Hylomorphism, or Something Near Enough

Abstract

Hylomorphists hold that substances are, in some sense, composites of matter and form. The form of a substance is typically taken to play a fundamental role in determining the unity or identity of the whole. Staunch hylomorphists think that this role is of a kind that precludes the ontological reduction of form to the physical and thus take their position to be inconsistent with physicalism. Forms, according to staunch hylomorphism, play a fundamental role in grounding their bearers' proper parts and that, it seems, rules out the physical grounding of form itself. I shall develop a physicalist version of hylomorphism that treats form as geometric structure and which, I shall argue, entails many of the central theses endorsed by staunch hylomorphists. Based on Shoemaker's notion of conditional powers, I shall argue that the geometric structures of complex wholes are the conditions on at least some of the conditional powers of their bearers' proper parts, transforming those powers into powers simpliciter. Thus, forms play a fundamental role in the dynamical evolution of the physical world, but without bestowing causal powers themselves and hence without violating the causal closure of the physical domain. If a substance's proper parts are taken to be individuated by their powers simpliciter, then they derive their identities from their places in the substantial whole, which thus determines the identities of its proper parts without changing their intrinsic natures.

1. Introduction

Hylomorphism is the Aristotelian doctrine that (at least some) complex particulars are composites of both matter and form and that form plays a crucial role of some kind in relation to the identity of the whole and its proper parts. On what Robert Koons refers to as *faint-hearted* interpretations of Aristotle's view,[1] forms might be regarded simply as structural properties of the whole's proper parts. On Kathryn Koslicki's view, for instance, complex particulars are mereologically composed both of concrete proper parts and abstract forms, with objects thus a fusion of their proper parts with a structural property.[2] Such views are liberal in that they recognise no distinction between artifacts such as chairs and statues, and Aristotelian substances such as human beings. According to *staunch* hylomorphists, by contrast, only genuine substances have substantial forms and the form of such a substance is more than a mere arrangement of its proper parts. Forms are fundamental and irreducible properties (or perhaps *principles*) that confer fundamentality on the complex wholes whose forms they

[1] Koons (2014).
[2] Koslicki (2008).

are. Some staunch hylomorphists treat the role of form in terms of identity-determination or individuation,[3] in which forms determine or transform the identities of their bearers' parts. Others prefer to think in terms of a novel causal role in which forms exhibit some kind of downward causal influence on the proper parts of their bearers.[4] They agree, however, that their position is an alternative to ontological reduction and hence incompatible with reductive forms of physicalism.

The kind of roles staunch hylomorphists claim on behalf of form seem to preclude its reduction to the physical. It is seemingly impossible for a mere structural property, for instance, to do the kind of work they take forms to do. Why? For the purposes of this paper, I will think of physicalism as a grounding thesis. Suppose we think of Aristotelian forms as shapes—the spatiotemporal forms of objects. Complex particulars instantiate such properties in virtue of the properties and relations of their proper parts. A complex particular's shape is thus grounded in its fundamental physical proper parts and their intrinsic and relational properties. This in turn seems to rule out the kind of novelty staunch hylomorphists take to differentiate their respective positions from reductive physicalism. If forms are grounded in the physical, how can they possibly *do* anything that is not ultimately explained by what their grounds do? Conversely, if forms are genuinely novel then it seems they can't also be physically grounded. Whatever it is that forms are supposed to be doing, it seems that if they are physically grounded, then that something is also physically grounded and hence not novel. Forms must therefore be either emergent properties that are caused but not grounded by the arrangement of their bearers' proper parts, or else not properties at all.

This is of course very similar to the causal exclusion problem in the philosophy of mind: if mental properties are physically realized, how can they cause anything that their realizers don't already cause?[5] Conversely, if mental properties are causally novel, then they must be emergent rather than realized and their novelty thus violates the causal closure of the physical. This familiar problem has a

[3] Marmodoro (2013), Inman (2016).
[4] Rey (2011), Koons (2014), Jaworski (2016). The kind of influence varies from case to case, as we will see.
[5] Kim (1998, 2005).

range of familiar solutions, versions of which are no doubt available to hylomorphists. Staunch hylomorphists typically don't want to get involved in that debate, which is why they defend what they take to be an *alternative* to physicalism. It's because hylomorphic forms are *not* physically grounded that they don't suffer from a corresponding exclusion problem.[6] Staunch hylomorphism thus seems committed to forms that are (in one way or another) ontologically something over and above the physical properties and relations of their bearers and hence able to do things that those physical properties and relations cannot.

In this paper, I will argue that spatiotemporal patterns of a certain kind can do many, if not all, of the things that staunch hylomorphists attribute to hylomorphic forms. Through this I will argue that both downward causation and identity-determination by form are consistent with the physical grounding of form. From there I will argue that several familiar Aristotelian theses—including the fundamentality of the whole—follow as a natural consequence. I will stop just short of describing my view as a version of staunch hylomorphism, and I certainly won't attribute it to Aristotle. My view is probably more liberal than Aristotle's, but it is not, I think, *too* liberal. Artifacts such as statues, for Aristotle, are not hylomorphic compounds of matter and form but merely *accidental unities*.[7] I will endorse a version of hylomorphism that does not apply to statues, but which does apply to complex mechanisms whose structure, in a sense to be defined, plays a fundamental role in their mechanistic operation. I don't know whether the resulting position is truly Aristotelian, but I do think many of the claims I will defend have a decidedly Aristotelian flavour. I aim to show that there is nothing faint-hearted about a physicalist version of hylomorphism that interprets form in terms of what I will refer to as *geometric structure*, its consequences being every bit as robust as those of its emergentist cousins.

[6] Jaworski is an exception: he agrees that forms are emergent rather than grounded but appeals in any case to the "dual explanandum" strategy defended by some physicalists in the context of the mental causation debate. I think it is unclear why one would reject physical grounding and then appeal to a strategy that is also available to physicalists; I discuss Jaworski's views in detail in section (2).

[7] Koons (2014), p. 153.

In section (2) I will give details of some forms of staunch hylomorphism and the kind of novelty that their proponents have taken forms to possess. As I will explain, this puts considerable pressure on staunch hylomorphists to reject both physicalism and the causal closure of the physical, like their emergentist cousins in the philosophy of mind. I will then proceed, in the following sections, to explain why that would be a mistake. In section (3) I distinguish various causal closure principles in increasing order of strength and show that there is room for a certain kind of downward causation within a reductive physicalist ontology. I shall understand this kind of downward causation in terms of Shoemaker's notion of conditional powers, my central claim being that although all causal powers are bestowed by physical properties such as mass-energy and charge, some of those powers are *conditional* powers with higher-level *conditions*. In section (4) I argue, via consideration of vector composition, that geometric structures have just this kind of conditioning role. Finally, in (5) I discuss the kind of hylomorphism that results from interpreting form in terms of geometric structure.

2. Staunch Hylomorphism, Grounding, and Causal Closure

Aristotle famously held[8] that a severed hand is no longer a hand except in name since it is unable to fulfil the defining *function* of a hand. This view at once encapsulates both Aristotle's commitment to the functional individuation of objects such as hands and his hylomorphism, since it is only within the body that a hand has its defining functional characteristics.[9] There have been many attempts at understanding exactly what role form plays in such cases and in making sense of how it could play such a role. At a first pass, if staunch hylomorphism is correct, then the forms of complex wholes must somehow be able to determine what the proper parts of their bearers can *do* and thus (though not necessarily thereby) determine their *identities*. If indeed they have such a role, then forms make an irreducible difference to the course of physical events at our world and so, plausibly, count as

[8] *Metaphysics* 1036b30–32. This has become known as the *homonymy principle*.

