Sorting Out Aristotle

How Contemporary Grounding Theory can Illuminate

The Metaphysics

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December 29, 2022

Abstract. Were Aristotle and the tradition that followed him Platonists? Were they resemblance nominalists? Or some kind of trope theorists? I will argue that Aristotle's theory is best understood as a kind of resemblance-based trope theory, with resemblance between particular forms (essential tropes) being explained in terms of what grounds (metaphysically) their mutual numerical distinctness. I will focus on the question of which interpretation of *The Metaphysics* makes for the most coherent and defensible version of the Aristotelian project, including such elements as the Porphyrean structure of species and genera, the unity of substantial form, the unity of substances both at a time and through time, the definability of form, the role of matter, and substances as composites of form and matter. The result will be a unique version of trope theory.

1. Thinking through the Text Metaphysically

There are three approaches to any philosophical text from a much earlier period of time, including all of ancient Greek philosophy. These are a purely antiquarian, *eisegesis* (reading contemporary issues and methods back into the text), and dialogue. In order to make dialogue possible, one has to find some comnon ground between the ancient philosopher and work taking place in our own time. This common ground could consist in common questions or issues, common problems that need to be solved, along with some tacit agreement about what an answer to the question or a solution to the problem might look like.

Some measure of dialogue is essential to understanding the text of any great philosopher, like Plato or Aristotle. The meaning of a metaphysical text can become clear only by thinking through the text metaphysically. What problem are they trying to solve? How do they propose to

solve it? I am assuming that the deepest metaphysical problems and questions are perennial, common ground between us (at our best) and any great philosopher in the past.

In particular, in making sense of the metaphysical texts of Plato and Aristotle, we have to understand and have some real sympathy with a central project: how to ex the phenomenon of similarity or conspecificity among numerically distinct things? Such things are not wholly different but not wholly the same, either. How is that possible?

Plato's solution was to introduce the Forms and a participation relation between individual things and the Forms that characterize them. Two distinct things can be the same in character by participating in the same Form. This solution, of course, raises many further questions: what are the Forms, how do they differ from particular things and from one another, how does each Form relate to itself and to other Forms, and what is the participation relation?

Nominalists, those who utterly reject Plato's solution, have two viable options.

- Ostrich Nominalist: to deny that there is any general solution to the problem. Each natural kind is a metaphysically fundamental category. No common account of similarity: as many different kinds of similarity as there are natural kinds of things.
- Resemblance Nominalists: qualitative sameness is a metaphysically fundamental, external relation among things. That x resembles or is similar to y is not grounded in anything intrinsic to x or y. Instead, their intrinsic similarity is grounded in the external relation of similarity.

ON is essentially a counsel of despair, a refusal to take metaphysical explanation seriously. It requires a huge inflation of fundamental, brute facts.

RN faces two fundamental problems: (i) it gets the order order of explanation is backward (that is, things resemble each other because they have some property in common; they do not have a property in common because they resemble each other), and (ii) it offers no explanation for the symmetry and transitivity of perfect resemblance. The latter requires an infinite coincidence within the class of metaphysically fundamental resemblance facts.

Here's another way to put the order-of-explanation problem: for Resemblance Nominalists, resemblance must be an external relation. In fact, it is obviously an internal relation:

Definition 1. *R is an* internal relation *iff, necessarily for any x and x, if Rxy, then there are facts G and H, intrinsic to x and y respectively, such that the fact that Rxy is grounded by the facts G and H.*

Resemblance Nominalists cannot accept that resemblance in an internal relation in this sense, since the intrinsic character of any particular thing is grounded by the resemblance relations in which the thing stands, and not vice versa.

These facts give us sufficient reason to look for another solution, one involving a kind of numerical identity (or something very close to numerical identity) of shared natures or features.

2. Plato's Theory of the Forms

Plato's theory of Forms avoids the defects of both ON and RN. It offers an explanation of resemblance in terms of sharing something in common. Consequently, it follows that exact resemblance is symmetric and transitive. Platonists can define resemblance in terms of the exemplifying of forms:

Platonic Definitions of Resemblance

> x r*esembles y* iff there is some form F such that both x and y exemplify F.

> x *perfectly resembles y* iff, for every form F, x exemplifies F iff y exemplifies F.

It is easy to prove, using just these definitions and first-order logic, that resemblance is symmetric and that perfect resemblance is transitive. In contrast, the resemblance nominalists must take these as brute, inexplicable facts.

I think it's clear that Aristotle is searching for another solution, or for a substantial revision of Plato's solution. It is also important to note that most of Aristotle's objections to the theory of Forms derive from objections developed by Plato himself. So, the situation is not one of a kind binary competition between two competing theories but an evolution within a single research program.

Plato does not in fact have a single theory of Forms. Throughout his career, he considers a number of alternative theories. For the sake of simplicity, I will pick one of those theories and

pretend that it is "the Theory of Forms" in Plato. It is a theory that Plato adopts early on and that he never decisively rejects. And the principal alternative theory that he considers is quite close to Aristotle's own theory, so it is useful for me to deploy the first theory as a foil.

Here are the basic commitments of one of Plato's theories of forms

1. Forms are unchanging, existing outside of space and time.
2. Each Form is a unique entity, existing independently of particulars.
3. Forms are present in their instances (the things upon which they confer the relevant property), either (a) in part or (b) wholly.
4. Forms are self-exemplifying. That is, they exemplify the properties they confer on particulars. The Form of F is an F.
5. There are Forms corresponding to nearly every meaningful predicate or concept.
6. The most fundamental Forms are the most general ones, like One and Being.

Of these, propositions 1 through 3 constitute the core of the theory. Plato is seeking to explain qualitative similarity by means of the numerical identity of some shared form. If Forms existed within space, there would be no bar to their being duplicated, in which we would have instances of similarity that the theory itself could not explain. If the Forms existed within time, they would be subject to change, requiring Forms to have changeable features, again introducing inexplicable similarities.

Each Form must be distinct from the others, if we are to use them to explain qualitative similarity and difference. And the Forms must be independent of particulars, if we are to avoid vicious circularity in our explanations.

Something like proposition 3 is required if the Platonist is to offer any explanation of the relation of participation. If participation were introduced as a *sui generis*, external relation between particulars and Forms, it is hard to see how the relation could explain the particulars' having the intrinsic natures that they do.

Proposition 4 is not essential to the account, but it does contribute something important to Plato's account of participation. If the Forms do not exemplify the properties they confer on particulars, how is that conferring (via participation) to be explained?

Propositions 5 and 6 seem to be even more peripheral features of the early theory. Many of Aristotle's criticisms are directed to these two. Aristotle proposes that is the forms of the *infimae species* that are most fundamental, not generic forms like oneness or being. He argues that there is no need for forms of negative properties. In effect, he argues for what is now called a 'sparse' theory of forms. Revisions to 5 and 6 are already prefigured in Plato's later dialogues, such as *Parmenides*, *Statesman*, and *Sophist*.

