

Substantial Forms and the Rise of Modern Science

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One way to consider what substantial forms were is to explore their demise during the Scientific Revolution. It is suggested here that their physicalization was what doomed them by thwarting their ability to function as formal causes, which was the primary reason for postulating them. After discussing formal causality and its role within hylomorphism, four early modern arguments against substantial forms are considered. The most obvious and natural way for Aristotelians to respond to these arguments is by increasingly physicalizing substantial forms. But then the physicalized notion of form are no longer able to function as formal causes. Thus there is no basis for retaining such entities in one's ontology. Thus the door for a "bottom-up" explanatory schema, like early modern Epicureanism, is opened.

Substantial form, or as it is often called simply "form," is a Scholastic and Aristotelian term of art. Like all technical terms, we typically hear it used, learn a number of its principal synonyms—principle, *ratio*, cause of being, soul, etc.—and wield it ourselves in philosophical discourses long before we secure a clear and distinct conception of what form actually is. Indeed, if you are like me, you might often feel as if your conception of it is so hazy and indistinct that it seems like seeking it is trailing an *ignis fatuus* deeper into the more treacherous swamps in the hinterlands of Being (which is a feeling I usually find following those manic periods I'm most sure I have clearly and distinctly perceived it). Thus, you might, like me, often feel that all we've been engaged in is a sort of sophisticated (and sophistical) word game. If you do find such feelings in yourself, I hope that this essay can help to alleviate them somewhat, even if I won't be claiming that the notion is in the end defensible. In any case, the question "what is a substantial form?" is a question I don't think I've been alone in puzzling over.

There are, of course, many ways of approaching this question. I suggest that we approach it indirectly and from behind. By indirectly I mean that we ought not to consider what it is, but rather what it does, what it contributes in other words to our understanding of Creation. Thus, I suggest we focus our energies first on the idea of formal causality in general (but with an eye toward the substantial variety in particular) and then piece together the characteristics necessary for something to act in just those ways. In getting to know people and their characters, it seems to me that we are often better off not asking them if they are honest or empathetic, but rather quietly observing them in ordinary circumstances over an extended time to see what behaviors they exhibit and then, on that basis, ascribe virtues or vices to them; so too are we sometimes better off in approaching concepts. And by from behind I mean from the direction of form's demise in the seventeenth century. Just as people's true mettle is best discerned in adversity, so too can we sometimes see more clearly conceptual strengths and weakness when analyzing the points at which the concept frays and fractures and is prevented from doing what it is supposed to. In a nutshell, this is the approach I'm taking here, to analyze the misfortunes of formal causality during the Scientific Revolution as a way of coming to identify and understand the

traditional, Scholastic notion of a substantial form. My thesis is that the core problem with substantial forms concerns their physicalization: they must be made physical entities (in some sense) to perform many of their traditional functions as formal causes, yet they cannot be physical entities to perform other of their traditional functions, or indeed to warrant their postulation in the first place. What the “new philosophers” of the seventeenth century essentially did was to reinterpret substantial form exclusively as that physical, causal entity (i.e. shape and/or texture), but to do so savaged its traditional conception that in essence substantial form was not retained at all. Leibnizian and contemporary biological attempts to reintroduce substantial form as “force” or “structure” fare no better, I shall suggest, for exactly the same reasons.¹

I: Formal Causes

Let's begin with something familiar, Aristotle's doctrine of the four causes:

Men do not think they know till they have grasped the 'why' of it (which is to grasp its primary cause). So clearly we too must do this as regards both coming to be and passing away and every kind of natural change, in order that, knowing their principles, we may try to refer to these principles each of our problems. [1] In one way, then, that out of which a thing comes to be and persists, is called a cause, e.g. the bronze of the statue, the silver of the bowl, and the genera of which the bronze and silver are species. [2] In another way, the form or the archetype, i.e. the definition of the essence, and its genera, are called causes (e.g. of the