[9] Does a severed hand lack the powers that define an embodied hand, or is it merely incapable of manifesting those powers? I return to this point in section (5) in my discussion of conditional powers and their relevance to the claim that the forms of complex wholes individuate their bearers' proper parts.

fundamental properties. And of course, *qua* bearers of fundamental properties, complex wholes will then have a similar claim to fundamentality. Identity-determination is perhaps a claim to fundamentality in its own right: if the form of the human body is what makes a hand a hand, then that form is playing a *metaphysical* role that nothing else does. It's important to note, however, that for Aristotelians, individuation and determination of functional role are inseparable. In an ontology of functionally individuated kinds, to determine the *identity* of a hand or an eye just is to (at least partially) determine what it can *do*.

The primary purpose of this section is to highlight the reasons why various forms of staunch hylomorphism seem to be inconsistent with physicalism, so that I can later argue that the appearances are misleading. I will adopt a grounding-based version of physicalism according to which everything that exists is either part of the ontology of (a suitably completed version of) fundamental physics, or fully grounded by such things.[10] For now, I will presuppose a standard account of grounding according to which it is an asymmetric, irreflexive and transitive relation of metaphysical explanation. The important points for present purposes are that according to this now familiar logic, grounded entities are explained by their grounds but not vice-versa.[11] With these simple points in mind, we will be able to see why hylomorphists feel the need to reject physicalism. The overarching reason, as noted, is that (1) hylomorphic forms play a novel and irreducible role in determining the identities of their bearers, but it seems that (2) if the forms themselves are grounded in the physical, then anything they do must also be so grounded. I will get off the bus between (1) and (2).

Let's begin with Michael Rea's hylomorphism by way of illustration of the problem that hylomorphists face with grounding. According to Rea,[12] all properties are powers, including substantial forms. However, while properties such as electric charge are powers to exert forces, substantial forms are powers to *unify*. Thus, one might be inclined to suppose that a form unifies the proper parts of its

[10] I will say more about how "physical" is defined when I discuss causal closure in section (3). See Crook & Gillett (2001) for more on this kind of proposal for defining the physical.
[11] I discuss the potential rejection of this logic within hylomorphism in (3) and reject it myself in (4).
[12] Rea (2011).

bearers either by causing or grounding that unity, with the unity then enabling the joint activity of the parts, by means of which they constitute the substantial whole. However, that's not what Rey says. His notion of unity requires that the form of a substance is itself a power whose manifestation is *grounded* in the collective manifestations of the powers of the parts it unifies. In what sense, then, does the form unify? As others have pointed out, it seems that on Rey's account, substantial forms are merely identical to the collective manifestations of powers possessed by a substance's proper parts thus-and-so arranged.[13] To put it differently, the form's power to unify is grounded in the collective manifestation of the substance's proper parts, but if those parts were not *already* unified, the collective manifestation of their powers would seem to be impossible. It's not at all obvious why we should treat substances so conceived, or their forms, as fundamental. All the real work seems to be bottom-up, exhausted by the way in which the intrinsic powers of the parts manifest in a particular spatiotemporal arrangement.

Koons' Aristotle is more squarely antireductionist than Rey's. Koons holds that substantial forms are responsible for grounding at least some of the powers of a substance's proper parts. The joint manifestation of those very powers is then responsible for the diachronic identity of the substance in question. As Koons himself puts it:

> There are two kinds of dependency relations: synchronic (occurring in a single instant), and diachronic (the dependency of something at one moment on a thing or things existing at earlier moments). The synchronic dependency is top-down, with the powers of parts grounded in the powers of the whole, while the diachronic dependency is bottom-up, with the later existence of the whole dependent on the earlier activity of the parts. Hence, there is no circularity; instead, the dependency diagram is a zig-zag path, running down at each moment and up as time advances.[14]

Assuming, as we currently are, that grounding is asymmetric, it follows right away that the substantial form of a whole cannot be grounded in the natures of its parts, for those natures are the very powers

[13] See Marmodoro (2013), p. 14; see also Koons (2014), pp. 158-9.
[14] Koons (2014), p. 172.

that the form itself grounds. The *initial* instantiation of the substantial form is not explained by the properties and relations of the substance's proper parts, even though its *continued* instantiation is.

Anna Marmodoro's Aristotle is, in turn, more antireductionist than Koons'. Marmodoro holds that forms are not constituents of substances at all, hence does not understand them as properties, or a fortiori as powers. Rather, she treats forms as a kind of metaphysical operation on material parts, which results in what she refers to as their *re-identification* as parts of the substantial whole. As I understand it, the operation of a form transforms physical entities by changing their causal powers, hence changing their identities *qua* functionally individuated. A given substantial form somehow encodes the causal roles that the entities in question must play if they are to compose into a substance of that kind and (under certain conditions) transforms them into entities with the powers needed to play the roles in question.[15] Forms, for Marmodoro, seem to be a way of talking about the primitive transformation and unification of physical particulars into substances of certain kinds. One might even suppose that forms, thought of as entities in the own right, represent a space of possibilities: the various ways in which physical particulars can be combined into substances. If suitable material bodies encounter each other in the right circumstances, they may interact and transform into proper parts of a substance, with the limitations—suitability, circumstances—delimited by the form. Clearly, on such a view, the form plays a role in determining the powers, hence nature of the parts of a substance. Thus, once more, it seems the form cannot be grounded in the substance's proper parts and their properties and relations, for it has a top-down grounding role in relation to those parts and their identities.

Following Koslicki, Koons treats Marmodoro's top-down determination of identity as a form of *reverse mereological essentialism*, which he expresses as follows:

> If *x* is a proper part of a substance of kind K, then, necessarily, if *x* exists, then *x* is a proper part of some substance of kind K.[16]

[15] Marmodoro (2013), p. 17.
[16] Koslicki (2008), Koons (2013), p. 160.

For my heart to exist at all, according to reverse mereological essentialism, it must be a proper part of something with the same substantial form as me. This principle is entailed by, but does not entail, Marmodoro's hylomorphism, because the latter requires not only that my heart be a proper part of some human being if is to exist, but also that it occupy the same role in that human's body as it does in mine. It follows from the top-down determination of identity of proper parts that the identity (hence the causal role) of my heart is determined by my form, which form includes the role my heart plays. It's interesting to consider what happens to a heart during a transplant, on this kind of hylomorphism. My heart cannot survive removal from my body because it gets its identity from my form. Hence when removed it is no longer a heart, as Aristotle intended. When transplanted into the host body, it once again becomes *a* heart, but it doesn't seem possible for it to be the *same* heart that it was before—we do not normally say that a single object can be spatiotemporally discontinuous. We can appeal to this idea to solve the Ship of Theseus puzzle. Can a ship survive piecemeal replacement of all its constituent planks? According to hylomorphists, yes. But what if we reassemble the original planks? Surely the resulting ship has at least as good a claim to being the original? Answer: you *can't*, because the planks don't survive their removal from the original ship! We can certainly reassemble the collection of ex-planks that we end up with to form a new ship, but they will be at most qualitative duplicates of the planks they used to be. The reconstructed ship thus has *no* claim to being the original, except insofar as it is composed of the same matter—the credentials of the repaired ship are clearly stronger.

For now, take the causal closure of the physical to be the principle that every physical effect has a fully sufficient physical case. I will discuss causal closure principles at length in section (3), but this one will do for now. Both Koons' and Marmodoro's hylomorphism reject causal closure so understood, because both hold, in their different ways, that substantial forms that are *not physically grounded* play a fundamental role in determining the causal powers of the physical proper parts of substances. Thus, there are things that happen in the physical world that do not have sufficient physical causes. This is a form of downward causation, in the sense that at least some of the causal powers whose manifestations are physical effects come from sources that cannot themselves be properly understood

as physical. This is no surprise, as noted previously: for a form to determine the identity or nature of a proper part just is for it to determine that part's causal role within the substantial whole. The versions of staunch hylomorphism endorsed by Koons and Marmodoro, then, are robustly anti-physicalist, in that they reject not only the physical grounding of form, but also causal closure.