With respect to proposition 3, Plato constructs a dilemma. If a Form is only *partly* present in its instances, how can it confer the corresponding property wholly to those instances? How can having only a small part of something that is paradigmatically *F* be sufficient to make the instance *F*? This is especially a problem for heterogeneous properties, like quantities (having a particular volume) or biological species (being a particular ant). One might have part of a paradigmatic ant (perhaps, one of its paradigmatic antennae) without being an ant. One might have part of the paradigmatic cubic meter without having a cubic meter of volume.

There's a problem, even in the case of homogeneous qualities, as Anna Marmodoro has recently pointed out (Marmodoro 2021, 89-93). If the form of Heat has many parts, each of which is individually a form of Heat, then this contradicts proposition 1, the uniqueness of each Form. By multiplying the forms of Heat, the division of the form of Heat into parts renders the whole theory ineffective, incapable of explaining the very phenomenon it was intended to explain (that is, the sameness of qualitatively similar but numerically distinct things).

Alternatively, embracing option 3b, in which each Form is *wholly* present in each of its instances, means that the Form will be "separate from itself," a consequence that seems to worry both Plato and Aristotle. Worries about the nature of participation form a major theme in the Parmenides. Aristotle also raises this objection repeatedly. It's not clear why this is supposed to be devastating. Why couldn't Plato have simply bit the bullet here, insisting that Forms (unlike particulars) can be wholly multi-located? As we'll see, there is good reason for Aristotle to reject this idea, a reason that is internal to Aristotle's own project, but I don't see any reason for Plato's being so averse to accepting self-separation?

The Third Man problem is perhaps more serious. The Third Man results from combining propositions 3 and 4. If the form of Heat is itself hot (as 4 requires), then proposition 3 entails

that the form of Heat must be hot by virtue of having some further form of Heat as a part. But here again there is a simple solution available to Plato: he could simply insist that the Form of Heat is hot by virtue of being present "in" itself. This would mean admitting that the Form of Heat is hot in a different way from the way in which other particulars are hot. The Form of Heat is hot by virtue of having itself as an "improper part" (as we would say nowadays), while other hot things are hot by virtue of having the Form of Heat as a proper part. That seems like a reasonably uniform account.

In conclusion, Plato's core theory of the Forms (propositions 1 through 4) seems to survive the objections that Plato and Aristotle lodged against it. So, is there any strong reason to look for an alternative theory? I think there is: a reason that depends on Aristotle's introduction of the category of substance or primary being (*ousia*).

3. Aristotle's Revised Theory

Here are the central propositions of Aristotle's theory:

0*. There is a special class of forms (substantial forms) that are responsible for the synchronic and diachronic unity of a special class of particulars (the substances).

1*. Corresponding to each species of form there is a unique and unchanging intentional entity (the universal), existing outside of space and time. This universal is either (a) merely potentially in existence, or (b) entirely outside of real existence (Meinong's *Aussersein*). Universals are not forms.

2*. Two forms of the same species are numerically distinct but stand in a relation of counter-possible identity, and their numerical distinctness is wholly grounded by the numerical distinctness of the two associated packets of Matter.

3*. Forms are wholly present in their instances (the things upon which they confer the relevant property), bu they are present dynamically, as continually present factors, not as static constituents.

4*. Forms are not self-exemplifying. Instead, we can say that individual essences are fixed points: the essence of the essence of a substance is the essence of that substance (where an essence is the unity of a substantial form with something that the form unifies).

5*. There are forms corresponding to the species, genera and *differentiae* of substance and to the various specific attributes falling in the categories of accident.

6*. The most fundamental forms are the substantial forms belonging to *infimae species*.

The key difference between Plato's theory and Aristotle's lies in proposition 0*. There is in Plato's theory no special class of particulars. Plato does not distinguish between coherent entities and mere heaps, nor does he distinguish between things that exist primarily as wholes and those that are merely parts of something else. Plato's ontology of particulars is a flat one, with no clear metaphysical priority of some particulars over others. There is no special synchronic unity possessed by some particulars and not others.

Similarly, Plato's theory of diachronic unity is a version of four-dimensionalism. What we call a persisting thing is merely a series of instantaneous stages, a spacetime worm. The only things that truly persist through time at a fundamental level are parts of space, parts of the *chora* or receptacle (in the *Timaeus*). There is no true locomotion in the *Timaeus*—merely the successive presence of the same geometrical form at different locations at different times..

Aristotle puts forms to much more work than Plato does. His is a more ambitious theory. Substantial forms must be the grounds for synchronic and diachronic unity. Thus, they must be the ground of the actual existence of a substance. A substantial form brings its own instance into existence as a whole, it does not merely inhabit a pre-existing domicile (as in Plato's theory).

Aristotle introduced substances to be the primary *loci* of causal powers, powers that are ultimately determined by the nature of the substance's species. These causal powers, especially the passive ones, the dispositions to change, require real persistence through time. The natures or essences of substances must be principles of persistence, principles of rest and change (as Aristotle puts it). Aristotle rejected (rightly as it turns out) any kind of metaphysical atomism. All of his substances are potentially divisible, even if actually undivided. Therefore, substances also require principles of synchronic unity, distinguishing them from mere heaps. It is substantial forms that provide the principles of both diachronic and synchronic unity.

Aristotle's forms, therefore, must be active and reactive in a way that Plato's Forms could not be. A substantial form is responsible for unifying a set of parts at each moment, and of sustaining

that unity through time, while absorbing new parts and extruding old ones. Could a merely static and transcendent form do all the work that Aristotle requires?

In Plato's theory, the Forms and the particulars exist independently of each other. The fundamental particulars are the parts of the Receptacle (space). A Form has an instance simply be being wholly located in some pre-existing region of space. Aristotle's substantial forms have a much greater role: a substantial form is responsible for the very existence of its instance. Each substantial form is the ground of the existence of a substance—it is that by which the substance exists at all. Again, it is hard to see how a single, multi-located Platonic form could simultaneously be the ground of the existence of multiple substances. And how could something that is in and of itself outside of space and time responsible for the spatiotemporal existence of any particular substance?.

In Aristotle's theory, it is no enough for a substantial form to merely *be there*, to be located within each instance. There is something that the Form must *do* in each case, and these metaphysical *actions* are multiple and mutually disjoint, because their results are multiple and disjoint. If we tried to press a single Platonic Form into taking on this task, we would face a fundamental problem. It wouldn't suffice for the one Form to be merely *present* in each instance, it would have to be both present and *active* in each instance. And, if we are to have a fully adequate account of specific sameness across the instance, we would have to suppose that the one Form performs the *very same action* in each case. But now we've destroyed the theory, since the theory depends on the specific sameness of a class of actions, and we have no explanation for that sameness. The same Form is the agent of each of the actions, but that is no guarantee that it *does* the same thing in each case. We need for the metaphysical actions of the one Form to be somehow the same, and yet they cannot be numerically the same, because they result in numerically distinct particular substances.