¹ I'd like to make two qualifications regarding the scope of my comments. First, my comments do not apply per se to Aristotle himself. To be sure, Aristotle is a large part of this story, but neither the Aristotle found in reading his texts ahistorically from the vantage point of contemporary analytic philosophy or contemporary theological movements, nor in reading them historically from the vantage of their Greek context. I'm interested in the Aristotelianism of the Scholastic era, roughly the thirteenth through seventeenth centuries, which was an Aristotelianism heavily filtered through the ancient commentators and the Arabic tradition. That we can fit Aristotle's texts to an alternative reading is unimportant for understanding the Scholastic notion of substantial form and its demise in the Scientific Revolution. That being said, however, for ease and simplicity of exposition, I will help myself to Aristotle and his texts, though my intention, let me be clear, is not to do so in a way that transgresses the Scholastic understandings of his thought. Second, Scholasticism itself is a broad movement, spanning several generations of radically differently-minded philosophers and theologians. Papering over these differences to create a single conception of *the* Scholastic doctrine of *x* is, in general, an exceptionally risky venture. And it is all the more so when the doctrine in question divides several schools as substantial form does, e.g. the monists vs. the pluralist regarding the number of forms informing a primary substance and the realists vs. the nominalists to name only two. All that being said, however, I am going to try to talk about *the* Scholastic doctrine of substantial forms, as it is abstracted away from these differences. If my analysis gets too moony-eyed and begins transgressing these important differences, I hope that you will call me on it. But I do think that these various thinkers accepted some common core of a doctrine of substantial forms, even if they applied it somewhat differently and fleshed out some of its details in different ways. These differences are, for the most part, like the differences arising when two sculptors working in the same medium and depicting the same event or figure carve rather different statues. (Compare Bernini's *David* to Michelangelo's.) My aim is not to ignore or paper over the important differences between the various schools but to synthesize the similarities within the Scholastics' thinking. One last thing: I am a historian of philosophy by training and temperament, but I'm not trying to write a historical paper here. I'm trying to do historically informed philosophical analysis & synthesis, that is giving my own philosophical reactions to the historical event rather than attempting to trace out the historical unfolding itself.

octave the relation of 2:1, and generally numbers), and the parts in the definition. [3] Again, the primary source of the change or rest; e.g. the man who deliberated is a cause, the father is the cause of the child, and generally what makes of what is made and what changes of what is changed. [4] Again, in the sense of end or that for the sake of what a thing is done, e.g. health is the cause of walking about. (“Why is he walking about?” We say: “To be healthy,” and, having said that, we think we have assigned the cause.) The same is true also of all the intermediate steps which are brought about through the action of something else as a means towards the end, e.g. reduction of flesh, purging, drugs, or surgical instruments are means towards health. All these things are for the sake of the end, though they differ from one another in that some are activities, other instruments.²

The four causes themselves (material, formal, efficient, and final) are familiar enough that no special mention of them is required. So too are the differences between the Aristotelian object-centric conception of causality and the more intuitive (to us at any rate) Humean, event-centric conception. What is perhaps worth a bit of our time are the connections between causality and explanation in the Aristotelian’s thinking.

We all know that it is difficult to really parse Aristotle’s *aitia* as simply “cause”. Vlastos, and after him Hocutt, have shown that Aristotle’s *aitia* is best translated as “because”.³ Some of these because are, of course, causal in our ordinary sense, but others, because they violate necessary conditions for causality like temporal priority (e.g. final causes) or spatial location (e.g. number), are not. Nevertheless, all factor into proper explanation for being and becoming. Aristotle clearly indicates that wisdom in knowing Nature, true knowledge or knowledge of Nature in the highest degree, involves some sort of synthesis of these four because.⁴ Thus the wise natural philosopher will possess all four of the explanations for a phenomenon and know just which appeal is warranted within any of its sub-disciplines based on the context surrounding the distinctive ‘why’ questions it asks. For example, consider the story of the aerospace company that wanted to test the strength of its new design for jet windscreens against the danger of bird collisions. Borrowing an air cannon capable of launching fowls toward the windscreen at precise speeds and angles (not live ones, of course, but carcasses purchased from the supermarket), the engineers intended on beginning with the smaller capons and slower launch velocities before proceeding to geese and turkeys. But alas, on the very first test, the small chicken didn’t merely crack the windscreen, he literally exploded it, and smashed through the back wall of the test

² Aristotle, *Physics* in volume 1 of *The Complete Works of Aristotle*, ed. Jonathan Barnes (Princeton: Princeton University Press, 1984), II.3, 194b19–195a2.