William Jaworski also rejects the physical grounding of form.[17] Unlike Rea, Koons and Marmodoro, Jaworski identifies substantial form with *structure*, which is necessitated by and supervenient upon the spatiotemporal arrangement of a substance's proper parts. The structure of a complex substance such as a person is an essentially powerful property that enables the person to *configure* their proper parts human-wise. This power is, in Jaworski's view, an emergent property that explains both what we are synchronically and how we persist. There are things we can do in virtue of the configuring power of structure that we could not otherwise do: we have beliefs and desires and engage in intentional actions in virtue of the way in which we configure our material parts, and we configure them that way in virtue of our human form. Crucially, for Jaworski, the structure of a substance is necessitated but *not explained* by the physical properties and relations of its proper parts. He writes:

> A structured individual comes into existence exactly when its activity of configuring materials commences, and the materials it configures are precisely those that compose it. Structured individuals are thus emergent individuals who are essentially engaged in the activity of configuring the materials that compose them.[18]

The spatiotemporal arrangement of my parts, for Jaworski, necessitates but does not explain why there is a structured human being where I am. I impose a human-wise structure on my parts because I am "a structured individual and configuring materials is what structured individuals essentially do".[19] There is an air of circularity about this proposal of a similar sort to the one we find in Koons. The answer to the question why my proper parts compose into a human being can only be explained in terms of structure, which is an emergent property necessitated by their spatiotemporal arrangement. What

[17] See Jaworski (2014, 2016).
[18] Jaworski (2016), p. 104.
[19] Op. cit. p. 209.

explains why my parts are configured human-wise is that I am a structured individual whose essence consists in so configuring them. My structure comes about through the activity of configuring, which in turn involves the manifestation of emergent powers I have in virtue of that very structure. For Jaworski, the commencement of what he calls *individual-making* activities and the coming to have the form that defines the individual are of a piece and physically unexplained. Jaworski, like Marmodoro and Koons, thus pays a high ontological price for his hylomorphism.

One might expect Jaworski to argue that structure plays a fundamental causal role alongside physical properties like mass-energy and charge to determine the dynamical evolution of the world, but he doesn't. In fact, Jaworski accepts both that behaviours are necessitated by lower-level physical events *and* that the lower-level events on which behaviours supervene are sufficiently caused by prior such events *independently* of the additional powers of emergent structure. Jaworski is explicit that his solution to the mind-body problem is an example of the *dual explanandum strategy*. He accepts that the effects of hylomorphic substances such as persons are fully necessitated by prior physical causes, where "physical" does not include emergent properties such as hylomorphic structure or the additional powers they bring with them. Whatever we do in virtue of our emergent properties is thus causally necessitated by prior physical conditions. What Jaworski denies is that necessitation is sufficient for *explanation*. He endorses what he refers to as *causal pluralism*, according to which only the intentional properties we have in virtue of our form can causally *explain* actions even though the same actions are causally necessitated by prior physical causes. However, this is not intended merely as causal-explanatory pluralism—Jaworski holds that causation itself is stratified into layers.

The overall strategy is thus similar to Stephen Yablo's classic defence of mental causation but with structure in place of determinable properties.[20] Yablo argues that sometimes, a determinable property such as being red is a better candidate cause than its specific determinate, for instance being scarlet. It depends on which of the determinable and determinate properties makes the right kind of difference

[20] Yablo (1992); see also List & Menzies (2010).

to that effect. Yablo gives the example of Sophie the pigeon, trained to peck at red things, pecking at a scarlet object on some occasion. Because the pecking would still have happened had the object been red *without* being scarlet, being scarlet rather than some other determinate shade of red makes no difference to whether the pecking occurs simpliciter; being red rather than some other determinable colour, by contrast, does. The scarlet shade she pecks at on this occasion is *sufficient* for the pecking, it's just that the scarlet is not *proportional* to the effect—it is *too specific* to make the right kind of counterfactual difference to count as its cause. However, if we want to explain why Sophie pecks *in the precise way she does on this occasion*, the determinate shade will be necessary, because it's plausible that she would have pecked in a slightly different way had the redness had a determinate other than scarlet. Causes, for Yablo, are neither too general nor too specific, they are *just right*. To count as a cause a property must be such that no more determinable (general) property is sufficient for its effect and no more determinate (specific) property is necessary.

My worry about Jaworski's hylomorphism is this: if the solution is based on a dual explanandum strategy that is available to physicalists, why is emergent structure a price worth paying? Being scarlet explains and hence grounds being red, but the dual explanandum strategy combined with causal pluralism, if it works at all, works just as well there as it does in Jaworski's theory. Why then does structure need to be emergent in order to be a higher-level cause of this kind? As in physicalist versions of the dual explanandum strategy, for Jaworski emergent structure does not do anything that is not necessitated by prior (non-structural) physical conditions. Jaworski can of course argue for the emergence of structure by other means, for example its role in unifying proper parts into substantial wholes. My point here is just that for Jaworski, structure doesn't earn its ontological keep *causally*. By contrast, if structure were part of the minimal dynamical base responsible for the causal necessitation of our actions, then there would be no doubt about its fundamentality. It would qualify as fundamental in virtue of an irreducible causal role in determining how the fundamental physical dynamics unfolds. Howard Robinson presses Jaworski on precisely this issue, arguing that the price of making hylomorphism consistent with causal closure is the causal redundancy of form, even if its causal-

explanatory novelty is secured.[21] Robinson argues that what staunch hylomorphists really need in order to make good on their central claims is to reject causal closure as well as the physical grounding of form, as (to my mind) is the case with Koons and Marmodoro. I disagree with Robinson on this. I think that a certain kind of physically grounded structural property can do all the work that staunch hylomorphists want form to do, and that it can do all this without violating any empirically well supported causal closure principle.

3. On the Idea that Physical Properties "Do all the Causal Work"

The central dilemma for hylomorphists, according to Koons, can be summarised thus:

> Is the whole something over and above its parts? Yes, if we are to avoid faint-hearted hylomorphism, a version of materialism. But if we answer "yes," then how can we ensure that the supposedly composite substance is truly composed of some smaller material elements, as opposed to being a wholly separate substance?[22]

What hylomorphists really need, it seems, is substantial forms that violate causal closure by determining the functional identities of the substance's proper parts. But how in that case can it be said that substances are composed of the very proper parts whose identities them forms determine? One way of making sense of the situation is to reject a core presupposition of the problematic, at least as I have set it up: the *asymmetry of grounding*. If grounding is non-symmetric, then there is room for substantial forms to ground the identities of a substance's proper parts *and* for those parts and their properties and relations to ground the form itself.[23] For illustration, let's combine symmetric grounding with the versions of hylomorphism defended by Koons and Marmodoro. In Koons' case, we might say that while form grounds the causal powers of a substance's proper parts, the form itself is synchronically grounded in the arrangement of those very parts. There is obviously a form of circularity inherent in this proposal, but it is not necessarily vicious because the two grounding relations are of

[21] Robinson (2014). Jaworski rejects the distinction between causal-explanatory and causal novelty.
[22] Koons (2014), p. 164.
[23] Thompson (2016) appeals to hylomorphism as a possible justification for non-symmetric grounding. Here I will show how non-symmetric grounding can help us make sense of many staunch hylomorphist claims.

different kinds: identity-determination via causal power bestowal in a top-down direction, with composition via spatiotemporal arrangement going from the bottom-up. I accept for present purposes that both are instances of a single abstract grounding relation. However, because grounding comes in different varieties, it is plausibly *non-transitive* so that symmetric cases do not entail *reflexive* grounding, which would clearly be problematic. Suppose now that we interpret Marmodoro's forms as grounded structural properties whose instantiation transforms the identities of the structured parts. Suppose we say that the parts *prior* to transformation ground the form by combining into a structure, which structure then transforms the natures of the parts, but *not in ways that alter their structure*, so that the *form remains constant* throughout the transformation. After the transformation, the form is both grounded in the arrangement of its proper parts and a determinant of their functional identities. The resulting position has much in common with the solution I will defend here.[24]