In fact, we can think of the substantial form as a kind of temporally and spatially extended action, a *making actual* the spatial and temporal unity of the matter. What is the agent of this action? For Aristotle's system, it doesn't really matter, since sameness of agent is neither necessary nor sufficient for sameness of action. We could suppose that each substantial form is both agent and action---an agent whose whole being comprised by a single action of formal causation. Or, we could suppose that the prime mover or the sun is the principal agent of formal

causation. Or that it is something like Aquinas's individual act of existence. What matters is that we secure the specific sameness of the metaphysical action.

So, there is good reason for Aristotle to multiply Plato's Forms, resulting in numerically distinct substantial forms for each substance. Similar reasons would support a similar multiplication of accident (non-substantial) forms. But how can Aristotle do this without undermining the whole point of the theory? How can a plurality of forms explain the real unity of the members of a species?.

In her recent book, Anna Marmodoro has suggested that Plato had already discovered a solution to this problem (Marmodoro 2021). Plato proposed that each Form is simple and undivided in itself, but divided into parts through its instantiation by multiple particulars. Marmodoro calls this *Cambridge Partitioning* (Marmodoro 2021, 116-7). The distinction between two such parts is grounded by and dependent on the prior numerical distinction between the particular instances. The Form is primarily one but derivatively many. Each of the parts would be identical to all of the other parts (and thereby identical to the whole) but for the distinctness of the particulars that instantiate the Form. There is a kind of counterfactual or counter-possible identity between the parts of the Form, and only a metaphysically derivative form of distinctness between them.

This is also the solution that Aristotle adopts, with one important difference. Aristotle treats the whole, undivided Form as itself only a counterfactual possibility, or even a counter-possible entity (as in Meinong's account of universals). In the actual world, the complete or universal Form plays the role of a merely intentional entity, the object of universal scientific knowledge. In actual reality, there is no whole, and certainly no *undivided* whole. This is a an improvement over Plato's account, since Plato's Forms, as actual entities, are a superfluous addition to the theory. They do no work in grounding the character or intrinsic similarity of particulars. They are needed only as intentional objects (as predicable entities), and for this role actual existence isn't needed. In addition, as I will argue in section 4 below, Aristotle's account enables him to give an explanation of the Porphyrean tree of genera, differentiae, and species without dividing each substance's substantial form. And, I will argue in section 5 that Aristotle's theory resolves a problem about quantitative accidents.

Aristotle's theory provides a substantive explanation for the existence of specific sameness among numerically distinct substances. Two substances are *conspecific* just in case they are numerically distinct, and their numerical distinctness is wholly grounded by the prior numerical distinctness of their two packets of Matter—ultimately, I suppose, by the fundamental numerical distinctness of their two packets of Prime Matter. Jeffrey Brower has attributed exactly this view to Thomas Aquinas (Brower 2014). What Aristotle proposes could be described as *Cambridge Individuation*: the individuation of the forms depends on extrinsic facts, facts about the mutual distinctness of packets of Prime Matter.

This is the point at which the contemporary work on metaphysical grounding by Kit Fine (2012, 2015), Gideon Rosen (2010), Jon Litland (2015, 2017), and others is relevant. Grounding theory gives us a kind of dependency that is prior to and possibly independent of modal dependency. An entity x is asymmetrically modally dependent on y if and only if it is impossible for x to exist while y does not exist, while it is possible for y to exist without x's existing.

Definition 2. *Modal Dependence. x is* asymmetrically modally dependent on y *iff it is impossible for x to be actual without y's being actual but possible for y to be actual without x's being actual.*

The numerical distinctness between a pair of entities P_1 *cannot* be modally dependent on the numerical distinctness between a disjoint pair P_2, on the plausible assumption that every case of numerical distinctness is metaphysically necessary. If the members of pair P_1 are numerically distinct, then they must be distinct in every possible world, and so that distinctness cannot be modally dependent on anything.

Metaphysically necessary facts cannot be modally dependent on any other facts, but there is no bar to a metaphysically necessary fact being *grounded* by another fact. For example, Kit Fine has argued that all metaphysical necessities are grounded by facts about the essences of things (Fine 1994). If we assume an S4 modal logic, every fact about what is metaphysically necessary is itself metaphysically necessary. So, Fine is proposing that some metaphysically necessary facts are wholly grounded by other metaphysically necessary facts.

Two substantial forms are conspecific (intuitively, belong to the same species) if and only if their numerical distinctness is not metaphysically fundamental but instead derived, and, in particular,

derived by the numerical distinctness of some class of bare particulars (prime-material entities, entities of pure and unqualified materiality). Socrates' substantial form and Callias's substantial form are numerically distinct, but they are not distinct of themselves but only by virtue of the prior numerical distinctness of Socrates' matter and Callias's matter (together with the fact that some of Socrates' matter is contemporaneous with some of Callias's matter), as Aristotle explains in *Metaphysics* Zeta 8:

> τὸ δ᾽ ἅπαν ἤδη, τὸ τοιόνδε εἶδος ἐν ταῖσδε ταῖς σαρξὶ καὶ ὀστοῖς, Καλλίας καὶ Σωκράτης: καὶ ἕτερον μὲν διὰ τὴν ὕλην (ἑτέρα γάρ), ταὐτὸ δὲ τῷ εἴδει (ἄτομον γὰρ τὸ εἶδος).

> The completed whole is Callias or Socrates, that is, such-and-such a form in these particular flesh-and-bones; they differ through their matter, for their matter is different, but they are the same by way of form, for the form is indivisible. (*Metaphysics* Zeta 8, 1034a7-9. My translation)

To say that they are "the same by way of form" (ταὐτὸ δὲ τῷ εἴδει) is not to say that their substantially forms are strictly identical (numerically one) but merely to say that the numerical distinctness of their forms is not metaphysically *fundamental*. Socrates and Callias are numerically distinct because their respective bits of matter are distinct, and the same is true of their substantial forms. The forms are the same in the sense that they would be one if the two relevant chunks of matter were *per impossibile* one.

Aristotle makes the same point in a parallel passage in *Metaphysics* Iota 9:

> οὐδ᾽ ἀνθρώπου γὰρ εἴδη εἰσὶν οἱ ἄνθρωποι διὰ τοῦτο, καίτοι ἕτεραι αἱ σάρκες καὶ τὰ ὀστᾶ ἐξ ὧν ὅδε καὶ ὅδε: ἀλλὰ τὸ σύνολον ἕτερον μέν, εἴδει δ᾽ οὐχ ἕτερον, ὅτι ἐν τῷ λόγῳ οὐκ ἔστιν ἐναντίωσις. τοῦτο δ᾽ ἐστὶ τὸ ἔσχατον ἄτομον: ὁ δὲ Καλλίας ἐστὶν ὁ λόγος μετὰ τῆς ὕλης: καὶ ὁ λευκὸς δὴ ἄνθρωπος, ὅτι Καλλίας λευκός: κατὰ συμβεβηκὸς οὖν ὁ ἄνθρωπος. οὐδὲ χαλκοῦς δὴ κύκλος καὶ ξύλινος: οὐδὲ τρίγωνον χαλκοῦν καὶ κύκλος ξύλινος, οὐ διὰ τὴν ὕλην εἴδει διαφέρουσιν ἀλλ᾽ ὅτι ἐν τῷ λόγῳ ἔνεστιν ἐναντίωσις.