³ Gregory Vlastos, “Reason and Cause in the *Phaedo*,” *The Philosophical Review* 78 (1969): 292–296; M. Hocutt, “Aristotle’s Four Because,” *Philosophy* 49 (1974): 385–399; R. J. Hankinson, *Cause and Explanation in Ancient Greek Thought* (Oxford: Clarendon Press, 1998), pp. 132–135. Cf. David Furley, “Aristotle and the Atomists on Formal and Final Causes,” in *Perspectives on Greek Philosophy: The S. V. Keeling Memorial Lectures in Ancient Philosophy 1992–2002*, ed. R. W. Sharples (Burlington, VT: Ashgate, 2003), pp. 70–84.

⁴ “Now, the causes being four, it is the business of the student of nature to know about them all, and if he refers his problems back to all of them, he will assign the ‘why’ in the way proper to his [special] science—the matter, the form, the mover, that for the sake of which,” (Aristotle, *Physics*, II.7, 198a22–25).

chamber to boot. Shocked, the engineers recalibrated the cannon and repeated the experiment to similar effect. What had gone wrong? Were the windscreens manufactured of defective glass (the material *aitia*); was the design horribly flawed (the formal *aitia*); or was the canon defective or so badly miscalibrated that the chickens were inadvertently being launched way too fast (the efficient *aitia*)? Aristotle's wise natural philosopher would be able to see that the proper explanation involves material causality—thaw out the chickens before testing! All joking aside, Aristotle's point is that the questions confronted by the natural philosopher can take any of these guises and he needs the wisdom and experience to know not only the various because, but which one is most relevant for explaining the phenomenon under consideration.

As I said before, this is all rather familiar. But I'd like to draw out a consequence that will be relevant for our topic tonight. It concerns an ambiguity within the notion of explanation. To steal a phrase from Aquinas, an explanation might either be explanatory to us or explanatory in itself. The absolute sense of being explanatory is, I take it, the sort of thing that an ideally rational and factually omniscient thinker would appeal to in understanding the relations between the facts. These would be the paradigmatically True (with a capital T) scientific explanations of phenomena. They would be completely reduced, non-idealized, non-metaphorical, non-analogical (and so forth) descriptions of the basic physical and metaphysical architecture of the natural world. The relative sense of explanation, I take it, involves something a bit more modest. I'm not going to try to give an analysis of it, but it seems that one would involve at least the relative notions of cohering with the limited facts that we do know and being intellectually satisfying for knowers like us, curious, imperfectly rational yet reasonable thinkers of limited factual awareness. We can see that most (if not all) of explanations that we typically encounter and accept are of the relative kind: when my four-year-old is satisfied by my explaining why the sky is blue merely in terms of the scattering of blue wavelengths of light, despite having (presumably) little or no idea what a wavelength of light is; when I'm content to accept some such an explanation despite not having much of an idea what the "blue" wavelength is (or even really know what a nanometer is, supposing that I bother to remember that the range of "blue" wavelengths is $460 \leq 493$ nanometers); when a Color Scientist accepts physical explanations of the sky's being blue without fully understanding the mathematics of wave-particle duality of quantum light; etc.

Indeed, it seems that in our current state we are somehow capable only of relative explanations. Consider the chicken example again. Our inclination is to take the proffered explanation as genuinely explanatory, as explanatory in itself. But suppose that the windscreens were in fact poorly designed and that the proper explanation is that they shattered because of their faulty form.⁵ I think we'd be incapable of accepting that explanation without repeating the experiment with thawed chickens, even if we were told this by the wisest natural philosopher possible (God), unless of course we accepted the explanation based solely on authority, in which case it would fail to really be an explanation. Possessing genuine explanations in themselves permits us to see through and eliminate counter-factual scenarios, like what Descartes demanded

⁵ So that, even if the chickens were thawed, they would fail at the least launch velocities.

with regard to the hyperbolic skeptical scenarios. The possession of merely relative ones, on the other hand, do not admit such of such a possibility. This limitation, I take it, is rooted in our reliance on experience rather than intuition for factual knowledge, which consequently infects our basis for making judgments about counter-factual possibilities. Perhaps mention could be made in this regard of the Socratic distinction between human knowledge and the divine wisdom actually knowing the Forms confers or of the Platonic line divided between opinion and understanding as based on some sort of transcendental intellection. But the nub of the problem with relative explanations concerns Aristotle's gap between experiences and the intuition of a "principle" (*aitia*) in the so-called intuitive induction. This was, of course, a problem Aristotle was as acutely aware of as the Scholastic were, even if neither he nor they ever adequately resolved it.

