½—can be had by other particles. Muon particles also have a unit negative charge, but have a much greater mass of 105.7 MeV/c^2 instead. So, there must be an ontological explanation of why those properties are always instantiated together in an electron—and necessarily, it seems. Natural kinds or substantial forms offer such an explanation because they are what ground or formally cause the essential properties of electrons or horses. The same defenders of natural-kind metaphysics, nevertheless, have also maintained that the essence of a kind like 'being an electron' is nothing more than to be something that has a unit negative charge, a mass of 0.511 MeV/c^2 and a quantum spin of ½. At least, it is part of the essence of an electron to be something that has these properties. Natural kinds, then, are essentially dependent on those properties. There

seems to be a tension between these two claims—that natural kinds ground or formally cause essential properties but, at the same time, natural kinds are dependent on those properties. We will argue that the conjunction of these two claims is indeed incoherent.

The incoherence comes from the fact that if natural kinds ground properties on which they depend, the requirement of non-circularity is violated. This requirement has been formulated for the relation of grounding and for the relation of essential dependence separately. But it is also a requirement that should be satisfied when grounding and dependence occur between the same *relata*, or so we will argue. We will argue that the problem of circularity is not assuaged if we switch from talk of 'grounding' to talk about 'formal causation'. Neither does a 'structuralist' stance work for a natural-kind essentialist.

In the first section we will present some of the main characteristics of the relations of grounding and dependence, and what constraints must be respected when they interact. In the second section, we will introduce the main problem as it occurs in natural-kind essentialism. The third and fourth sections will discuss some alternatives that may be attempted by defenders of natural-kind ontologies to assuage the problem presented, in particular, a theory of 'substantial forms' and a structuralist stance towards the connection between kinds and essential properties. What appears through this examination is a significant concern for all those enthusiastic about the prospects of 'formal causes' in metaphysics. The function attributed to these causes should be treated carefully to avoid incoherent structures of ontological explanation.

1. Grounding and Essential Dependence

A lot of recent work has been devoted to improving our understanding of notions of 'ontological priority' and 'ontological explanation'. These developments have been made under the supposition that these notions do not admit of an analysis in terms of other concepts like, for example, modal notions about what is necessary or possible, or distributions of facts across possible worlds. The notions of 'ontological explanation' have been taken to be primitive. There are many issues that are still hotly debated, but here we will rely only on some very general features of the concepts of ontological explanation that have been—almost— universally accepted in the literature (for extensive discussion see Bliss and Priest 2018). When it comes to 'explaining' something, say *X*, from the metaphysician's point of view, there are two main questions that might be addressed: *what* is *X* and *why* there is an *X* (Fine 2015: 296). An answer to the first question is an answer that aims at the *essence* of *X*, i.e. aims at what is the *identity* of an *X*. An answer to the second question, on the other hand, is an answer that aims at what *grounds* the existence of *X*.

The relation of grounding, in the first place, has been considered to be the relation that obtains between entities b_1, b_2, … and *c* when the existence or obtaining of b_1, b_2, … is 'constitutively' sufficient to necessitate the existence or obtaining of *c*. 'Constitutively sufficient' here means that the connection between the grounded and its base of grounding is a fact of metaphysical necessity. It has been—almost—universally accepted that grounding is a transitive relation and non-circular, which implies asymmetry (among many others, Fine 2012: 56; 2015: 296–7; Audi 2012b: 692; Raven 2012: 689; 2013). So, if *b* grounds *c*, then it is not possible that inversely *c* grounds *b*. There is a reason for this requirement. The ground of an entity is its ontological base that guarantees its existence. A grounded entity is something ontologically 'deficient'. It cannot exist on its own, but only in virtue of the existence of a base of entities that, for this same

reason, are ontologically prior. If there is a situation of mutual grounding between two different entities, then something ontologically 'deficient', that requires the prior existence of its ontological base of grounding, should ground—in its turn—that very base. It is, then, an incoherent situation.

In the second place, the relation of essential dependence is the relation that obtains between entities *b* and *c*, when *b* is part of the essence of *c*, such that it is impossible for *c* to exist without the existence of *b*. The 'essence' of an entity is taken to be a primitive fact (Fine 1994, 1995). It is the 'identity' of the being in question. An entity 'depends' ontologically on another if the second is 'constitutively' necessary for the existence of the first. 'Constitutively necessary' means here that the connection between an entity and its base of dependence is a fact of metaphysical necessity. Essential dependence has been taken—almost—universally to be a transitive relation that, like grounding, satisfies the requirement of non-circularity (Fine 2015: 296–7; Lowe & Tahko 2015: § 3). So, if *c* essentially depends on *b*, then it is impossible that *b*, in its turn, essentially depends on *c*. The reasons for this requirement are analogous to those presented for the non-circularity of grounding. An entity that is essentially dependent on other is ontologically 'defective' because it cannot exist by itself. It requires a 'complement' without which it could not exist. In a situation of two mutually dependent entities *b* and *c*, *c* requires the necessary 'complement' for its existence that comes from *b*. But *b*, in its turn, is also requiring a 'complement' to exist, that comes from the very same entity *c* that requires it in the first place. It is, then, an incoherent situation.