The flesh and bones of which this and that man consist are different, to be sure, and any concrete individual (*synolon*) is, indeed, distinct (from any other individual), but not therefore of another species, because there is no contrariety in their definitions; and whatever things can be defined without such contrariety belong to the same ultimately indivisible (*atomon*) species. But "Callias" implies a definition that includes his matter, and so does "the white man"; because it is Callias who is white, whereas "man" is white only incidentally (*kata symbebekos*). Similarly, a ring of bronze and one of wood do not differ as to species; but between a triangle of bronze and a ring of wood there is contrariety in the definition, and not merely in matter. (*Metaphysics* Iota 9, 1058b8-15; my translation)

Here Aristotle stretches the notion of definition so far as to suppose that an individual like Callias can be defined as such. Under this extended notion of definition, we would have to include Callias's particular matter in his definition, since it is by virtue of that particular matter that he is distinct from other human beings. Aristotle then pretends that shapes are the species of physical objects (something that is clearly not literally true), and under that pretense, any two rings belong to the same species. Two rings are two because of their matter, not because of any repeatable feature that the two possess. It's not essential to Aristotle's example that the two rings be made of qualitatively different proximate matter (bronze and wood): the example would work just as well (in fact, even better) were we to consider two rings of wood.

Here is a more formal statement of Aristotle's notion of conspecificity, a notion that can replace the Nominalist notion of resemblance. As we shall see, Aristotle's conspecificity has several crucial advantages over resemblance as a metaphysical primitive.

Definition 3. *Conspecificity. Substantial forms x and y are* conspecific *if and only if either (a) x = y, or (b) their numerical distinctness is wholly grounded by the numerical distinctness of the members of the class of prime-material entities.*

Two substantial forms are *specifically different* iff they are not conspecific.

If that makes sense, we can consider Aristotle's claim that the distinctness between two substantial forms, even if that distinctness is metaphysically necessary, is wholly grounded by the numerical distinctness of two other things (in this case, two packets of matter). Things that

have only derived or grounded numerical distinctness stand in an identity-like relation to each other. If we are allowed to speak of impossible worlds (and I think we should be allowed to do so), we could say that two substantial forms of the same species would have been identical if (*per impossibile*) their respective packets of matter had been identical. In fact, we could say that they would have been identical if all of the world's packets of prime matter had (*per impossibile*) been numerically identical.

This fact gives the Aristotelian account two big advantages over resemblance nominalism. Let's say that there is a kind of resemblance that holds between any two members of a species. For resemblance nominalists, this will have to be a fundamental relation, and therefore it will have to be an external relation. In contrast, the relation of conspecificity is an internal relation for the Aristotelian. Whether two substantial forms are conspecific depends on their own internal character. Self-identity is a paradigmatically internal relation, and so, by analogy, should any form of counterfactual or counter-possible identity. Therefore, Aristotle is immune to the charge of reversing the order of explanation. He explains resemblance in terms of intrinsic sameness and not vice versa.

Second, Aristotle can explain the two formal facts about the resemblance relation, namely, its symmetry and transitivity (in the limit of perfect resemblance). Aristotelians can rely on the corresponding logical facts about identity, just as Platonists can and as resemblance nominalists cannot. If x and y would be identical under counter-possible condition C, and y and z would be identical under that same condition C, then x and z would be identical under C. And, of course, the symmetry of the relation is even easier to obtain. We don't need actual identity as Platonists do. Counter-possible identity works just as well.

4. The Unity of Substantial Form: Genus, Differentia, and Species

One of the principal functions of the substantial form is, for Aristotle, as a ground for substantial unity (see proposition 0*). The form explains why the resulting substance is one *per se*. The form explains both the synchronic unity of the parts of the substance, and the diachronic unity of the substance through various intrinsic, accidental changes. The nature of the form grounds the

criteria of synchronic and diachronic unity: a set of rules or principles for determining where a substance exists, which parts it contains, and which changes it can and cannot survive.

Definition 4. *C is a* complete criterion of substantial unity *iff C consists of a set of principles sufficient to define the spatial limits and persistence conditions of a particular substance. Such a criterion is grounded by a set of proper accidents or* propria*, properties that flow essentially from the substance's substantial form.*

We can also talk about indeterminate or generic substantial forms. An indeterminate substantial form would be one that grounds an indeterminate set of criteria of unity. Substantial forms become more or less determinate by the addition or deletion of differentiae. Each differentia corresponds to a set of criteria of unity. A more determinate differentia corresponds to a proper subset of the criteria associated with a less determinate differentia. The ultimate differentia of an *infima species* corresponds to a singleton set, containing a single, complete criterion of substantial unity.

Definition 5. *A set D is a* differentia *iff D is a set of complete criteria of substantial unity.*

Just as two conspecific forms are individuated by their respective prime-material substrates, so two forms of different species but the same genus are individuated by their respective differentiae. Each substantial in the genus must express itself in exactly one differentia that is strictly more determinate than is the differentia that defines the genus. It is impossible for a substantial form to change this mode of expression (since substantial forms do not undergo any kind of intrinsic alteration). If and when a substance is generated, the efficient cause of the generation is responsible for ensuring that the substantial form of the new substance expresses itself in exactly one appropriate differentia.

If we have a class of genera that belong to a common super-genus, then the same set of facts iterates. There will be some generic differentiae that are responsible for the numerical distinctness of any two substantial forms belonging to different genera in the super-genus. And so on, until we reach one of the highest genera in the category of substance. Any two substantial forms belonging to different genera at the highest level will be fundamentally distinct from each other. Here again, the metaphysical buck stops.

Definition 6. *Highest Level Difference. Two substantial forms are* different at the highest level *(i.e., belong to the different highest-level genera) if and only if their numerical distinctness is fundamental (ungrounded).*

In summary, if we take two substantial forms at random, there is a range of possibilities. It could be that the two forms are fundamentally distinct. In that case, they belong to different genera at the highest level. It could be that their generic difference at some level in the tree is grounded by the distinctness of the members of a corresponding class of differentiae, in which case the forms belong to different species of common genus that is not at the highest level. And, finally, it could be that the distinctness of the two forms is grounded by the distinctness of a class of prime-material entities, in which case the two forms belong to the same species.