But let's now turn to the analysis of one of these explanations, formal causality and its operation. Formal causes are often characterized as the causes of being. How are we to understand this vague idea, the causing of being, if not in the ordinary sense of efficiently causing something to exist? I'm going to divide this analysis into three planes, Being, Unity, and Actualization or Determination.⁶

A) Being: Formal causality in general is marked by a said-of predicative relation. When simultaneously present-in as well, the result is an accidental determination, e.g. whiteness is said-of and present-in Socrates. When the causal relation is marked by a said-of relation simpliciter, the result is a substance, e.g. humanity is said-of Socrates. In both cases, however, the formal cause imparts some sort of permanence and persistence to its objects (whiteness and Socrates respectively), which I take to be the two main characteristics of Being. Unless acted upon by something else in some process of becoming or annihilation, the substance will persist precisely as it is. The difference between the two types of formal causality involve only the synchronous relation of dependence. Because said-of and present-in formal causality results only in accidental determinations, they have a merely dependent persistence (i.e. they persist no longer than their subject of inherence persists). Said-of simpliciter formal causality results in a per se existent, i.e. a primary substance. This latter function is, of course, the primary function of substantial form.

In according permanence and substantivity to a thing, the substantial form accords Identity to it as well. (N. B., I am not talking about Individuation here, a matter indeed closely related to Identity and, on the Scholastic model, generally identified with the role of matter rather than form in the hylomorphic composite.⁷) We talk of Identity in a variety of ways—synchronic vs. diachronic identity; generic vs. specific vs. numeric identity; formal identity; material

⁶ Strictly speaking, these planes, it should be noted, do not completely separate.

⁷ The difference between Identity and Individuation lies principally in the epistemic connotations of Individuation. It's always struck me as one of the oddities of the Scholastic metaphysics, and as we'll see shortly one of its fault lines, this separation of the metaphysics of Identity from Individuation. This is also, I've always thought, one of the main motivators for the Thomistic doctrine of individual essences as a bridge between that which accords identity to the substance and that which accords the possibility of individuation, but that's another story.

identity; etc. The substantial form confers identity on a thing both synchronically and diachronically. What I want to highlight is that it does so by conferring specific and numeric identity onto the thing. The former is obvious, but the latter is not. Indeed, the latter is probably obscure and contentious, so let me explain. I'm not saying that a thing is made one by the oneness of the substantial form it partakes in. Rather, I'm saying that it is made one by the uniqueness of its partaking in that substantial form. The partaking relation is different for each primary substance, even though that which each partakes in is universal and that doing the partaking (prime matter) is not a thing.