It might have been noticed that in our presentation of the relations of grounding and dependence we have supposed that both obtain between entities of any ontological category. It is usually

assumed that the relata of the relation of essential dependence are objects (see, for example, Fine 1995). The usual treatments of grounding, though, suppose that its relata are 'facts', and not objects (see, for example, Rosen 2010; Audi 2012a, 2012b; Raven 2012). Some have analysed grounding as a sentential operator (Fine 2012) in which the type of entities that are involved as truthmakers of statements of ground is left undefined. Here we require a unified treatment of both relations to formulate the framework for the central problem that is going to be discussed. That unification can be done in at least two ways: either by supposing that both grounding and essential dependence are some sort of sentential operator, or by supposing that both relations hold between entities of any ontological category. Fine has developed a unified treatment with sentential operators (Fine 2015). We prefer here a unified treatment using trans-categorial relations (Wilhelm 2019), but everything we argue here can be formulated in terms of Finean operators, if someone has reservations about the applicability of relations of grounding to any entity whatsoever.

The existence of two different relations of ontological priority, i.e. grounding and essential dependence, opens up the conceivability of situations in which both relations occur—or don't. For example, Elizabeth Barnes has maintained that an 'emergent' entity is something that is dependent on an ontological base, but is not grounded in it (Barnes 2012). Kit Fine has maintained that in the case of reductive conditions of identity for a type of beings, the identity of something is both grounded in and essentially dependent on an ontological base (Fine 2016). In cases of material constitution, it has been supposed that a hunk of matter structured in a certain way grounds an object, but the object does not depend essentially on that individual piece of matter rather than some other of the same type (Baker 2000: 27–58). In the cases described by Fine there are relations both of grounding and essential dependence, but they run in the same direction. Something similar happens with sets and their members, or with

mereological sums and their parts. A set is both grounded in and dependent on its members. A mereological sum is grounded in and dependent on its parts. In the cases of emergence and material constitution there is just one of the relations of ontological priority but not the other. In cases of emergence something is dependent on an ontological base, but it is not grounded in it. In cases of material constitution something is grounded in a hunk of matter—or a plurality of objects—organized in a certain way, but it is not dependent on it.

In the philosophical tradition, the idea of a 'formal cause' is the idea of a 'form' that determines *why* something is the way it is. The idea was arguably introduced by Plato, and canonized by Aristotle in *Metaphysics* V 2, 1013a24–7. 'Forms' sometimes integrate adequate ontological explanations. A 'substantial form' determines *what* something is. If X is a cat, it is because there is some structure or 'form' determining that the hunk of matter composing X at a time is organized in the characteristic way in which cats are organized as living organisms. A 'substantial form', then, seems to be something that, precisely, grounds the essential properties (Oderberg 2011: 98; but see also the reservations in Sandstad forthcoming). It is also something that such a substance has as its essence.[2] We will consider how an example of 'formal causation' is apparent in the way that several philosophers have treated the explanatory role that natural kinds have. First, *objects* that fall under a natural kind have that kind as its essence—or, at least, as part of its essence. Second, natural kinds ground the essential *properties* that the objects of the kind have.[3] The problem that will be presented below has to do with a further explanatory relation of dependence that is typically endorsed by defenders of natural-kind ontologies between the kinds and essential properties themselves. Of course, this is not the place to discuss the delicate issue of whether, in general, 'causation' can be conceived as a species of grounding or dependence, or vice versa (see for discussions of this topic, Sandstad forthcoming; Schaffer 2016; Wilson 2018). Although it seems to us that 'formal

causation' is simply a type of grounding, our argumentation does not rely on this assumption. Even if one were to suppose that 'formal causation' is a type of causation *sui generis*, the problem that is going to be presented below still stands.

The kind of difficulty that we have here in mind involves occurrences of grounding and essential dependence, but in opposite directions. This is, in effect, a situation in which *c* is grounded in *b*, but at the same time *b* is dependent on *c*. We contend that a situation of this type is incoherent (see Jaag 2014, who makes a similar claim in connection with the dispositional theory of properties). Note that it is not a violation of the requirements of non-circularity either for grounding or for dependence taken by themselves, because it is not a situation in which the same items are grounded both ways, or dependent on each other. It is a situation, nevertheless, in which there is a problem of circularity. Here is why: there is something *c* whose existence is in some sense 'defective' because it is grounded in some other thing *b*—that is ontologically prior to it—but the base of grounding *b* is, in its turn, ontologically defective because it depends precisely on the same thing *c*. So, *b* requires for its existence something that, supposedly, *b* itself guarantees 'constitutively'. We are afraid that exactly this problem affects several conceptions about natural kinds put forward in recent decades.

2. The Problem for Natural-Kind Essentialism
In the previous section we saw why it is incoherent to suppose that something could ground that on which it essentially depends. This argument works on the assumption that grounding and essential dependence are asymmetric, an assumption that is widely held in the literature. Let us assume this asymmetry claim and introduce the problem facing natural-kind essentialism.