My position can be summarised thus: (1) forms are grounded geometric properties, which (2) exert a downward causal influence on the physical domain, but (3) *without* violating any reasonable closure principle, and which (4) determine the identities of their bearer's proper parts. Claims (1)-(4), I will suggest, are the key to a modern, materialist hylomorphism—or something near enough. To see how this solution works, we first need to get clear about causal closure. The following claims are frequently assumed without a great deal of argument: (i) causal closure entails that every physical effect has a fully sufficient basic physical cause (where the basic physical domain includes only entities and properties found within the ontology of fundamental physics, such as electric charge); (ii) causal closure is empirically well-supported. What's more, these claims are typically assumed without offering a particularly precise definition of the closure principle in question. The first assumption is often implicit in the discussion, but it is why Yablo, Kim, Jaworski, and many others, think that the basic physical domain has what it takes to causally necessitate physical effects. I agree that there is a causal

[24] In Yates (2018) I argue for treating relational individuation within pure powers ontologies in terms of symmetric grounding: powers compose into and hence ground a type-level nomic structure, which structure determines the identities of its component powers. The version of hylomorphism I develop here is in a similar same vein.

closure principle that is empirically well-supported. However, *that* principle does not have the consequences ascribed to closure in (i). What's more, the same evidence that supports that closure principle shows that (i) is straightforwardly false.

Here is a typical way of stating the causal closure of the physical:

CC: Every physical event E that has a cause at *t* has a sufficient physical cause C at *t*.[25]

According to CC, wherever in its causal history a given physical event has a cause at all, it has a sufficient physical cause. The content of 'physical' comes ultimately from physical theory, so that the closed domain is determined by our best fundamental science. There is undoubtedly more physics to be discovered and those yet-to-be-discovered things are holes in the causal structure of current physics. Nonetheless, I will assume that there is a complete theory in the vicinity and that it resembles current theory closely enough for CC to be non-vacuously true.[26] The intended scope of 'physical' in 'physical event' is not limited to the ontology of a completed physics. Rather, CC quantifies over the *broadly* physical, where an entity is broadly physical iff it is either part of the ontology of completed physics or related to such entities by a grounding relation of some kind.[27] The deflection of a particle in a magnetic field counts as a physical event under this definition and so does the eruption of a volcano.

CC is already quite a strong closure principle, but I will work with a stronger one.[28] The trouble with CC is that causal sufficiency is too metaphysically coarse-grained. Suppose events to be property-instances. A physical event C might be causally sufficient for another such event E at *t* by means of an intermediary effect. Suppose C is synchronically sufficient for a *non*-physical event e*—an instance of

[25] In this formulation and those that follow, the notion of a sufficient cause may be read in probabilistic terms, i.e. as a cause that suffices to determine the chances of the effect.

[26] According to Hempel's dilemma, causal closure principles are either false (because indexed to current physics), or vacuous (because indexed to a future physics whose content is obscure). I am betting on future physics being sufficiently close to current physics to avoid the threat of vacuity. See Crane & Mellor (1990) for the dilemma; see Papineau and Spurrett (1999) for arguments that we don't need to define 'physical' to formulate contentful closure principles, provided we are clear about what the fundamental ontology will *not* include; and see Wilson (2006), for arguments that betting on future physics is the way to go, but with the addition of a 'no fundamental mentality clause' to rule out sui generis mental properties counting as physical.

[27] See Crook & Gillett (2001) for this way of thinking about the physical. Note that the scope of 'physical' in 'physical event' and 'sufficient physical cause' can be varied *independently*. I return to this point presently.

[28] For further details of the arguments that follow, see Yates (2009).

a sui generis phenomenal property, say—and that it's only C and e* together that have the power to bring about E. This is an instance of traditional emergent downward causation, in which C synchronically causes an instance of a sui generis conscious property, e* and e* then contributes a novel causal power, which (perhaps in combination with the powers of C), causally suffices at *t* for E. Given that CC does not rule this kind of situation out, we need a stronger closure principle. One way to secure such a principle is to add a clause stating that the physical cause in question has the power to bring about the effect in and of itself, in virtue of its physical properties alone. In the example sketched above, it's not the case that C's physical properties directly bestow upon C the power to cause E. Rather, they bestow upon C the power to cause e* and then the combined properties of C and e* bestow upon them the power to cause E. A causal power bestowal clause rules out emergent causal powers; I refer to the formulation below as *strong causal closure*:

> SCC: Every physical event E that has a cause at *t* has a sufficient physical cause C at *t and* C's physical properties bestow upon C all the powers necessary to cause E.

According to SCC, every physical event that has a cause at some point in its history has a sufficient physical cause at that time, whose sufficiency is entirely in virtue of its physical features. The idea that basic physical properties bestow *all necessary* powers is intended to capture the idea that no *further* powers are necessary, and I shall say more about this presently. SCC is a *very* strong closure principle, but I propose to make it even stronger, by narrowing the scope of 'physical properties' to *basic physical properties*. What is a *basic* physical property? As I use the term here, it refers to physical properties whose instantiation is metaphysically ungrounded and so are not instantiated in virtue of any *further* properties. Potential examples of basic physical properties include electric charge, mass-energy, spin, entanglement, and spatiotemporal relations. In my usage, 'higher-level' as applied to properties just refers to any that are not basic physical in the sense just defined. Higher-level properties will thus be instantiated in virtue of other properties and such that their instances are metaphysically grounded. With this understanding of 'basic physical' properties in mind, we can define an even stronger causal closure principle—call it *very* strong causal closure:

VSCC: Every physical event E that has a cause at *t* has a sufficient physical cause C at *t* and C's basic physical properties bestow upon C all the powers necessary to cause E.

Because C is a broadly physical event, the broadly physical particulars to which it happens are fully composed of fundamental physical particles. The idea behind VSCC is that the basic physical properties of these particles are responsible for C's power to cause E, in that they bestow upon C's basic physical proper parts all the powers whose manifestation is necessary for E to happen. Suppose the effect C is my reaching for my glass of wine in order to take a sip. Obviously, nobody thinks that properties such as electric charge, mass-energy, and spin bestow upon me the power to reach for my glass. Rather, the idea is that once all of my basic physical powers manifest on this occasion, no further power-manifestations are necessary in order for me to reach for my glass. To put it differently, the basic physical powers manifest as a collection of basic physical events whose joint occurrence grounds (or is identical to, depending on how you think of actions) my reaching for my glass. That is the sense in which these are all the powers necessary to bring about a broadly physical event.

I think that VSCC is empirically well-supported. Much progress has been made in fundamental physics, chemistry, and biology without the need to posit special causal powers other than those bestowed by basic physical properties such as electric charge. Current physics recognises a finite stock of fundamental forces, and while the current list is no doubt not the final one, it seems all causal powers ultimately stem from such forces. Any completed future physics is likely to look very much like current physics in this respect—there will be a finite stock of fundamental forces, however many or few they may be, and these forces will be responsible for all the interactions between fundamental particles. VSCC says that *this* is where all the causal powers that manifest in physical causal relations ultimately come from—they are bestowed by the basic physical properties of the cause, whatever they may be.[29] This is clearly a very strong causal closure principle. What I want to suggest now is that even this principle not only leaves room for, but also requires, a kind of downward causation. In addition to

[29] See Papineau (2001) for this argument, which he terms the argument from physics.

powers and their manifestations, there are also higher-level determinants of how multiple powers compose on a given occasion.

The reason I think this is fairly straightforward. Basic physical powers are typically powers to exert forces, and wherever there are multiple forces acting jointly, we need to apply composition principles to determine how those forces compose. Here I focus on vector composition, but I do not claim, or believe, that this is the only such principle for the composition for multiple causes in general. Since composition principles determine how multiple basic physical causes compose on some occasion, they are not themselves basic physical. They are *structural* principles and it is for that reason that they refer to properties that look and behave very much like Aristotelian forms. Because I focus on vector composition, the crucial property will be geometric structure. I will argue that geometric structure is a causally fundamental yet grounded property because: (i) it plays an irreducible role in the dynamic evolution of systems in which multiple forces compose, and (ii) it is grounded in basic physical properties and relations and hence not itself part of the basic physical domain. The determinative influence of geometric structure, as I see it, is thus a case of downward causation.