I appreciate how easy and natural it is to want to accord this function of conferring numeric identity to matter rather than substantial form. Matter is what individuates, after all, and it is natural for us to want to find the source for numeric identity in one of the *relata* of the hylomorphic union rather than the relation itself. (Objects individuate relations, not vice versa, we tend to think.) The *relatum* of substantial form absolutely cannot be the source of numeric identity since many things wholly partake of the same substantial form; thus matter is all that seems left. However tempting, this chain of reasoning is invalid. First of all, remember that what individuates is not matter per se but designated matter. It is impossible for matter per se to confer numeric identity onto anything. Were this to be the case, matter per se would have to have some determinate nature itself, which is impossible. (One of the ways of emphasizing this impossibility is to characterize prime matter as pure potentiality, but that is not the only way.) The main thing is that matter per se does not have a determinate nature (it has only the indeterminate nature of materiality) because it is receptive of a variety of substantial forms. Whatever prime matter or matter per se is, it is the mere receptacle of substantial forms. Attempting to make matter per se the principle of numeric identity is moreover theologically suspect as well. It seems to entail Manichaeism insofar as it requires unin-formed, prime matter to pre-exist Creation as a sort of thing with a determinate nature. Secondly, it seems to make the problem of the Trinity utterly recalcitrant insofar as it fuses the issue of individuation (discernibility) with numerical identity. These considerations thus far pertain to prime matter: but designated matter is what actually individuates, so why can't it be the source for numeric identity, one might think? The problems with that concerns the priority of numeric identity for individuation and the priority of the substantial form for designating matter. Individuation is possible because a object is single, not vice versa; in other words, in order to be individuated, something must already exist as a single thing. Thus individuation cannot be the *cause* of numeric identity; it can only be a sign of it. Secondly, the substantial form is what designates matter, and it designates matter by virtue of according numeric identity to the material thing. In other words, matter only becomes designated when it exists and it only exists in single, unified primary substances, that is it exists only in a substance in-formed by an essence. (Even menses or Prometheus' mucky clay, the closest natural things within Aristotelian biology to being undesigned material stuff, still are things and subjects of some true predications, even if they are mass nouns and the respects to which they are determined are rather limited.) Moreover, it would be impossible for substantial forms to perform the other two functions of formal causality if matter were the source for numeric identity, since numeric identity is the consequence of, or at

least partially constituted by, the unity accorded the primary substance via the substantial form and the determination or actualization of that substance's properties.

So, the significant consequences of this aspect of substantial formal causality are two-fold. First, the substantial form is the proper, indeed the only legitimate, basis for the classification of substances. This immediately follows from the substantial form's according specific identity to a thing: x is S if x participates in form S . Second, the substantial form also accords a regularity to Nature and the hierarchy of beings. All substances must possess a substantial form and each substantial form must exclude all the others. (N.B., Scholastic pluralists still abide this requirement, they just apply it within, rather than across, the stratifications of the multiple substantial forms a substance partakes in [i.e., vegetative, animal, and rational forms].) Thus, the Aristotelian structure of the hierarchy of being is discrete rather than continuous, and there cannot be any borderline cases of being and classification.

B) Unity: Formal causality also accords unity to things. As before, the difference between said-of simpliciter and said-of and present-in formal causality is worth briefly noting. Said-of and present-in formal causality fuses the accident to its subject in a strong way (not the strongest way, mind you, but a strong way nonetheless)—the accident is united *per se* to the substance. I'm using the phrase "united *per se*" in a somewhat uncommon way. It is not equivalent to traditional idea of a *unum per se*. What I am trying to convey by it is the idea that it is in the nature of the accident to fuse itself to its subject such that it not merely partially constitutes that subject at a given time (the parts of the substance's designated matter satisfies this requirement) but that it is identified with the subject. The accident is only contingently united to the substance, of course, and the relation of *per se* unity is not a symmetrical one, but what I am trying to say is that this union at the moment it obtains is not like the much weaker unities of a part to a heap or a point to a continuum.⁸ On the other hand, said-of simpliciter formal causality is another relation of *per se* unity, only from the opposite direction. In this case, the substantial form is united *per se* to the substance. This is the dependence of the universal on its instantiation codified by the idea of *universalia in rebus*. The substantial form is also identified with the subject by virtue of its in-forming the subject. Of course this said-of simpliciter relation results in essential properties rather than accidental ones, which is why substantial formal causality has priority over accidental formal causality. But the unification relation in both instances is, I suggest, the same.⁹

⁸ Cf. Dennis Des Chene, *Physiologia: Natural Philosophy in Late Aristotelian and Cartesian Thought* (Ithaca: Cornell University Press, 1996), p. 135. Perhaps I ought not to call this relation unity *per se* and contrast it with what is commonly called accidental unity. I'm open to suggestion on this point. Let me emphasize again that my use of *per se* here is non-standard and to a certain extent prescriptive. Part of what motivates me to a neologism of this sort are attempting to clarify the conceptual relations within the puzzles Des Chene sketches out in this section of his book. So, what I would mean by something like "the relation of unity *per accidens*" is the mereological unity exhibited by things externally joined together," that is, "by things joined by something in and of itself distinct from the thing itself." Basically, the difference has to do with what is imposing and/or keeping the property on the subject, something about the subject itself or internal to it, or something outside of and independent the subject.