We believe the problem outlined below is common to most (if not all) versions of natural-kind essentialism, including those developed within a neo-Aristotelian hylomorphic framework (e.g. Oderberg 2007, 2011) and those who hold a primitive substance metaphysics along the lines of Lowe's four-category ontology (Lowe 2006, 2015). We shall mention a selection of other natural-kind essentialists who appear to face the problem, but we shall also provide general reasons for thinking that the problem is widespread.

Consider the following two claims, which we believe natural-kind essentialists are committed to (either implicitly or explicitly):

> **(1)** *Being an electron* is essentially dependent (in part) on *being unit negatively charged* and *having a spin of quantum number ½*.

> **(2)** *Being an electron* grounds *being unit negatively charged* and *having a spin of quantum number ½*.

In the light of the discussion of the previous section, one can see that the conjunction of these two claims is problematic, for it entails that being an electron is both essentially dependent on, and the grounds of, certain properties (namely having a certain charge and spin). Before showing in more detail why natural-kind essentialists are under pressure to accept both of these claims, first some clarifications.

Under the natural-kind essentialist framework we are assuming, the kind term *being an electron* and the properties *being unit negatively charged* and *having spin ½* are to be interpreted as *immanent universals*., i.e. as universals which are necessarily instantiated and exist through

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those instantiations. Thus, whenever we use the term 'universal' in what follows, we shall mean 'immanent universal'. Note also that in the literature, kind universals (as we are calling them) are sometimes referred to as *substance universals* or *substantial forms*. Given that the formal relations in **(1)** and **(2)** (essential dependence and grounding) are posited at the level of universals, they are second-order claims. However, given that we are dealing with immanent universals, the formal relations involved in **(1)** and **(2)** will also be manifested at the level of particulars. For example, in the light of **(1)**, it will be the case that each individual electron is essentially dependent on its being unit negatively charged and having spin ½. In the light of **(2)**, a particle's being an electron will ground its being unit negatively charged and having spin ½. Hence, although we have formulated our argument above in terms of the universals themselves, the same argument will apply at the level of particulars.

Further clarifications: In **(1)** we say that *being an electron* is 'in part' essentially dependent *on being unit negatively charged* and *having a spin ½*. This is because we do not claim that these two properties exhaust the essence of the kind electron. As we saw earlier, an electron is also characterized by having a certain mass, which may well be essential to it. However, for simplicity we will just focus on two properties. Regarding **(2)**, we intend to employ the term 'grounds' in a flexible way. All that matters for our purposes is that there is an asymmetric determination relation running from kinds to the properties necessarily associated with them. Some may wish to view this grounding as a primitive determination relation (e.g. Audi 2012a: 117) along the lines of Fine (2001), Rosen (2010) and Schaffer (2009). However, as we shall see below, we believe that our criticisms still hold if 'grounding' refers to formal causation (e.g. in Oderberg 2011) or something like entailment (e.g. Dumsday 2019: 100).

We believe it is uncontroversial to claim that natural-kind essentialists are committed to the sort of claim expressed in **(1)**. That is to say, in order to specify the essence of a natural kind, one has to specify the properties that a thing must instantiate in order to count as a member of that kind. Those properties express what it is to instantiate the relevant kind, and therefore the kind depends for its identity and existence on them (see Heil 2012: 113, who explains Lowe's Natural-kind essentialism in these terms). This is precisely what is captured by the essential dependence claim in **(1)**. In neo-Aristotelian terms, the properties on which a kind essentially depends are those properties that appear in the *real definition* of that kind (Oderberg 2011: 87). Since it is plausible that being negatively charged and having spin ½ are part of the real definition of being an electron, we believe that the essential dependence claim expressed in **(1)** should be uncontroversial for natural-kind essentialists. Indeed, in many discussions of Natural-kind essentialism, the electron example is explicitly used to illustrate the view, which is in part why we have chosen it. For example, when outlining Natural-kind essentialism, Mumford writes: 'the natural electron kind has the essential property of being negatively charged' (Mumford 2005: 422; see also Dumsday's essentialist discussion of the electron kind, 2010: 619–620). We note, though, that even if such characterisations of being an electron are empirically mistaken, the natural-kind essentialists will still maintain that there are some properties out there that essentially characterize the kind. Claim **(1)** could then be adjusted accordingly.

Let us now turn to **(2)**, which is perhaps more controversial. We do not claim that a commitment to **(2)** is *entailed* by a commitment to **(1)**. However, we believe that natural-kind essentialists are under pressure to accept **(2)**. Here's why. Sometimes, when a thing is essentially dependent on an entity or entities, it is also *grounded* in that entity (Fine 2015). For example, to use Fine's favourite example, Socrates' singleton set is essentially dependent on Socrates and the set is

also *grounded by* Socrates. If Natural-kind essentialism were to follow a similar metaphysical structure, it would have to accept the reverse of **(2)**, and say that natural kinds are *grounded in* the properties or attributes that essentially characterize them. But this is surely something that Natural-kind essentialism cannot accept. If a natural kind is both essentially dependent on certain properties *and* grounded in those properties, this would suggest that natural kinds are not fundamental—in the same way that singleton Socrates isn't fundamental. Rather, it would begin to look as though the category of properties or attributes is fundamental, while natural kinds are derivative from, or reducible to, them. In contrast, for natural-kind essentialists natural kinds *do* form an irreducible and fundamental ontological category. The upshot of this is that the natural-kind essentialists are under pressure to explain why a fundamental category of natural kinds really is needed. Why not just say that properties ground natural kinds? It is here that **(2)** begins to look attractive to natural-kind essentialists. If there are reasons for thinking that natural kind universals are needed to ground the properties that characterize them (rather than vice versa), then natural kinds would again look fundamental and irreducible. By insisting on the fundamentality of natural kinds in this way, one can rebut the arguments of Armstrong (1997), Bird (2012), and others, who all claim that natural kinds are reducible to clusters of properties. By accepting **(2)**, fundamental natural kinds can earn their metaphysical keep.