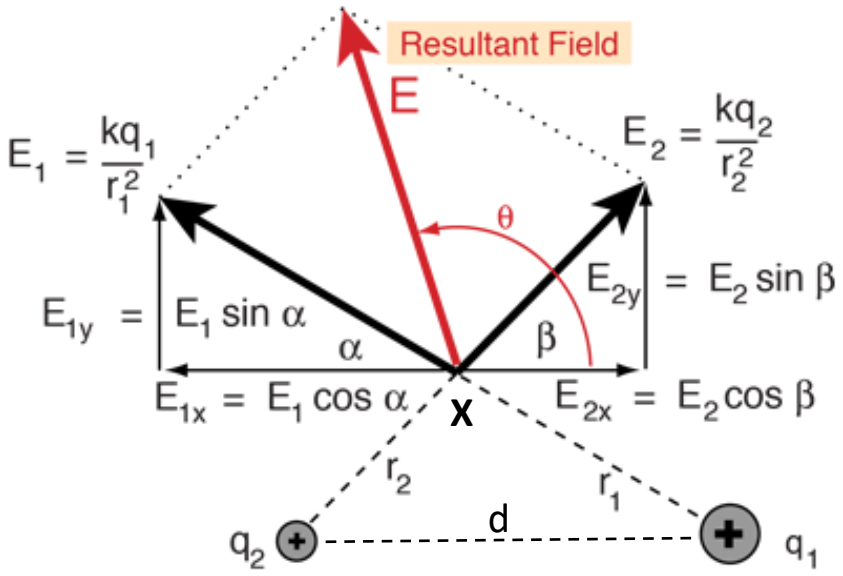

Figure 1: Calculation of the electric field E due to two point charges

Figure 1[30] shows the calculation of the resultant field E due to two point charges, q_1 and q_1, at a distance r_1 from q_1 and r_2 from q_2, where the dotted lines from the two charges meet, marked 'X'. This is an illustration of the *parallelogram rule*. The calculation proceeds by resolving E_1 and E_2 into their horizontal and vertical components. The x- and y-components of the resultant field E are given by:

- $E_x = E_{1x} + E_{2x}$
- $E_y = E_{1y} + E_{2y}$

The magnitude and direction of the resultant field E are then given, respectively, by:

1. $E = \sqrt{(E_x^2 + E_y^2)}$
2. $\tan\theta = (E_y/E_x)$

Figure 1 depicts both basic physical and higher-level properties of the two charges. It shows (A) the specific spatial relations that obtain between q_1 and q_2 and the point X at which we want to calculate the resultant (being separated by r_1 and r_2 respectively); and the distance d between the particles. But in addition to this, it shows (B) what I call the *geometric structure* of the particles in relation to X, in this case given by the angles α and β that we used to factor the component vectors into their horizontal and vertical components. Why isn't geometric structure basic physical? Simply put, because the geometric properties in (B) are instantiated *in virtue of* the basic physical properties given in (A) and hence grounded therein. The specific spatial relations in (A) are not the only way to achieve the geometric structure in (B). We can vary r_1 and r_2 independently while holding α and β fixed, resulting in the same geometric structure. I shall now argue that in the present case, geometric structure is causally fundamental in the sense that it plays a novel and irreducible causal role in the dynamic evolution of the physical world.[31]

As noted above, we can vary basic physical properties without changing geometric structure. Suppose we move q_1 away from X without changing α. The x- and y-components of E_1 will decrease in magnitude as $1/r_1^2$, but they will remain in constant proportion to each other, since the direction of E_1 will remain

[30] Reproduced with permission from url: http://hyperphysics.phy-astr.gsu.edu/hbase/electric/mulpoi.html#c3.
[31] The arguments that follow are developed from Yates (2016, 2020).

the same. This change will alter both the direction and magnitude of the resultant field E, in a manner given by equations (1) and (2) above. This shows that the basic physical spatial relations of the particles make a difference to the resultant field independently of the geometric structure they realize. However, *the converse is also true*. Imagine now moving q_1 towards q_2 in a circle of radius r_1 about X. This won't change the magnitude of E_1, but as α varies, its direction will change, resulting in different values for E_{1x} and E_{1y}, hence altering the magnitude and direction of E according to equations (1) and (2). This, then, is a way for geometric structure to make a difference independently of the values of r_1 and r_2, which remain constant. There is a complication, however. Because geometric structure is realized by, hence supervenient on, basic physical properties, it isn't possible to change the former without some change in the latter. It might be suspected, then, that it is this basic physical change that is the real difference maker in respect of E.

It's important to get clear about which basic physical changes occur. We start out with q_1 and q_2 located a distance r_1 and r_2 from X respectively and a distance d apart. As we move q_1 towards q_2, it remains r_1 from X and q_2 remains r_2 from X. The only basic physical parameter we change is the distance between q_1 and q_2. But there's nothing special about moving the particles from d to d' apart that explains *why* the magnitude or direction of E changes in the way that it does. Rather, what explains the changes in E is that we move q_1 towards q_2 *holding fixed r_1 and r_2*. In order to do that, we have to change the geometric structure of q_1, q_2 and X. It's only given r_1 and r_2 that a certain separation between q_1 and q_2 determines the magnitude and direction of E, because it's only *together* that these three parameters suffice to determine a geometric structure. The basic physical property we have to change in order to change the geometric structure makes a difference to the resultant field only *because* it makes a difference to the geometric structure. In and of itself, the basic physical change alone doesn't causally explain the change in the resultant.

What follows from this? To specify the complete physical cause of the acceleration of a charged particle at point X, we must do more than specify the charges of the particles q_1 and q_2 that give rise to E and

the basic physical properties such as the spatial relations r_1 and r_2. In addition, we have no choice but to specify the geometric structure formed by q_1, q_2 and X. There's a simple reason for this: part of what determines the magnitude and direction of E is the degree to which the two vector fields due to q_1 and q_2 point in the same direction at X. And *pointing in the same direction* is a an irreducibly geometric property. If I am correct that geometric structure is grounded in basic physics and multiply realizable, then an entire family of familiar, simple dynamic explanations involve both basic physical and grounded broadly physical properties. Crucially, in cases of vector composition geometric structures are *not* merely a proxy for their basic physical realizers. As we've seen, in the case of the difference-making role of geometric structure, the basic physical properties that realize that structure are efficacious only insofar as they realize the structure in question. I must emphasises that my central claim here does not depend on any kind of causal or explanatory pluralism. It's not that we can only explain the resultant force *in an especially perspicuous and elegant way* by appealing to geometric structure; rather, my claim is that without geometric structure, *we can't explain it at all*.

Let's take stock. The strongest causal closure principle that is empirically well-supported gains its support from progress in physics, in particular the evidence we have there is a finite stock of fundamental forces that are responsible for all basic physical interactions. Those basic physical interactions in turn ground macro-causal relations, making it plausible that all such relations are ultimately due to the manifestation of basic physical powers. However, when multiple basic physical forces interact, there are composition principles that govern how they do so. Vector composition is governed by the parallelogram rule, according to which they geometric structure of a system of fundamental forces plays an irreducible role in determining its resultant. There is more causal work involved in the basic physical dynamics than just the generation of forces—in addition, there is the role played by the spatiotemporal *patterns* such forces make in relation to each other. Something similar to what Jaworski calls structure thus has a novel and irreducible causal role in relation to the fundamental dynamical evolution of our world, and that it has this role is not only consistent with the strongest well-supported causal closure principle, but also arguably *presupposed* by that principle.

VSCC requires that basic physical causes compose so as to bring about broadly physical effects. Causal closure should therefore not be understood—as it almost always is—as a principle attributing *all the causal work* to basic physical causes. Instead, it should be seen as a claim about the source of causal power at our world. But there's a world of difference between locating the source of causal power and determining how multiple powers compose.