⁹ Both unity *per se* relations obtaining provide, I think, for the primary substance's being a *unum per se*. Reasons why I want to maintain that will become clear shortly, when I begin to talk about what a substantial form is.

Now, what should be focused on here is the contrast of the unity conferred by formal causality with the unities conferred by material and efficient causality, i.e. heap unity and continuum unity. Heap and continuum unity are characterized by in principle physical divisibility. A part of a heap may be removed from any other part. Ditto for a continuum, even if that division could only be performed by God's omnipotence. For example, even if Locke is right and God could not pull apart two conjoint parts of space without new points of space interposing, it is clear that God can physically pry apart the two conjoint parts of space, as well as that He can reorder the points of space and destroy one part of space to create a smaller spatial universe. Such physical division is not possible between substances and their forms, however. Socrates' maleness, for example, is an accident he himself, that is Socrates simpliciter, has. To be sure, there is a mark of maleness in the possession of a certain organ, but that is not constitutive of maleness. Socrates might lose it in an accident, and still he'd be male. Rather than possessing the organ conferring maleness, it's that being male confers the possession of that organ, and so physically separating Socrates from that organ doesn't separate him from his maleness. The same goes for Socrates' humanity: it may not be separated out of Socrates or removed by the removal of some special organ (not even the brain). Socrates' humanity is wholly diffused throughout him.

This is expressed in a couple of well-known phrases: the form is "*totaliter in toto*," or "wholly in the whole," and "*tota anima est in toto corpore et in qualibet parte*," or "the whole soul is in the entire body and entirely in each of its parts." Without doubt all of you have noticed that I've been speaking about unification of properties and subjects rather than the unification of prime matter and form, which would seem to be the crux of hylomorphic substantial unity. I've downplayed it thus far for a couple of reasons. One is that I believe there is an intimate relationship between the logical and the metaphysical in Aristotelian thinking (although this is less pronounced in Scholastic as opposed to Peripatetic thinkers) and that this would be overlooked were we to focus too heavily on the matter-form relation. More importantly, however, the matter-form relation is, I believe, conceptually problematic—indeed it butts up against the core early modern complaint with the whole notion of prime matter and consequently formal causality in general. Thus, if we aim to describe the matter-form union in more than metaphoric terms and conclude merely that it is a *sui generis* category of unity, we need to seriously consider whether it in fact differs from the unity of properties in a subject. You see, there is a profound tension here between our tendency to objectify prime matter as a special sort of subsisting thing (i.e. as an incomplete substance) and the residual strands of the decidedly non-objectified, Platonic notion of matter as the privation of or limitation on being. And this tension is never fully resolved, in either Aristotle or the Scholastics. Taking the objectified, subsistent substance route lets one make literal sense of the recurrent Craftsman analogies in causality and Creation, although at similar theological and philosophical cost to taking prime matter as the source for numeric identity. Taking the non-objectified, Platonic route, on the other hand, requires one to understand the Craftsman analogies metaphorically, which have the problems of rendering forms irrelevant for natural philosophy and *scientia* impossible (at least

until one reverts to the ineffable awareness of The One).¹⁰ We could say that the union of form and matter involves a complete and mutual saturation of being and we could understand this as a kind of mutual metaphysical saturation as opposed to a comingling. But because we also conceive of this union as involving actualization (form) of a potentiality (matter), we'd probably be much better off to likening it to the way essences and accidents mutually complement one another—i.e. nothing can be a body (determinable) unless it is a (say) triangular body (and a determinate sort of and sized triangle to boot); nothing can be an animal (determinable) unless it is (say) that human animal; no one can be rational (determinable) unless he posses precise abilities for rational thought. The point is that essence without exemplification, which is the realm of the accidental, is impossible. It is this sort of complementation that I say presents the better model for the hylomorphic union and best highlights their mutual dependence while fulfilling different metaphysical roles. For just as an essential property cannot exist independent of the accidental properties actually instantiating it, so too an essence or substantial form cannot exist independent of the designated matter containing it *totaliter in toto et in qualibet parte*. More will be said about this below.