How then can a natural-kind essentialist motivate claim **(2)**? A common line of argument is that grounding claims like **(2)** can help solve a *unity* problem (Oderberg 2011: 90), or what Dumsday (2010: 619–20) calls the 'problem of complex essences'. Oderberg summarizes the 'unity' problem as follows:

> if the essence is a group (set, bundle) of properties, what holds those properties together? Why, in the
>
> case of a K with putative essential properties F, G, and H, are those properties always and only found

together in the Ks, assuming that the essential properties specify what a K is such as to distinguish Ks from every other kind of thing? (2011: 90)

The problem, then, is that of explaining why the relevant properties of a natural kind always cluster together in the way that they do. On a non-essentialist, Humean theory of natural kinds, this would be considered a cosmic accident, which is surely something that natural-kind essentialists will not accept. Fortunately, there is a fairly obvious answer to the problem: the natural kinds themselves are *sui generis* universals whose instantiation simultaneously *grounds* the essential properties associated with them. Grounding, as we are understanding the term, is a relation of determination and necessitation that underpins *metaphysical explanation.* Thus, it is the natural kinds themselves that explain the property clustering patterns. When formulated as a second-order claim, this solution leaves us with grounding claims along the lines of **(2)**. In his later work, Dumsday asserts precisely this grounding claim on behalf of natural-kind essentialists as a way of unifying the properties that characterize kinds, writing that

the *substance-universal* or *kind* […] is real and irreducible to the properties necessarily associated with it; moreover it serves to ground those properties, explaining their presence and coherent unity (2019: 118)[4]

If one does not like the contemporary notion of grounding, one can solve the unity problem just as well by insisting that natural kinds *formally cause* properties (e.g. Oderberg 2011: 103; see also Oderberg's contribution to this volume) or that natural kinds *entail* certain properties (Dumsday 2019: 100). Again, we use the term 'grounding' in a flexible way so as to allow these different interpretations.

The sort of grounding claim expressed in **(2)** also leads to a related benefit, which is that an anti-Humean account of natural laws seems to be available. Recall that the term 'being an electron' is being used here to refer to a universal. If one instantiation of being an electron

grounds certain charge and spin properties, then all such instantiations will. Hence, it seems natural kinds can be exploited in order to give an underlying metaphysical explanation for laws like 'electrons are negatively charged'. According to the Humean conception of laws, such a law expresses a brute, contingent regularity. Many find such a conception of laws incredible, in part because it fails to explain why our world is so highly ordered. Many feel that there has to be genuine necessitation at work in laws. Fortunately, Natural-kind essentialism promises to provide a necessitarian account of laws like 'electrons are negatively charged'. This nomic fact—about being negatively charged—can be grounded by the natural kind *being an electron*, which means that fact is naturally or metaphysically necessary.

The most prominent advocates of this approach are Lowe (2006) and Ellis (2001) (see also Keinänen and Tahko 2019; Sandstad and Jansen, 2020). Ellis explicitly uses grounding terminology when summarising this account of laws, for instance:

> …laws are not superimposed on the world, but grounded in the natures of the various kinds of things that exist. Even the most general laws of nature, it is argued, may have such a foundation, since they would appear to be distinguished only by the fact that they derive from the natures of the most general kinds of things. (2002: 36)

This concludes our main discussion of claims **(1)** and **(2)**. We believe that, within the natural - kind essentialist framework, there are good independent reasons for accepting both **(1)** and **(2)**. As well as providing examples of natural-kind essentialists who explicitly accept claims along the lines of **(1)** and **(2)**, we have marshalled general considerations to suggest that most (if not all) natural-kind essentialists are under pressure to accept both **(1)** and **(2)**. Unfortunately, this brings us to the overarching point of the paper which is that the conjunction of **(1)** and **(2)** is problematic. In section one we examined general reasons to think that something cannot ground that on which it is essentially dependent. In order for such a structure to obtain, an entity has in some sense to be metaphysically or explanatorily prior to its essence, which is arguably incoherent. Our aim in this section has been to show that natural-kind essentialists tend to unwittingly commit this error.

We also doubt that the situation is improved if we replace the grounding terminology in **(2)** with some other *sui generis* determination relation. We anticipate that many natural-kind essentialists will protest that they would not endorse a grounding claim along the lines of **(2)** because in the contemporary grounding literature grounding structures are said to impose a strict partial order on reality, such that grounded entities are less fundamental than their grounds. On this interpretation of grounding, **(2)** might look immediately mistaken because natural-kind essentialists typically take the category of kinds and properties to be equally fundamental (e.g. Lowe 2006). This might lead natural-kind essentialists to insist instead that kinds are merely *causally* prior to their properties, which is consistent with saying that the natural kinds (the formal causes) are not ontologically prior to the properties they cause.