How should we *understand* this determinative role metaphysically? And what is its *source*? As to the first question, in order to develop a novel version of hylomorphism, I will appeal to a variation on Shoemaker's notion of *conditional powers*. Much will turn on whether this variation is defensible. Here is how Shoemaker draws the distinction between conditional powers and powers simpliciter:

> A thing's having a power *simpliciter* is a matter of its being such that its being in certain circumstances, for example, its being related in certain ways to other things of certain sorts, causes (or contributes to causing) certain effects. A thing has a *conditional* power if it is such that if it had certain properties it would have a certain power simpliciter, where those properties are not themselves sufficient to bestow that power simpliciter. So, for example, the property of being knife-shaped bestows on its possessor the conditional power of being able to cut wood if it is made of steel, and the conditional power of being able to cut butter if it is made of wood. Some properties confer powers simpliciter all by themselves; and we can think of powers simpliciter as a special case of conditional powers. But the more usual case is for the powers simpliciter of a thing to be determined jointly by a number of different properties of it – as the knife's cutting powers are determined jointly by its composition, shape, and size.[32]

It's clear that Shoemaker sees the conditions—the further properties that turn conditional powers into powers simpliciter—as further intrinsic properties of the empowered particular. Powers simpliciter are typically (but not always) bestowed by multiple intrinsic properties of an object and in such cases, each of these intrinsic properties in isolation bestows the corresponding conditional power. Extrinsic properties such as relations to other particulars are then seen merely as stimulus conditions of the powers simpliciter—as what it takes to get powers simpliciter to manifest. I see things a little differently. I think it's reasonable to say that my heart has the power simpliciter to pump blood around my body, with this power manifesting when my heart receives nerve impulses from my brain. The

[32] Shoemaker (2001), p. 77.

stimulus conditions therefore involve, as in Shoemaker's case, relations to other empowered particulars. Where I differ, however, is in how I conceive the conditions for this power simpliciter. If it were *removed* from my body, my heart would no longer have the power simpliciter to pump blood around my body, but it would retain the corresponding *conditional* power—the condition being that it is reconnected to my body in the appropriate way. I claim that there is a principled distinction between these extrinsic conditions on my heart's power simpliciter and its triggering conditions. It is perfectly possible, for instance, to temporarily stop someone's heart within their body by interrupting the electrical signal from the brain. This does not affect the heart's power simpliciter to pump blood but only whether that power is appropriately stimulated. If these considerations are correct, then at least some conditional powers have *extrinsic conditions*, which are not merely triggering or manifestation conditions of the relevant powers, but conditions whose instantiation is required to transform them from conditional powers to powers simpliciter.[33]

Let's return to the simple case of vector composition discussed at length in section (3). We may suppose that positive charge bestows the *unconditional* power to attract negatively charged particles and repel positively charged particles. However, electric charge also bestows *conditional* powers. In virtue of their charges, q_1 and q_2 in figure (1) jointly possess the causal power to accelerate a positively charged particle located at X at a certain rate in the direction of the resultant, but they don't have this power simpliciter. They have it *conditionally* on r_1, r_2 and their geometric structure. Geometric structure bestows no causal powers in and of itself, which is why it doesn't violate the causal closure of the physical as defined in VSCC. Structure is one of the conditions on the conditional powers bestowed by basic physical properties like electric charge. We may therefore say that in at least some cases, structure *conditions* the powers of the structured entities.

On the second question, following Lange,[34] we may distinguish two potential sources of the law of vector composition: it can be a fundamental higher-order constraint imposed on all dynamical laws, or

[33] I thank Beatriz Soares Sousa and João Borba for pressing me on this issue.
[34] Lange (2017). For full discussion of this issue, see Yates (forthcoming).

a coincidence of the actual dynamics. I favour the former account and see vector composition as a constraint stemming from the symmetry properties of spacetime itself. On the latter, spacetime has the symmetries it does because that is the best way of encoding the primitive symmetries of the dynamical laws—for example, on this view the Lorentz transformations of Minkowski spacetime stem from the primitive Lorentz invariance of the dynamics. We need not concern ourselves with this debate here because what that is at stake is not the existence but the *source* of geometric structure's causal novelty. Those who think that the law of vector composition is written into the actual fundamental dynamical laws think precisely that those laws determine, primitively, that the vector quantities they quantify over compose parallelogram-wise. On the other side, it's the structure of spacetime itself that determines the way in which forces *must* compose. Whichever side you pick, there is no escaping the causal novelty of geometric structure, because that only requires that the parallelogram rule is *true*, regardless of its truth*maker*. With these points in mind, let's return to hylomorphism.

4. Geometric Hylomorphism: Not for the Faint-hearted!

Let geometric hylomorphism be the theory that substantial form is to be interpreted as geometric structure. The theory states that the geometric structures of substances are fundamental due to their downward causal influence and that this downward causal influence also plays a role in determining the identities of the substance's proper parts. In short, structure is in certain cases a causally fundamental property through which the parts of a complex object interact and through this an *individuator* of those very parts. In what cases, though? I certainly do *not* intend this theory to apply to every geometrically structured plurality (such as the electrons discussed above), or even to every concrete object. Consider the human body. The relevant geometric structure here is not simply given by the shape of the region of space that a body occupies, but by the way its parts are arranged in relation to each other—the geometric *pattern* they form. The organs themselves also have a geometric structure in this sense, the structure of the body extending all the way down to individual cells and perhaps beyond. At each level of decomposition, the geometric structure of the parts exerts a

downwards conditioning influence on their operation and thereby, I shall argue, plays a role in their individuation. It is structures that meet *these* conditions that I regard as hylomorphic compounds of matter and form. A statue arguably does not count as a genuine substance in this theory and a plurality of thus-and-so arranged particles certainly does not, although devices such as computers and other non-natural mechanisms do.

If I am correct about the causal role of geometric structure, and if my conclusions hold in full generality for mechanisms at different scales and of different degrees of complexity, then several things follow. First, a human being is the possessor of a causally fundamental property—our geometric structure plays a conditioning role that helps to determine what our proper parts can *do*. The bearers of causally fundamental properties, I think, have a very good claim to fundamentality themselves. There are of course different conceptions of fundamentality available, and I make no effort here to say which is the correct one. On a very popular conception, however, the fundamental properties are those that are minimally required to account for the causal history of our world. As we saw in section (3), this set of properties includes not only basic physical force-generating properties but also geometric structures that determine how those forces combine. I do not claim that any plurality of interacting particles is an Aristotelian substance, despite the fact that all such pluralities possess causally fundamental geometric structures. There are other necessary conditions on being a substance, one such condition being diachronic stability of structure. Hylomorphists such as Koons and Jaworski focus not only on the synchronic role of form but also on its role in determining the diachronic identity of its bearers. I will not try to give sufficient conditions under which a plurality of parts composes into an object. Suffice it to say that when they do, and that object has a geometric structure that plays an irreducible role in the dynamic interactions of its parts, then the object has a pretty good claim to being an Aristotelian substance. Where I differ from (at least some) other hylomorphists is that I have no trouble accepting, say, a water molecule as a case in point.[35]

[35] I argue at length for the fundamentality of geometric structure based on the water molecule in Yates (2016). In that paper I thought of geometric structure as itself bestowing causal powers, but I no longer think that way.

What about the core hylomorphist idea that the proper parts of a substance are individuated by its form? Focus on the heart. I do not think that the intrinsic properties of a heart change when it is removed from the body. Causally fundamental it may be, but geometric structure does not have the power to determine intrinsic nature. How then can I make sense of the Aristotelian idea that the proper parts of a substance are individuated by their places in the substantial whole? Individuation, for Aristotle, is functional, so any individuative role for geometric structure must involve a change in the powers of the structured parts. Without intrinsic change, such transformation seems impossible. If a heart doesn't undergo intrinsic change when removed from the body, then how can it possibly cease to be a heart? There is simple but not entirely unproblematic way of making sense of this idea, and here I will appeal to the notion of conditional powers detailed at the end of section (3).