Definition 7. *Congenericity at level 1. Two substantial forms x and y are* congeneric at level 1 *iff either (i) they are conspecific, or (ii) there is some class A of differentiae such that the specific difference of x and y is grounded by the numerical distinctness of the members of A.*

Definition 8. *Generic Difference at level n. Two substantial forms are* generically different at level n *iff they are not congeneric at level n.*

Definition 9. *Congenericity at level $n + 1$. Two substantial forms are* congeneric at level $n + 1$ *iff either (i) they are congeneric at level n, or (ii) they are generically different at level n, and there is some differentia D such that the generic difference at level n of x and y is properly grounded by the numerical distinctness of the members of D.*

Definition 10. *A fact f is* properly grounded by *the facts in set G iff f is wholly grounded by the members of G, and f is not wholly grounded by the members of any proper subset of G.*

The genus provides a space of criteria of substantial unity, and the differentia contracts that space to a sub-space. Prime matter is maximally indeterminate. It is compatible with any criteria of unity. Thus, matter is generic. And, conversely, we can think of generic forms as a kind of matter whose potentially is made more determinate by differentiae. This explains why the more specific species are more fundamental for Aristotle. They are fully determinate, fully functional as substantial forms. Moving up the hierarchy is moving toward greater indeterminacy. An indeterminate form cannot be the ground of unity of a proper, complete substance. Creatures

with indeterminate substantial forms, like mules or monsters, are only second-class substances, borderline cases of substantiality, with some heap-like character.

On this Aristotelian picture, every substance has a single substantial form, and this form stands in a series of congenericity relationships to other substantial forms, giving rise to a Porphyrean structure of genera, differentiae, and species, with maximally indeterminate genera at the top and infima species at the bottom. I am assuming that it is an empirical fact that we find such Porphyrean trees throughout nature, within biology, chemistry, and particle physics (for example). If so, then the fact that Aristotelian metaphysics generates these tree-like structures is a great theoretical advantage.

Can Platonists duplicate this theoretical advantage? I don't think so. For Plato, the species would have to be merely the conjunction of two Forms, the genus and the differentia. Why can't a conjunction be a principle of synchronic and diachronic unity? The conjuncts would have to be ordered. Otherwise, we could obtain two conflicting set of unity criteria. The ordering must be one of (Indeterminate + Determinate). But, if so, the Platonist faces a problem: the more determinate differentia makes the less determinate ones logically redundant. For example, suppose that the genus of Vertebrates is defined as (Animal + Four-Footed), and the genus of Animal is defined as (Organism + Mobile), with Four-Footed as a more determinate differentia than Mobile. This means that Four-Footed entail Mobile, and so (Organism + Mobile + Four-Footed) is logically equivalent to (Organism + Four-Footed). The intermediate genus of Animal, with its intermediate differentia of Mobile, simply disappears.

Thus, the Platonist faces a dilemma. If there are both generic and specific substantial forms present in a substance, then the unity of the substance is destroyed. There would be multiple, independent sources of the substance's existence, with the potentiality for the imposition of contradictory criteria for substantial unity. In contrast, if only forms of infimae species exist, then we lose any metaphysical foundation for the Porphyrean tree and, with it, any hope for definitions of substantial kinds.

What is the ontological status of these intermediate genera and their intermediately indeterminate differentiae? Are they merely mental constructs, useful fictions? We cannot suppose so, if we are to find ontological foundations for genera above the *infimae species*. If several species belong to

a genus at the next higher level, there must be some set of contrary differentia, such that the specific difference of forms in different species is *grounded by* the contrariety and numerical distinctness of those contrary differentiae. Without this use of grounding, in particular, the idea that specific or generic difference can be grounded by the mutual numerical distinctness of certain differentiae, we have no metaphysical foundation for the Porphyrean tree.

5. Quantities and Qualities: Determinates and Contraries

Aristotle's system naturally generates a distinction between substantial and accidental forms. Substantial forms constitute complete substances, while accidental forms presuppose them. Platonists can impose such a distinction only by brute force–by supposing the presence of certain Forms (the accidental ones) somehow requires the presence of other Forms (the substantial ones). Platonists can't suppose that substantial Forms somehow constitute or organize their instances, since such a supposition would destroy the simplicity of Plato's account of participation as simple presence. To suppose that Forms actively organize their instances is to raise the problem of accounting for the specific sameness of this action across the multiplicity of instances.

A similar problem will plague a Platonic account of certain accidental Forms, including Forms of quantity. Consider the Platonic form of Having a Cubic Meter of Volume (HCMV). Now consider the property of having half a cubic meter of volume (hhcmv). The Platonic form of HCMV, since it exemplifies itself, must have an infinite number of distinct proper parts, each having half a cubic meter of volume. This would seem to entail that the Form of Having Half a Cubic Meter of Volume (HHCMV) has an infinite number of instances within the Form of HCMV. But then what accounts for those parts' having the volume they do? Is it HCMV or HHCMV, or both? Any of the three answers seem to be unsatisfactory.

Let's suppose that X is a particular part of HCMV, and let's suppose that X has the property of hhcmv. This means that X has the universal HHCMV present within it. What accounts for X's size? To say that it is explained by both universals, both HCMV and HHCMV, would be to introduce massive explanatory redundancies into the system. To say that X's size is determined by the presence of HHCMV is to begin an infinite causal regress, since the size of the universal

HCMV is now partly dependent on the size of X, and, by symmetry of reasoning, X's size is dependent on the sizes of its parts, and so on ad infinitum.

So, it seems that we must say that X's size, and the size of all of HCMV's parts, must be wholly explained by HCMV itself. But now consider a particular that instantiates HCMV, say, a particular bronze sphere S. S must have quantitative parts that have the volume of half a cubic meter of volume. These parts of S will instantiate parts of HCMV, since HCMV, with all of its parts, are present in S. As we have seen, the size of these parts must be explained by the universal HCMV. Thus, HCMV cannot be merely present passively in S. It must organize S's parts and assign appropriate volumes to those parts. So, again, we need a particularized action in each instance and not merely the passive presence of the same universal. The actions must be numerically distinct, since the resulting instances are distinct. And so their specific sameness must consist in the fact that their numerical distinctness is grounded by the numerical distinctness of the substances in which they inhere.

Definition 11. *Two accidental forms x and y are* conspecific *iff either $x = y$, or the numerical distinctness of x and y is grounded by the mutual distinctness of the members of S, the class of substances.*

Definition 12. *Two quantitative accidents x and y are* comparable *(i.e., determinates of the same determinable) iff one is conspecific with a part of the other.*

Definition 13. *Two quantitative accidents x and y are* contrary *iff one is conspecific with a proper part of the other.*

Aristotle escapes Plato's dilemma. The quantitative accident of the sphere is conspecific with every other quantitative accident that confers a cubic meter of volume. The conspecificity of two equal-sized proper parts of two such substances will be explained in terms of the conspecificity of the two accidental forms belonging to the two substances as a whole. The equivalence of the volume of one sphere with the volume of a proper part of another substance will be also be grounded in the natures of the two quantities of the two wholes, and again no grounding regress results.