In response, we think that the problem still stands even if natural-kind essentialists express claim **(2)** in terms of formal causation, and this is in part why we are happy for the term 'grounding' in **(2)** to be a placeholder for whichever metaphysical determination relation one wishes to posit. If **(2)** is interpreted in terms of formal causation, the conjunction of **(1)** and **(2)** leaves us with the claim that natural kinds are causally prior to the properties on which they essentially depend. We still find this idea difficult to comprehend. If X essentially depends on Y, then surely Y must already exist in order for X to exist, since an entity depends for its identity on its essential properties. And surely X cannot cause something (formally or otherwise) unless it already exists. So, we fail to see in what sense something could be causally prior to that on which it essentially depends. Certainly, it is difficult to think of any other case where such a structure sounds plausible.

In sum, our worry is that it is difficult to see how different elements of the natural-kind essentialist project fit together in a metaphysically coherent way. In section four we shall consider some ways of avoiding the problem. However, these strategies either rely on controversial claims about grounding and essential dependence, or require a significant departure from a robust form of natural kind essentialism. Before examining these alternatives, though, we shall briefly consider whether a neo-Aristotelian metaphysics of substantial forms—along the lines of that developed by Oderberg—might be able to avoid the criticism that we have raised against the essentialist theories discussed so far.

3. Can Substantial Forms Solve the Problem?

Neo-Aristotelians might reply to the previous section by insisting that our arguments above assume a naïve version of natural kind essentialism, one on which the essence of a natural kind is given by a conjunction of properties. This sort of Natural-kind essentialism is what Oderberg calls 'privileged group theory' (2011: 9) and he thinks many influential essentialists hold this view, among them Kit Fine (1995). So, perhaps the way forward is to construct a theory of kind essences that is more sophisticated. Oderberg's essentialism aims to do just that by moving away from privileged group theory. As we shall see, according to Oderberg's hylomorphic theory—which conceives natural kinds as principles of unity called 'substantial forms'—the constituents of a form's essence are not properties at all, properly speaking. Moreover, Oderberg's notion of formal causation is applied to the genuine properties or 'necessary accidents' (2011: 98), which means Oderberg may have reasons to question the grounding claim expressed in **(2)**, which concerns essential attributes. In this section, then, we shall briefly discuss Oderberg's theory and consider whether it avoids the problem as formulated in the previous section. We doubt that it does overcome the problem but even if it does, the theory requires us to accept some controversial metaphysical theses.

One of Oderberg's reasons for denying that kind essences are properties is that it leaves us with a muddled view about the nature of kind essences:

> That the constituents of essence explain a thing's properties is not something the essentialist should dispute. That the constituents are themselves properties should, however, be denied. For if the constituents of essence are properties, and these essential properties need an explanation of their unity in terms of form, then we have something of a case of metaphysical double vision. It would be otiose to hold the essence to consist both of the unified essential properties and the real principle that unifies them. Since the unifier is metaphysically distinct from what it unifies, essence on this view would simply have a duality it does not need. (Oderberg 2011: 94–5)

Like us, Oderberg thinks that common versions of Natural-kind essentialism harbour an internal problem, one which arises (in part) from the need to solve the unity problem. On his version of the problem, there is pressure on privileged group theorists to say, oddly, that natural kinds have two different essences—a set of properties on one hand, and a unifying essence on the other.

Oderberg's proposed solution is to find a middle way between privileged group theory and a view on which natural kinds have a 'bare' essence—a something we know not what. Oderberg's idea is that the natural kind essences ('substantial forms') are primitive unities that have universals (what we have been calling the essential properties) as constituents (see also the latter parts of Oderberg's contribution to this volume). However, these primitive unities are in some sense metaphysically simple, which means that these constituents should not be thought of as distinct parts of the form. This is why, on his theory, we should not think of kind essences as consisting of a conjunction of distinct *properties*. Unlike the kinds in privileged

group theory, Oderberg's forms already come with a ready-made unity. Oderberg illustrates this neo-Aristotelian theory with the example of the form *being human*:

> What unifies human beings, however, is not a definition but their form. Their form is a combination of rationality and animality, but not in any way that enables us to say that rationality and animality are parts of the form of a human any more than that they are parts of a human themselves. Rationality and animality are universals; as such, they are distinct entities. Animality can be instantiated where rationality is not (in non-rational animals). Rationality could be instantiated where animality was not (in the case of God, spirits, or other disembodied intelligences).

> None of this means, however, that in the human being rationality has a distinct existence from animality or animality from rationality, as though there were two forms in the human being, combined or added together in some way. The rationality of the human being is animal, and the animality of the human being is rational [...] Hence we must say that that substantial form, i.e. the form of the substance, is simple and without elements (Oderberg, 2011: 96).