Conditional powers are intrinsic properties. As I understand them, they are powers an object would have if it had certain other intrinsic *or relational* properties. Now some of an object's powers simpliciter will also be intrinsic to it. My heart, for instance, has the power to exert a certain force on a balance. This power of course makes up part of my weight, but it doesn't depend on my heart's being part of my body. Crucially, however, not all of my heart's powers simpliciter are intrinsic. Some are such that were my heart to be removed from my body, they would become *conditional* powers, for instance its power to pump blood around my body. This is a power that my heart has partly in virtue of the arrangement of all my organs, in relation to each other, throughout my body—that is, of the geometric structure my organs make in relation to each other. Of course, the intrinsic properties of my other organs also matter; the point is not that geometric structure does *all* the work. The point is just that it does work that nothing *else* does, and if we understand form as geometric structure, then the form of the body plays a crucial role in determining the powers simpliciter of the body's constituent organs.

Which powers individuate an object? We have two options. If we say that an object is individuated by its *conditional* powers, then objects are intrinsically individuated and no change in identity occurs when a heart or a hand is removed from a body. However, if we say that objects are individuated by

their powers *simpliciter*, then things are different. The powers simpliciter of the proper parts of a complex mechanism are not all intrinsic—at least some of them are *conditional* powers whose conditions include that the object be thus-and-so structured in relation to other objects of various kinds. When my heart is removed from my body, it loses some of its powers simpliciter and hence, if these are partially determinative of its identity, it is transformed. When it is transplanted into another body, it regains the powers simpliciter that it previously lost and becomes a heart once more. It is, to use Anna Marmodoro's phrase, *re-identified* by its place in the new body's structure.

The version of hylomorphism defended here involves a kind of symmetric grounding. How is it possible for an object such as a heart to compose into a body and yet at the same time be individuated by its place in that very body? Let me explain how I see things. When objects come together to form a complex particular, the geometric structure of that particular changes some of their conditional powers into powers simpliciter. A disembodied heart gains new powers simpliciter when it is transplanted into a new body. Assuming kinds such as hearts to be individuated by their powers simpliciter, that change is the *coming into existence* of a heart, but it is not a mysterious intrinsic change in the heart itself. That's not the kind of "re-identification" the current theory proposes. The combination of a plurality of objects to form a complex substance is possible because those objects can be structured *prior* to their re-identification. The formation of the relevant structure does not require that the objects already have their new identities, and the transformation that occurs does nothing to affect the geometric structure so formed. The transformation of conditional powers to powers simpliciter enables the parts to collectively constitute and sustain the new object. A severed hand is thus not a hand, except in perhaps *in potentiality*, insofar as we may understand what it is to be a hand in potentiality in terms of the conditional powers to grasp, stroke, and wave.

It remains the case that after their re-identification, the newly individuated proper parts of the substance compose into the substantial whole whose form individuates them. If both composition and individuation are forms of grounding, and if grounding is irreflexive, asymmetric and transitive, then

this proposal is incoherent. The proposal itself is a form of symmetric grounding, so asymmetry must be rejected from the outset. We must then reject either transitivity or irreflexivity. Assuming symmetry and transitivity, reflexive grounding would follow right away. The proper parts of a substance would both ground the substance and be grounded by it, from which reflexive grounding would follow by transitivity. The solution, as discussed earlier, is to reject transitivity as well as symmetry. When we consider how different the two grounding relations are—the composition of a whole by its proper parts and the individuation of the parts by transformation of their conditional powers into powers simpliciter—there is no reason to suppose that the transitive closure of these two relations represents a *further* grounding relation. Provided it is accepted that: (i) some conditional powers have extrinsic conditions, and (ii) objects are individuated by their powers simpliciter, the possibility of symmetric grounding follows. It is simply the possibility that a given object's individuative powers simpliciter are conditioned by its relations to other proper parts of a substance they jointly compose. That, it seems to me, is a fairly unmysterious case of symmetric grounding without reflexive grounding.

There are further interesting consequences of the present proposal. On a positive note, there are many conditional powers that individual human beings possess whose transformation into powers simpliciter depends on co-operation with other human beings in a social group. For instance, the jobs we perform (woodcutter, waiter, teacher, butcher, baker, candlestick-maker) all depend on our places in a social structure. If these powers simpliciter are taken to be among the individuative powers of persons, then persons are individuated in part by social structure—by the patterns that we make in relation to each other. At this level of abstraction, it is perhaps less clear that the patterns in question are geometric—spatiotemporal structures seem to be involved but that can't be all there is. What about structure such as social conventions, ethical norms, and laws? The details are beyond the scope of this paper. Still, I think it is plausible that persons are partially individuated by our social roles, and that this consists in the transformation of an individual from person-in-potentiality to person simpliciter under the influence of social structure broadly construed.

A less friendly case: I have the power simpliciter to read the text I am now writing, because I am wearing my glasses. If I take them off, this becomes a mere conditional power. Is my identity therefore changed by the removal of my glasses?[36] I don't think so, but I confess I don't have a theory that explains why. One response is that not *all* of the powers simpliciter of a complex object are individuative, but then no doubt there are those who will feel the need for a criterion that enables us to draw a line around those that are, and within the scope of the present theory I don't know how to give one. This is a disadvantage of geometric hylomorphism in relation to antireductionist versions such as those of Koons and Marmodoro. They can appeal to substantial forms qua irreducible principles of individuation and say that the forms dictate the kinds of substances there are, and which powers are essential to them. For my part, all I can really say is that some causal powers are more important to a particular individual, conceived in a certain way, than others. Perhaps if I were a *Reader*—one whose purpose in society and in life is to read books, and who would cease to exist without the power simpliciter to do so—then it wouldn't feel quite so artificial to regard my glasses as part of the substantial form that makes me who I am.

There is a further issue with my proposal that deserves attention.[37] What about cases in which a hand loses its defining powers simpliciter without any change in the body's form? Such cases include anaesthesia and temporary paralysis, in which at least some of the hand's powers simpliciter seem to revert to conditional powers due to changes in the intrinsic conditions of the body, for example the ingestion of a substance that blocks certain neurotransmitters, the effects of extreme cold on the body, or simply the effects of being asleep. It seems that I am committed to saying that a temporarily paralysed hand loses its essential nature, which is defined in terms of powers simpliciter and *not* the conditional powers that the hand retains in such cases. When the paralysis wears off and the paralysed "hand" returns to normal—that is, when it returns to *being* a hand—I then need to deny that it is the same hand that it was previously. Had it been detached and reattached, it would now be a numerically

[36] I thank Bruno Jacinto for pressing me on this point.
[37] I thank Patricia Gaspar for raising the problem of temporary paralysis for geometric hylomorphism.

different instance of the same kind and it is unclear what could justify saying anything different about the paralysis case. Why don't I lose my hand when I go to sleep, if when sleeping I can grasp only conditionally on waking up? For that matter, why don't I lose my eyes whenever I close them? Clearly, I need to say that in cases such as temporary paralysis, closed eyes, and sleep, the relevant organs retain their powers simpliciter.

Suppose the hand is temporarily anaesthetised and thus the subject loses their ability to feel and grasp properly. This is only a partial loss of function, but the general points apply. If the anaesthetic works by binding to neuroreceptors in the brain, then it seems clear that it prevents the hand from manifesting its defining powers—in the case of sensation, it prevents sensory signals from the hand from reaching their intended targets in the brain and thus reduces the hand's function. A similar case is the following: I have the power simpliciter to break a certain fragile vase, but am unable to manifest this power if the vase is encased in a packaging material that masks its fragility. The mask prevents both my power to break and the vase's power to be broken from manifesting, but it does not alter the powers simpliciter of either. Likewise, an anaesthetic is best seen as masking some of the defining powers simpliciter of a hand and not as rendering them conditional. The same applies, mutatis mutandis, to a hand that is temporarily gloved or numb from cold; and to eyes that are temporarily closed. A severed hand, by contrast, is not merely a hand whose powers simpliciter are masked, it is a hand that *would* have those powers if it were reattached but which, in isolation, has them only conditionally. In contrast, *permanent* paralysis caused by nerve damage results in a change in the structure of the body which in turn suffices to reidentify the hand as a non-hand, by rendering some of its defining powers merely conditional. There is clearly more to be said about these issues that I have the space to say here, and the plausibility of my reply depends on whether a principled distinction can indeed be drawn between extrinsic properties that render a power simpliciter a conditional power, and those that merely prevent such a power from manifesting.