Theres's an additional problem with respect to accidents of shape. The Platonic Form of the sphere would have to have infinitely many proper parts that are sphere. This means that the Form of the Sphere would have to be present within itself many times over. It's not clear what this could mean. Aristotle also avoids this problem. Each spherical accident is conspecific with an infinite number of its proper parts. They can be conspecific without being numerically identical.

6. Matter: Prime and Proximate

Aristotle's theory of substantial forms requires the positing prime matter. This requirement is independent of the need for prime matter to serve as the substrate of substantial change at the level of elements. Even if such elemental transformation were impossible, we would still need prime matter to function as an expanse of gunky bare particularity. Only such bare particulars can ground the numerical distinctness of all cases of specific sameness, both substantial and accidental.

If we tried to use proximate matter, like flesh, blood, and bone, to serve as the ultimate ground of numerical sameness, we would be unable to explain the specific sameness of two samples of blood (or flesh or bone or whatever). There are many, numerically distinct instances of bone within a single organism. The specific sameness as bone of these various instances must be grounded in the fact that they are not fundamentally distinct. The instances of proximate matter must borrow their numerical distinctness from a more fundamental source. If this source were itself to be characterized by repeatable properties, the same problem will arise again. We have to reach a fundamental level at which there is no specific sameness to explain. The ultimate individuator must be absolutely featureless (see *Metaphysics* Zeta 3 1049a20-25 and Theta 7 1049a24).

This is consistent with bits of prime matter bearing properties of a categorial and metaphysical nature, such as: self-identity, numerical distinctness, and having the potential of being informed by substantial and accidental forms. These sort of facts have to be treated as metaphysically fundamental. To the extent that one portion is like another in these metaphysical respects is a bedrock fact, not susceptible of further explanation.

Since prime matter lacks any intrinsic nature, prime matter is incapable of providing the grounds for its own persistence or locomotion. If a portion of prime matter persists from one moment to another, this fact must be explained in terms of the substantial forms that have been active throughout the relevant region of space and time. Prime-material entities do not have temporal, spatial, or mereological relations to one another in and of themselves (fundamentally). Rather, they *derive* these mutual relations from facts about the substantial and quantitative forms that modify them. Substantial forms do persist over time: substantial forms are a temporally extended action or activity. It is one of the crucial jobs of substantial to unify the different temporal stages of a substance into a single career. In doing this, a substantial form also grounds the persistence of packets of prime matter.

What happens in cases of substantial change? In this case, a packet of persistent prime matter survives the corruption of the original substance and is *handed off* to the new substance. This handoff is governed by the nature of the substantial form of the corrupting substance and the active powers of the agent that is responsible for causing the substantial change. Prime matter in its fundamental character is needed to individuate substantial forms in the same species, and this activity of these individuated substantial forms is needed to explain the persistence of prime-material entities.

Prime matter is needed to explain the possibility of internally symmetrical, Max-Black worlds (Black 1952). A world consisting of two indistinguishable spheres revolving forever around their common center of gravity is possible, because each of the two spheres could contain a different set of prime-material entities, each of which is fundamentally distinct from all the others. However, there is no need to suppose that there are two worlds with only haecceitistic differences – for example, two internally non-symmetric worlds that differ only in the permutation of prime-material entities. To eliminate such superfluous duplication, we can adopt three principles.

Say first that two worlds belong to the same *constellation* just in case there is a time t_1 in w_1 and t_2 in w_2, such that w_1 and w_2 are qualitatively and structurally indistinguishable with respect to all facts intrinsic to times identical to or earlier than t_1 or t_2 (respectively). This is an equivalence relation, so constellations of worlds are equivalence classes of this relation.

Here are the three plausible assumptions about prime-material entities that prevent the superfluous duplication of possible worlds:

- All prime-material entities are constellation-bound. If two worlds belong to different constellations, then they have no prime-material entities in common.

- Two worlds in the same constellation contain exactly the same prime-material entities.

- There are no haecceitistic differences between worlds: if two worlds are qualitatively and structurally isomorphic throughout spacetime, then they are identical. Or, to put it more naturally, no two distinct worlds are qualitatively and structurally isomorphic throughout spacetime.

7. Spatial Quantities and Parti-substances

There is one kind of accident that is closely tied to prime matter—that of spatial quantities. By 'spatial quantity' I mean the combination of size and three-dimensional shape possessed by corporeal substances and their material (or 'quantitative' or 'integral') parts, both actual and potential. These spatial-quantity accidents cannot be individuated by their substances, since one substance can have many parts of the same size and shape. Think of a brazen sphere and its many congruent hemispherical parts.

Congruent material parts of a substance must be individuated by the associated packets of prime matter, as it illustrated by the thought-experiment of a perfectly homogeneous spinning disk, created independently by Saul Kripke (Shoemaker 1984, 242-7) and D. M. Armstrong (1980). That the disk is rotating in one direction and with some determinate speed must be grounded in the persisting identity of the disk's parts. However, the disk's many parts are qualitatively and quantitatively indistinguishable from one another. If their mutual relations of numerical distinctness are grounded by anything at all, they must be grounded in the bare particularity of the associated packets of matter.

8. Formal Axioms and Theorems

If we consider the class of all human substantial forms, the pairwise numerical distinctness of the members of that class is wholly grounded by the pairwise numerical distinctness of certain prime-material entities, the entities each of which is the prime matter of some human being. On this supposition, we can assert a counter-possible or *per impossibile* conditional:

Principle 1. *If all the members of M (the prime-material entities) were* per impossibile *numerically identical to each other, then the members of S (where S is any* infima species *of substances) would also be numerically one.*

Now consider a pair of substantial forms that belong to the same genus but not to the same species, like the forms of Socrates and Bucephalus the horse. These two forms do differ intrinsically, and so their numerical distinctness is not grounded in the numerical distinctness of the members of a class of prime-material entities. However, it is still not the case that the two forms are primitively or fundamentally distinct. Instead, the distinctness of the substantial forms is wholly grounded in the mutual distinctness of a class of differentiae, one for each of the species in the lowest common genus. The relevant class of differentiae might include rationality (the differentia for humans) and fleet-footedness (the differentia for horses). Any pair of differentiae are fundamentally distinct from each other. Here, as in the case of prime-material entities, the numerical-distinctness buck stops.