The idea, then, is that although the essence of 'being a human' involves universals, such as *being rational*, these universals are not composed in a *mereological* sense. The elements are not loose and separate but rather fused together as a primitive unity—in this example the unity of being a rational animal. Although the rationality of humans can be separated out in thought from the animality of humans, this is only because we are capable of cognitive processes of abstraction or partial consideration (to use a Lockean phrase). Given the primitive unity of the forms, there is no longer any need to invoke a further entity in order to explain the unity of a kind's essence.

We think the most problematic feature of Oderberg's 2011 theory is that, in one sense, the forms seem to have an internal structure—in part to help distinguish each form from others—while on the other hand they are said to be simple and indivisible.[5] However, perhaps a comparison with Armstrong's states of affairs can help to shed light on the theory. According

to Armstrong (1997), the world is fundamentally made up of states of affairs (sometimes called 'facts'), which are primitive fusions of particulars and universals. This is not a case of mereological fusion because the relevant particulars and universals could exist without the state of affairs involving them existing. What Armstrong requires, then, is a *non-mereological* form of combination in the case of states of affairs. We think that something similar must be going on in Oderberg's substantial forms. The constituent universals of a form's essence (some of which may themselves be forms) could each exist without the form existing, and what unifies them is simply the form itself, which combines them in a non-mereological way. It is perhaps less clear whether Armstrong would say that states of affairs are metaphysically simple—in the way that Oderberg says forms are simple in the quote above—but there is at least one interpretation of states of affairs that interprets them in this way (see e.g. Bynoe 2011: 99 and Hossack 2007: 45–6 on the 'structuralist' interpretation of facts). In any case, the problem here is that many philosophers are unhappy with the idea of non-mereological combination (e.g. Lewis 1986). Moreover, it is unclear to us how entities which are metaphysically simple could each explain different sets of properties or accidents, which is what Oderberg's theory of formal causation requires.

What, then, must Oderberg say about our claims **(1)** and **(2)** in the previous section? First, we do not think that Oderberg's theory entails a rejection of claims along the lines of **(1)**. It is true that Oderberg would resist saying that charge is an essential *property* of the electron form, but this in itself is not problematic because **(1)** does not employ the concept of propertyhood. All that **(1)** says, under our interpretation, is that the kind 'being an electron' essentially depends on the universal 'negative charge' and the 'universal of having spin ½'. This is consistent with the Oderberg quote above, where he speaks of rationality being a universal. Elsewhere it is clear that Oderberg is happy for these universals to be regarded as constituents (in the non-

mereological sense) of the kind essences (e.g. 2011: 90 n. 40). All that is then needed to get us to **(1)** is the idea that the universals which constitute a form's essence are *essential* constituents, and we do not see how Oderberg could reject this idea.

We suspect that if a supporter of Oderberg's theory were to respond to our argument in the previous section, then they would have to question **(2)**. At first glance, this seems to be the route that Oderberg takes because his account of formal causation is restricted to *properties*, and as we have seen Oderberg does not regard constituents of a form's essence (in the case we are using, charge and spin) as being properties. An example of a property (or what Aristotle calls *propria*) in this sense would be, for example, the redness of blood (to use Oderberg's example) or the boiling point of water. These properties may well be necessary attributes of the relevant kinds but they are arguably not essential.

What emerges from Oderberg's account of formal causation is a threefold distinction about how universals can enter into a substance (so to speak). Universals can sometimes be essential constituents of a substance's form, they can sometimes be necessary properties which *flow* from the form, or they can be mere contingent accidents (as in Oderberg's case of the redness of a fire engine, 2011: 107). Oderberg certainly asserts that forms (kinds) are the formal causes or grounds of the properties associated with them (e.g. 2011, sect. 5), but it is less clear whether he needs to say that forms are the formal causes or grounds of the universals that are their essential constituents. Hence, perhaps a supporter of Oderberg's theory could reject claims like **(2)**.

We are not entirely convinced by this line of response, however. As we saw earlier, Oderberg is aware of the challenge of how to unify the various essential attributes of a kind and it is one that he takes seriously. It seems to us that Oderberg's primitive unities (the forms) are well placed to metaphysically explain the distinct facts that electrons are negatively charged and that they also have spin of ½. Like Armstrong's states of affairs, the forms are in some sense prior to the components that they unite.[6] And the reason why electrons are both negatively charged and have spin ½ is that these universals are united in the electron's kind essence. Importantly, this is a non-trivial explanation because, as noted earlier, non-kind universals (like charge and spin) can in principle characterize more than one kind of thing and are therefore separable—even though they are indivisible when united by a form.

If the notion of formal causation is restricted only to non-essential (but necessary) properties, so that claims like **(2)** are ruled out, then it is not clear that formal causation will be applicable at all in the case of elementary particle kinds like *being an electron*. This is because, in the case of elementary particles, they have so few attributes that it does not seem implausible to view *all* of the non-relational universals associated them as being essential. As Armstrong puts it (1997: 96), all electrons are thought to be *identical* in nature. However, if one denies that particle kinds formally cause their attributes, it is unclear how a metaphysics of fundamental natural kinds can earn its metaphysical keep at the level of fundamental physics. Hence, we suspect there is pressure for all robust natural kind essentialists to accept claims like **(2)**, including Oderberg.