5. Conclusion

The position defended here combines elements of the versions of staunch hylomorphism defended by Koons, Marmodoro and Jaworski. I maintain Jaworski's commitment to causal closure, but hold that closure is compatible with a form of downward causation and use that idea to develop a novel version of hylomorphism. The strongest empirically supported causal closure principle says that all physical effects have sufficient physical causes and that the basic physical properties of those causes bestow all the causal powers needed for the effect to occur. But causal power bestowal is not all there is to causation: in addition to causal powers, there are composition principles that determine how multiple powers compose, and these principles cannot avoid reference to geometric structure. One way of interpreting this role is to say that some of the powers bestowed by the basic physical properties of causes are *conditional* powers and that geometric structure is among the conditions on which those powers become powers simpliciter. If we interpret form in that way, I have suggested, then it has a fundamental causal role in the dynamic evolution of the physical world.

I agree with Koons that the form of a substance plays a role in grounding the powers of its proper parts, where these latter are understood as powers simpliciter. Many of the powers of objects in isolation are conditional powers, and the form of the whole is one of the *conditions* on those powers being powers simpliciter. As such, form is part of the grounding explanation of why the conditional powers of the proper parts become powers simpliciter when the parts combine spatiotemporally so as to realize the form in question. There's no emergence involved, no mystery and no magic: all the relevant conditional powers come from the parts' basic physical properties in isolation. Form doesn't supply any oomph, so to speak—it just transforms conditional powers into powers simpliciter. Finally, I agree (tentatively) with both Koons and Marmodoro that the identities of a substance's proper parts are grounded in substantial form. For this we need to hold, as is uncontroversial for Aristotelians, that kinds such as hands are individuated by the functional roles they occupy. We also need to hold that those functional roles are given in terms of powers simpliciter and not conditional powers, which seems plausible—a thing can hardly occupy a functional role based on powers that it *would* have if

things were different. If all this is accepted, then the transformation of conditional powers to powers simpliciter that comes about when things combine into wholes really does re-identify them, because the functional identities of a substance's proper parts are not intrinsic powers. My claim that some conditional powers have extrinsic conditions is central, for if form merely acts as a triggering condition of the intrinsic powers of a substance, then it will not *transform* its bearers. If a transplanted heart is not transformed but merely deprived of an irreducibly structural trigger, then the resulting position is probably not a version of hylomorphism—but it is, perhaps, something near enough.

Just as there are things my heart can do only when it occupies a certain place within a body of the appropriate kind, so there are things I can do only when I am a member of the right kind of social group. If the arguments of this paper are sound, my place within such a group transforms at least some of my intrinsic conditional powers into powers simpliciter. If any of these latter powers individuate me, then my essence too is extrinsic. If the structure of society plays the same kind of top-down causal role that I have argued for in the case of geometric structure, then there is room for a theory on which that structure transforms our natures without intrinsic change. Evidently the structure of society, however it is to be understood, must go beyond spatiotemporal arrangement. But it is, I think, plausible that society *has* a higher-level structure and that this structure conditions the causal powers of its constituent people. And, one might suggest, it is these socially conditioned powers that make us who and what we are. I am not, it goes without saying, the first philosopher to suggest such a thing.

> Thus also the city-state is prior in nature to the household and to each of us individually. For the whole must necessarily be prior to the part; since when the whole body is destroyed, foot or hand will not exist except in an equivocal sense, like the sense in which one speaks of a hand sculptured in stone as a hand; because a hand in those circumstances will be a hand spoiled, and all things are defined by their function and capacity, so that when they are no longer such as to perform their function they must not be said to be the same things, but to bear their names in an equivocal sense. It is clear therefore that the state is also prior by nature to the individual; for if each individual when separate is not self-sufficient, he must be related to the whole state as other parts are to their whole, while a man who is incapable of entering into partnership, or who is so self-sufficing that he has no need to do so, is no part of a state, so that he must be either a lower animal or a God.[38]

[38] Aristotle, *Politics* 1253a.

Bibliography

Aristotle, *Metaphysics*. XX

Aristotle, *Politics*. XX

Crane, T. & Mellor, D. (1990). 'There is no Question of Physicalism', *Mind* 99, pp. 185-206.

Crook, S. & Gillett, C. (2001). 'Why Physics Alone Cannot Define the 'Physical', *Canadian Journal of Philosophy*, 31, pp. 333-359.

Inman, D. (2018). *Substance and the Fundamentality of the Familiar: A Neo-Aristotelian Mereology*. New York: Routledge.

Jaworski, W. (2014). 'Hylomorphism and the Metaphysics of Structure', *Res Philosophica* 91, pp. 179-201.

Jaworski, W. (2016). *Structure and the Metaphysics of Mind*. Oxford University Press.

Kim, J. (1998). *Mind in a Physical World*. MIT Press.

Kim, J. (2005). *Physicalism, or Something Near Enough*. Princeton University Press.

Koons, R. (2014). 'Staunch vs. Faint-hearted Hylomorphism: Toward an Aristotelian Account of Composition', *Res Philosophica* 91, pp. 151-177.

Koslicki, K. (2008). *The Structure of Objects*. New York: Oxford University Press.

Lange, M. (2017). *Because Without Cause*. Oxford University Press.

List, C. & Menzies, P. (2010). 'The Causal Autonomy of the Special Sciences', in C. Macdonald and G. Macdonald (eds.), *Emergence in Mind*, Oxford University Press, pp. 108-128.

Marmodoro, A. (2013). 'Hylomorphism without Reconditioning', *Philosophical Inquiry* 37, pp. 5-22.

Papineau, D. (2001). 'The Rise of Physicalism', in C. Gillett and B. Loewer (eds.), *Physicalism and its Discontents*, Cambridge University Press, pp. 3-36.

Rea, M. (2011). 'Hylomorphism Reconditioned', *Philosophical Perspectives* 25, pp. 341–358.

Robinson, H. (2014). 'Modern Hylomorphism and the Reality and Causal Power of Structure: a Sceptical Investigation', *Res Philosophica* 91, pp. 203-214.

Shoemaker, Sydney (2001). 'Realization and Mental Causation', in Carl Gillett and Barry Loewer (eds.), *Physicalism and its Discontents*, Cambridge University Press, pp. 74-98.

Thompson, N. (2016). 'Metaphysical Interdependence', in M. Jago (ed.) *Reality Making*, Oxford University Press, pp. 38-55.

Wilson, J. (2006). 'On Characterising the Physical', *Philosophical Studies* 131, pp. 61-99.

Yablo, S. (1992). 'Mental Causation', *Philosophical Review*, 101, pp. 245-280.

Yates, D. (2009). 'Emergence, Downwards Causation and the Completeness of Physics', *Philosophical Quarterly* 59, pp. 110-131.

Yates, D. (2016). 'Demystifying Emergence', *Ergo* 3, pp. 809-841.

Yates, D. (2018). 'Inverse Functionalism and the Individuation of Powers', *Synthese* 195, pp. 4525-4550.

Yates, D. (2020). 'Neural Synchrony and the Causal Efficacy of Consciousness', *Topoi* 39, pp. 1057-1072.

Yates, D. (forthcoming). 'From Multilevel Explanation to Downward Causation', in *Levels of Explanation*, eds. K. Robertson & A. Wilson. Oxford University Press.