Let's suppose that genus G is a lowest-level genus containing a class of *infimae species*, and let's suppose that $D(G)$ is differentia (a class of criteria of unity) the mutual distinctness of whose members is the ground for the specific difference between any two forms belonging to different species in G. We can again assert a *per impossibile* conditional:

Principle 2. *If the members of $D(G)$ were numerically identical to each other, then any pair of substantial forms belonging to different species in G would conspecific.*

Principle 3 is the generalization of Principle 2:

Principle 3. *Any pair of substantial forms belonging to G (where G is a genus at level n in the Porphyrean tree) that are generically different at level n would be congeneric at level n if the members of $D(G)$ were identical to each other, then .*

Here are some formal axioms that we'll need to realize these principles:

Axiom 1. ***From Grounding to Conditional***. *If the distinctness of x and y is wholly grounded by the distinctness of the members of M, then if* per impossibile *the members of M were identical, then x and y would also be identical.*

There should be some such connection between grounding and conditionals. If a ground is a kind of sufficient explanation, then the absence of a ground ought to be associated with the absence of the fact explained. There might be some exceptions to this, in cases in which a fact is independently by more than one set of facts, but such over-grounding should be truly exceptional.

The *per impossibile* conditionals that I need are only conditionals with antecedents that are materially impossible: that is, propositions that are metaphysically impossible but do not contravene any principles of logic or mathematics. If two entities x and y are in fact distinct, I take it to be materially impossible for them to be identical. However, to suppose that x and y are identical does not involve supposing any logical or mathematical principle to be false.

For this reason, we should expect the *per impossibile* conditionals to be given something very like the standard Stalnaker-Lewis semantics for subjunctive conditionals (Lewis 1973). We just have to include materially impossible worlds in the semantics. None of the worlds validate logical or mathematical absurdities, and so nothing like relevance logic is required. We could model the logic using worlds with disjoint domains of quantification, interpreting each term with a function from world's to entities in that world. Thus, variables that are assigned distinct individuals in the actual world might be assigned the same individual in a different world.

The next axiom is a standard axiom for the subjunctive conditional, applied to the case of *per impossibile* conditionals:

Axiom 2. ***Minimal Conditional Logic 1***. *If (if* per impossibile *s were the case, p would be case), and (if* per impossibile *s were the case, q would be the case), and* $(p \,\&\, q)$ *logically entails* r, *then (if* per impossibile *s were the case, r would be the case).*

Even a *per impossibile* conditional ought, like normal counterfactuals, allow for closure under logical entailment with respect to the consequents of two conditionals with the same antecedent.

Axiom 3. ***Grounding to Distinctness***. *If (i) if* per impossibile *the members of the members of M were identical to each other, x would be identical to y, and (ii) x and y are distinct, then the distinctness of x and y is wholly grounded by the mutual distinctness of the members of M.*

Axiom 3 is the converse of Axiom 1, again expressing a connection between conditionals and grounding. Per impossibile conditionals concerning numerical distinctness should backed by grounding relations.

Axiom 4. ***Fundamentality of Prime-Material Distinctness***. *The mutual distinctness of the members of M, the class of prime-material entities, is ungrounded.*

Theorem 1. ***Transitivity of Conspecificity***. *If x is conspecific with y, and y is conspecific with z, then x is conspecific with z.* (Proof in Appendix)

Corollary 1. *Every substantial form belongs to exactly one species.*

Next, I will show that congenericity at each level is also transitive. I will need some additional axioms:

Axiom 1*. ***From Grounding to Conditional***. *If the generic difference at level n of x and y is wholly grounded by the mutual distinctness of the members of A, where D is a differentia of level* $n + 1$, *then, if* per impossibile *the members of D were all identical, the x and y would be congeneric at level n.*

There should be some such connection between grounding and conditionals. If a ground is a kind of sufficient explanation, then the absence of a ground ought to be associated with the absence of the fact explained. There might be some exceptions to this, in cases in which a fact is independently by more than one set of facts, but such over-grounding should be truly exceptional.

Axiom 3*. ***Grounding of Generic Difference***. *If D is a differentia of level $n + 1$, x and y are generically different at level n, and (if per impossibile the members of set D were identical, x would be congeneric at level n to y), then the congenericity at level $n + 1$ of x and y is wholly grounded by the mutual distinctness of the members of D.*

Axiom 3* is the converse of Axiom 1*, again expressing a connection between conditionals and grounding. *Per impossibile* conditionals concerning numerical distinctness and congenericity should backed by grounding relations.

Axiom 5. ***Grounding Distribution***. *If substantial forms x, y, and z are all pairwise generically different at level n, then if any fact grounds one of the generic differences, then some fact must be a common weak ground of at least two of the differences.*

Suppose, for example, that some fact F wholly grounds the fact that x is generically different at level n from y. That x is generically different from y logically entails the disjunction $(Diff(x, z) \lor Diff(y, z))$, given the transitivity of congenericity at level n (which we will prove by mathematical induction). Suppose that F grounds neither the fact that $Diff(x, z)$ nor the fact that $Diff(y, z)$, and suppose that these two facts have no common weak ground. Then the truth of the disjunction would be strangely overdetermined, guaranteed to be true with metaphysical necessity by at least three independent grounds, even though it is a disjunction of just two simple facts.

Axiom 6. ***No Double Grounding of Difference***. *If the fact that x and y are generically different at level n is wholly grounded by the distinctness of the members of D and by some distinct fact f, then both the distinctness of the members of D and fact f have a common weak ground.*

Axiom 6 reflects a reluctance to posit more independent grounding relations concerning numerical distinctness facts than are strictly necessary.

Theorem 2. ***Transitivity of Congenericity***. *If x is congeneric at level n with y, and y is congeneric at level n with z, then x is congeneric with z at level n.* (Proof in Appendix)

Corollary 2. *If two genera have a non-empty intersection, then one is a subset of the other.*

This follows from the cumulative way in which congenericity is defined at each level, together with the transitivity of congenericity at each level. This gives us the characteristic picture of the Porphyrean tree. All of the genera to which a given form belongs can be linearly ordered by the subset relation.

Corollary 3. *Porphyrean Tree*. *The genera to which any substantial form belongs are linearly ordered by the strict inclusion relation.*

Corollary 3 gives us the classic tree-like structure of Porphyrean genera.

9. Three Interpretive Payoffs

In addition to providing an attractive explanation of the data, the Aristotelian trope theory developed in section 4 has three interpretive payoffs in making sense of Aristotle's texts.

8.1 Interpretive Payoff 1: Forms both Particular and Universal

There is an apparent inconsistency in Aristotle. On the one hand, there is plain statement in *Metaphysics* Zeta 13 (1038b8-9) that no universal can be a substance. On the other hand, a simple syllogism drawn from the same text proves that no form can be a particular, either:

- Every substance is definable. (Zeta 4.1030a6-13, Zeta 13.1039a20)
- No particular is definable. (Zeta 11.1037a20ff, Zeta 15.1039b27)
- So, no substance is particular.

But this conclusion contradicts Zeta 13.