We could, of course, be wrong about Oderberg's theory and that there could be reasons for his supporters to reject **(2)** that we have overlooked. In that case, the conclusion of this section

would be that if one accepts Natural-kind essentialism, then one ought to accept a view of kind essences along the lines of Oderberg's, on which kind essences (forms) are primitive unities. But as noted above, this theory does not come without costs because it has a number of features that some will regard as problematic. As we noted above, some philosophers are hostile to non-mereological conceptions of constitution, and there is still the puzzle of how a heterogeneous property profile could flow from (i.e. be formally caused by) a form that is itself metaphysically simple.

4. Alternative Strategies for Natural-Kind Realists

Let us assume that the core argument of the paper, presented in section two, is sound. Where should those who take natural kinds seriously go from here? Of course, a defender of natural kinds could change the structure of ontological priority proposed. She could suppose that natural kinds are not essentially dependent on properties but ground them. Or she could suppose that natural kinds don't ground those properties, but depend on them—in which case, she must suppose that natural kinds are either 'emergent' from essential properties or grounded by them. We will briefly discuss here, nevertheless, a different strategy that may be described as 'structuralist', in the spirit of structuralist ontologies that have been put forward in philosophy of mathematics and philosophy of physics. For example, it has been argued that the essence of a mathematical object, like the number Three, is determined by the totality of the relations that it has to all other members of the natural number series. As the same happens with the other numbers of the series, a mathematical object like number Three is both dependent on all other numbers of the series, but all those other numbers depend on number Three (Shapiro 1997: 77-84). In the ontology of physics some have maintained that, at the fundamental level, the essence of an object is determined by the relations that it has to other entities in a system. So fundamental physical objects are both dependent on the other objects of a system, but those

objects are also, in turn, dependent on the first (Ladyman & Ross, 2007: 130-154; see also Bird 2007, Ch. 6, for a structuralist view at the level of fundamental property universals). Naturally, any of these cases are likely to be in violation of the requirement of non-circularity referred to earlier.

It has been pointed out that the type of problem that affects natural-kind ontologies is not a violation of the requirements of non-circularity for essential dependence or for grounding taken individually, but it is a problem of circularity nevertheless. So, a 'structuralist' strategy may attempt a relaxation of the formal constraints normally attributed to the relations of ontological priority. The idea that a defender of an ontology of natural kinds could propose is that natural kinds and essential properties have no hierarchy of ontological priority between them. They form a unitary structure whose identity is determined by the mutual relations that obtain between its components. So, natural kinds should not be conceived as something ontologically prior or posterior to the essential properties connected to them. Neither should essential properties be conceived as something that, somehow, are prior or posterior to the natural kinds to which they are connected. Natural kinds are what they are only as 'nodes' of a structure in which their position in it is what gives them their essence. The same happens with essential properties. So, for example, *being an electron* is nothing prior to the property of *having negative charge*, nor is *having negative charge* prior to the kind *being an electron*. The essence of the kind *being an electron* is just the position in a structure in which it grounds and depends essentially on the property of *having negative charge*. The essence of the property of *having negative charge* is just the position in the same structure in which it is grounded in and is the base of dependence of the kind *being an electron*. If structures analogous to these are acceptable—or, at least, intelligible—for mathematical objects or for fundamental physical

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entities, a structure having natural kinds and properties as constituents should also be intelligible.

In fact, in the same philosophical tradition in which 'forms' are conceived as things that 'cause' properties and the nature of an object, they are postulated as things that integrate a hylomorphic structure with a 'material cause' (Suárez, *Disputationes metaphysicae* XVI, 8–9). It has been explained above how the theoretical function attributed to a 'formal cause' can be described as grounding and essential dependence. Something analogous happens with the 'causation' that a hunk of matter contributes in a material substance. The matter of a substance at least partially grounds it—although it is not clear if the substance must be taken as essentially depending on the matter. So, the hylomorphic structure of a material substance seems to require the mutual 'causation' of form and matter. Even for 'efficient' causation there are some cases of symmetric causation that have been discussed in the literature, like the case of a pair of mutually supporting cards (Molnar 2003: 192–4; but see also Frankel 1986: 365–6). So, it seems that someone who is inclined to accept the idea of a 'formal cause' and a hylomorphic ontology is already accepting structures in which their constituents have connections of grounding and essential dependence, but there is no ontological priority between them. Philosophers like Oderberg, then, should not be uncongenial to a 'structuralist' strategy like the one presented here.[7]

Nevertheless, we see here at least two important problems for a 'structuralist' ontology of natural kinds and essential properties. In the first place, a relaxation of the formal requirements for the relations of grounding and essential dependence does not come for free. It is not mere prejudice to suppose that grounding and dependence are irreflexive, asymmetric and

transitive—as has been supposed almost universally. We cannot offer here a detailed discussion of the reasons that have convinced philosophers that reality has a hierarchical structure determined by relations of grounding and dependence, but these reasons exist (see, for example, Raven 2013). The requirements of non-circularity for grounding and dependence are not only intuitive. It seems obvious that nothing grounds itself, as well as that something that depends on itself is simply something *in*dependent. It seems obvious that if *a* grounds *b*, and *b* grounds *c*, then *a* grounds *c*. It seems obvious that if *a* essentially depends on *b*, and *b* essentially depends on *c*, then *a* essentially depends on *c*. And from the irreflexivity and transitivity of grounding and essential dependence, it follows that those relations should also be asymmetric.[8] A defender of a 'structuralist' view of natural kinds must explain why we have to abandon all or some of those restrictions. We think that the extant defences of unorthodox conceptions of grounding and dependence (e.g. Thompson 2016 and Barnes 2018) are far from having given convincing reasons.