C) Actualization or Determination: In my reading about formal causality, this last function seems to me to be the least studied and appreciated.¹¹ Yet it is vitally important. Substantial form is commonly recognized as a thing's "internal principle of activity." Thus it has often be assimilated to the soul quickening the body, the soul resulting in and determining its internal activities. But I'm not thinking about the internal behaviors and activities of substance here; rather I'm thinking about the determination of properties more broadly speaking. The form determines the various *internal* properties of a thing. By internal properties, I mean firstly the set of essential properties, secondly *propria* or Properties with a capital P (*propria* are necessary consequences of the essential properties, like being shaped is a *proprium* of the essential property of being extended), and thirdly certain accidental properties and potentialities that result entirely from the thing's internal operations, e.g. my distinctive whiteness even when I appear bright red from having fallen asleep in the sun.¹² It might seem kind of strange to attribute this sort of determination or actualization to the formal causality of the substantial form rather than the material causality of the matter in-formed by the substantial form, so let me explain.

¹⁰ Emanationism was common in Scholastic thinking, planted there not only by Augustine and pseudo-Dionysius but also by the *Liber de causis* and a large number of Arabic works. See: *Le liber de causis*, ed. Adriaan Patton (Leuven: Uitgave, 1967); St. Thomas Aquinas, *Commentary on the Book of Causes*, trans. by Vincent Guagliando, Charles Hess, and Richard Taylor, (Washington D. C.: The Catholic University of America, 1996); *Neoplatonism and Islamic Thought*, ed. Parviz Morewedge (Albany: SUNY press, 1992); and Thérèse Bonin, *Creation as Emanation: The Origin of Diversity in Albert the Great's On the Causes and the Procession of the Universe*, (Notre Dame: University of Notre Dame Press, 2001).

¹¹ Denis Sullivan complained of this lack, or loss, of focus: "In the Thomistic interpretation of Aristotle, formal causes are seen as somehow dynamic, as somehow productive of the characteristics and behaviors of substances. But in recent interpretations, interpretations which stress the modernity of Aristotle, this dynamic aspect is either ignored or explicitly denied" ("The Function of Formal Causes," *New Scholasticism* 56 (1982): pp. 490).

¹² Trying to sort out these "internal" accidents, like my whiteness, from "external" accidents, like the scar on my knee, can get a bit murky. Sex, which we moderns would identify as an internal accident, was historically thought to have been an external one, the efficient product of the developing embryo's orientation in the womb and the uterus' relative heat and humidity. The distinction is clear enough, even if the boundary between the two categories is not precisely mapped.

Suppose that we attribute this function of determination to the matter rather than the form. It then follows that we have to abandon the idea that the form has metaphysical priority over matter with regard to the being of the primary substance. There are many sorts of priorities within Aristotelian thinking. The variety relevant here is “*priorem dignitate*,” that the substantial form is “more noble” than matter because it is the greater principle of Being. It is the principle of actualization rather than the potentiality actualized, and as such is more divine and closer to God. In thinking about *actus*, we might think about it in terms of capacities on the patient’s part being fulfilled by the agent. For example, the jet windscreen has the property of being fragile when struck by a force greater than x Newtons, and frozen chickens, because of their rigidity, have the power of striking with at least x Newtons. Applying this same capacity-power model to the causes of objects rather than events is straightforward: menses has the capacity for receiving human sperm, which has the power of trans-forming menses, but menses cannot receive other animal and plant seeds.¹³ There is supposed to be a mutual dependency between the capacity and the power such that they are isomorphic. But if we reflect on the cases of failed actualizations, we can wonder which side the failure lies on, the agent’s or the patient’s side? Does, say, equine sperm fail to have the power to active menses or does menses fail to have the capacity to receive equine seed? Think of the problem as like describing a key opening a lock: is the event caused by the shape of the key or the setting of the lock’s tumblers? Ideally they’d be isomorphic so that each key opened one and only one lock and each lock had one and only one key that could open it, but in actuality that is rarely the case. A key with three bittings partially inserted into a lock with only two pins (corresponding exactly to the key’s first two bittings of course) would be opened by that key—is what’s responsible for the key’s opening the lock the formal *aitia* of the key’s shape or the material *aitia* of the pins’ setting? It does not seem possible to non-vacuously decide this (by non-vacuously, I mean in a way not spoofed by Moliere, i.e. the key has the *vis reserativa* because it opens the lock and the lock has the capacity for *esse reserantum* because it is opened by the key). Yet such scenarios must be either impossible or decidable.