The model I propose resolves the difficulty. Substances are definable because their substantial forms are definable. Every form is in itself universal but is derivatively particular by virtue of its informing of some prime-material entities. Forms are definable qua existing in themselves, apart from any relation to prime-material entities. However, no form does in fact exist apart from such a relation, and so every actual form is a particular. Forms are not Platonic universals, which are in no way particular, even when contained by particulars. Nor are forms self-individuated particulars, with no intrinsic universality. They are universal in themselves and particular in actual existence. That is, they are particulars simpliciter, but their particularity is derived or

grounded and not fundamental. Hence, they can be defined as they are in themselves, but not qua particulars.

8.2 Interpretive Payoff 2: Prime Matter is Bare *Per Se* but not Bare *Simpliciter*

There have been three extant views on prime matter:

1. Prime matter is a relatively featureless substratum, essentially and fundamentally extended and persisting through.
2. There is no such thing as prime matter. The ultimate substrata are elements—simple substances with forms.
3. Prime matter is featureless in itself but always qualified by form. It does not have in and of itself any potentiality for persistence, but its persistence is determined by the active and passive powers of relevant substances.

Following Avicenna, Aquinas, and Brower (2014), I have defended view 3. Just as form is universal in itself but derivatively particular, so is prime matter featureless in itself but derivatively natured. In itself, it cannot primordially persist through time, but as natured by form non-primordial prime matter does persist, even through instances of substantial change, by virtue of genidentity relations among instantaneous bits of prime matter. Prime matter is in itself both featureless and lacking in spatiotemporal and mereological relations, but it is both natured and persisting through form.

8.3 Interpretive Payoff 3: The "Composite" Substance is Composite

There are also three views on the composite substance (which Aristotle calls the *sunolon*):

1. The composite is composed of two independent parts, one universal and one particular.
2. The so-called "composite" is really simple. The form and matter are merely abstractions from something *per se* one.
3. The composite *is* the prime matter *as* informed by the substantial form. The matter and form are really distinct from each other and yet radically inter-dependent, and both are parts of the substance.

I have defended the third view, which makes sense of Aristotle's use of the term *sunolon* without making a substance a strange hybrid of the universal and the particular. The prime matter is fundamentally particular but derivatively natured, while the form is fundamentally natured but derivatively particular. The whole substance is derivatively natured and derivatively particular.

Why are the matter and form parts of the substance? In what sense are they *parts*? Not, as we have seen, in the way that Plato's Forms are parts of their particular instances. Form and Matter are dynamic factors, continually responsible for the existence of a substance of a certain kind. Form and Matter are dynamic, combinant factors, not passive or static components. Nonetheless, they are and remain "in" the substances that result from their action, since the form must actualize the prime matter in the relevant way at every moment at which the substance exists.

Appendix I: Proofs of the Theorems

Proof of Theorem 1. Suppose that x and y are conspecific, and that y and z are conspecific. We can assume without loss of generality that all three are numerically distinct. Then the class of prime-material entities M is such that the distinctness of x and y and the distinctness of y and z are both wholly grounded by the mutual distinctness of the members of M. By Axiom 1, From Grounding to Conditional, the set M is such that the members of M were identical, x would be identical to y. By the same axiom, if the members of M were identical, y would be identical to z. By Minimal Conditional Logic (Axiom 2), if the members of M were identical, then x and z would be identical. By Grounding to Distinctness (Axiom 3), the distinctness of x and z must be grounded by the distinctness of the members of M, and so x and z are conspecific.

Proof of Theorem 2. Assume that x and y are congeneric at level n, as are y and z. We can assume without loss of generality that all three are numerically distinct. We can also assume (by induction on n) that at least one of the pairs (we can stipulate that it be the pair x and y) are not conspecific or congeneric at any level less than n. So, there is some class A of differentiae of level n such the numerical distinctness of x and y is wholly grounded by the mutual distinctness of the members of A. There are then two cases: y and z are congeneric at some level k less than n, or y and z are not congeneric at any lower level.

Case 1. Forms y and z are congeneric at some level less than n. By the definition of differentiae of level n, the distinctness of x and z is wholly grounded by the mutual distinctness of the members of A, and so x and z are congeneric at level n.

Case 2. Forms y and z are not congeneric at any level less than n. So, there is a class B of differentiae of level n such that the distinctness of y and z is wholly grounded by the mutual distinctness of the members of B. If A and B are identical, then the distinctness of x and z is wholly grounded by the distinctness of the members of A, and so x and z are congeneric at level n. So, assume that A and B are not identical. By Grounding Distribution (Axiom 5), the distinctness of the members of A either grounds the distinctness of x and z or the distinctness of y and z, or else the distinctness of x and z and of y and z have a common weak ground.

(2a) The distinctness of the members of A grounds the distinctness of y and z. By No Double Grounding (Axiom 6), the distinctness of the members of A must ground the distinctness of the members of B. But, by the definition of differentiae of level n, the distinctness of the members of B is ungrounded. Contradiction.

(2b) The distinctness of the members of A grounds the distinctness of x and z. By definition of congenericity at level n, x and z are congeneric at level n.

(2c) The distinctness of x and z and of y and z have a common weak ground. Since the distinctness of the members of B wholly ground the distinctness of y and z, by No Double Grounding (Axiom 6), any ground of the distinctness of y and z will be some fact F that weakly grounds the distinctness of the members of B. By the definition of differentiae of level n, the distinctness of the members of B is ungrounded. Consequently, F is identical to the distinctness of the members of B, and so the distinctness of the members of B wholly grounds the distinctness of x and z. By definition of congenericity at level n, x and z are congeneric at level n.

Appendix II: The Semantics of *Per Impossibile* Conditionals

The only impossible worlds I need are worlds in which entities (including impure sets) that are distinct in the actual (and other possible worlds) are identical. We could model this by assigning to each world w a domain of quantification D(w), with the domains of any two worlds disjoint. To capture transworld identity, we add a counterpart relation. Between any two possible worlds, the counterpart relation must be a 1-1 function. This reflects the fact that the semantics is possibilist: we quantify over all possible entities in each world. More generally, a world w_2 is accessible from w_1 only if the counterpart relation is a surjective function from $D(w_1)$ onto $D(w_2)$. Any two possible worlds will be mutually accessible, but a possible world need not be accessible from an impossible one, since two entities that are distinct in the possible world may have been identified in the impossible one. This means that the accessibility relation is not transitive across the whole set of worlds, and so the modal logic will lack the B axiom.

We can now define the semantics for the subjunctive conditional in the usual way, following David Lewis (Lewis 1973). If we used the conditionals to define possibility in the usual way, we would have to interpret the defined notion as 'true in some world, whether really possible or not'. No logical or mathematical laws will be interpreted as false in any impossible world, so no paraconsistent logic, like relevance logic, will be needed. The axioms of set theory (including Extensionality) will be validated in each world, so two impure sets whose members are identical in a world will also be identical in that world. If an entity belongs to a set, then its counterpart will belong to the set's counterpart in any world. The number of members belonging to a given set will be interpreted as varying from one impossible world to another, depending on the structure of the counterpart relation.

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