On the other hand, it is not obvious that a conception in which natural kinds and essential properties are conceived as nodes in a structure needs to reform the characteristics of grounding and dependence as strict orders. There is at least one way in which a structure can be conceived without supposing nothing but irreflexive, asymmetric and transitive connections of grounding and essential dependence. In the 'structuralist' view presented here natural kinds and essential properties are grounded in and dependent on each other. But one can conceive natural kinds and properties as grounded in and dependent on relations that are ontologically fundamental, instead of conceiving those natural kinds and properties as mutually dependent or grounded. A conception that supposes that relations are ontologically fundamental goes against a philosophical orthodoxy that has traditionally thought of relations as dependent on their *relata*, but a 'structuralist' defender of natural kinds has to break with some orthodoxy or other

anyway. The problem here, though, is that there is no clear reason why a defender of natural-kind essentialism should opt for an alternative along these lines rather than a rejection of the requirements of non-circularity. The problem, also, is that a conception in which natural kinds are reduced—or eliminated—as mere nodes in a structure constituted by fundamental relations doesn't seem to be a natural-kind essentialism anymore, because natural kinds are not doing the explanatory work they are supposed to do in respect of essential properties and their unification. It is not even clear why one should keep natural kinds as part of the metaphysical machinery in a structuralist conception along these lines.

It seems, then, that a structuralist conception of natural kinds could not be a promising alternative for a natural-kind essentialist. Either it requires a drastic reform of basic tenets that the notions of grounding and dependence have—or, at least, have traditionally been assumed to have—or requires the adoption of an ontology in which the theoretical functions of natural kinds disappear.

5. Conclusions

We have argued here that defenders of various forms of natural-kind essentialism are committed to two theses that together are incoherent, namely that natural kinds are both dependent on essential properties and, at the same time, ground essential properties. A situation of this type violates the requirement of non-circularity that has been adopted both with respect to grounding and with respect to essential dependence. It is a situation in which something, say b, that supposedly necessitates the existence of something else, say c, requires the previous existence of c as a constitutively necessary component of b's essence. We have shown that although there are terminological variations between defenders of natural-kind essentialism,

most of them are committed to the idea that natural kinds ontologically explain essential properties. Talking here of 'formal causation' of essential properties by natural kinds does not improve the situation, besides bringing further obscurity—if 'formal causation' is taken to be something different from grounding. We have also considered whether some sort of 'structuralist' stance towards the connection of natural kinds and essential properties might be a way to assuage the problem of incoherence presented. It is not. A structuralist stance either requires a drastic reform of basic constraints almost universally accepted for grounding and dependence, or requires the abandonment of natural-kind essentialism altogether.

The problems that have appeared for natural-kind essentialism are instructive for those who are enthusiasts about the philosophical uses of 'formal causes'. Both defenders of natural kinds and 'substantial forms' should be careful about the coherence of the explanatory structures on which they are relying, or that are implied by what they are relying on. We think that a coherent ontology of natural kinds should either assign a definite priority to natural kinds over properties—in which case, they should not depend on essential properties—or assign a definite priority to essential properties—in which case natural kinds should not be expected to ground or 'formally cause' essential properties.

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[1] The authors have made an equal contribution to this chapter.

[2] In the philosophical tradition, formal causation is not restricted to 'substantial forms', but also applied to 'accidental forms' (e.g. Suárez, *Disputationes metaphysicae*, Disputatio XVI). What in this tradition has been called 'formal causation' is not too distant from the types of non-causal explanation that have been described by, for example, Lange (2017).

[3] 'Substantial forms' then have an ontological priority both in terms of grounding and in terms of essential dependence, but in respect to different relata: grounding with respect to properties and essential dependence with respect to the particular substances that have them.

[4] Dumsday (2010) proposes a more complicated solution to the problem of complex essences. However, we shall not discuss that solution here. Dumsday's solution seems to require that individual objects or substances are in some sense prior to their natural kinds and we suspect that many robust natural kind essentialists would want to resist that idea. See Section five of Oderberg's contribution to this volume for criticism.

[5] We note, though, that in his contribution to this volume, Oderberg seems less willing to describe form essences as being simple: see section five of his chapter.

[6] This means, incidentally, that Armstrong's theory also faces structural problems: see Alvarado (Manuscript).

[7] Oderberg, in effect, defends a hylomorphic structure along these lines for material substances. See Oderberg, 2007: 71–6.

[8] These connections also work in the inverse direction. If asymmetry is given up for grounding or dependence, then either irreflexivity or transitivity should also be given up. But which one? And, why? The defender of the structuralist view has here an explanatory task to fulfil.