Renaissance and early modern naturalists are going to make the first disjunct impossible; hence there must be some way of deciding on which side the true *aitia* lies. The discreteness of the Aristotelian hierarchy of being means that the cause cannot lie on the side of the substantial form, for then the same form would be capable of giving rise to two species, horses and silens or centaurs in our example. Thus the cause properly speaking must lie on the side of the patient, the seminal matter. So, whence does the seminal matter derive its capacities? They cannot be in or derived from prime matter, for, in addition to the familiar problems with prime matter having a pre-existent nature, there is the additional problem of these capabilities failing to be uniformly distributed across all species of things. Thus these capacities must be in and/or derived from designated matter. But of course what else does or could designate matter except substantial forms? It is impossible to think of matter requiring some prior capacity for the reception simpliciter of the substantial forms, as detailed earlier. The best that we can do is conceive of informing as a two-stage process: in the first state prime matter receives some sort of actualization

¹³ Although see the brief discussion of monsters below. The trans-formation of all seminal matter is a legacy of classical thinking and the central premise of alchemy.

of capacities (first actuality) which are then¹⁴ determinately activated (second actuality). But of course all of the work here is being done by the substantial form, and so it alone is responsible for the primary substance having just those internal properties it in fact has.¹⁵ So, this is what was meant by the form being *priorem dignitate* and the consequence of the commitment to this sort of priority on the part of the principle of activity.

Too much has probably already been said about formal causality itself. I now want to briefly canvass four main early modern arguments against formal causality so that we can better see the pressure points within the notion of a substantial form.

II: Naturalistic Problems with Formal Causality

During the Scientific Revolution, Scholastic natural philosophy was assaulted on a variety of fronts by the “new philosophers,” the mechanists and corpuscularians. As in the previous section, I will divide these arguments into three basic sorts corresponding to the three functions of formal causality. And as before, my division of these arguments is somewhat artificial; they all are interconnected in important ways. But first, two points about these arguments ought to be briefly noted. First, their power lies more in their cumulative effect rather than in the effect of any one argument. There’s no single, unanswerable argument here, but to early modern thinkers their collective weight make the Scholastic position look weaker and less plausible and more and more ad hoc. Such gradual undercutting does not in itself suffice to trigger a paradigm change, of course, which is the second point: a viable alternative to Scholastic natural philosophy, one that appears to account for the physical phenomena at least as well as the Scholastic one and possess some of the “theoretical virtues,” must be available. Most early moderns believed that such an alternative had been found, first in mechanism itself and then specifically in its Epicurean variant, corpuscularianism.¹⁶

A) Empiricist Arguments:¹⁷ Two arguments fall under this heading, the Argument(s) from Monsters and the Argument from Nominal Classifications.¹⁸ The former argument attacks

¹⁴ Notice that a considerable weight hangs on the precise force of this notion of “then”.

¹⁵ I am afraid that this notion of an internal property might lead to the accusation that I’ve misunderstood the traditional notion of an accident because I’m anachronistically importing atemporal modal notion that rely on a possible world semantics instead of the classical (but confused) temporal notions of modality. But remember that I’m aiming to talk broadly about the Scholastic conception in general (especially the later thinkers) rather than the notion of Aristotle himself. Though we most generally associate the first possible worlds semantics with Leibniz, his thinking on this matter is actually the culmination of movements begun in the eleventh and twelfth centuries regarding Divine omnipotence, future contingents, and the free activities of free beings. For a convenient overview of these topics and their consequences for Aristotelian conceptions of modality, see Simo Knuuttila’s “Medieval Theories of Future Contingents,” *Stanford Encyclopedia of Philosophy*, <http://plato.stanford.edu/entries/medieval-futcont/> and idem, “Medieval Theories of Modality,” *ibid.*, <http://plato.stanford.edu/entries/modality-medieval/>.

¹⁶ For discussion of these seventeenth-century debate, and the transition from Cartesian mechanical philosophy to the corpuscularian philosophy, see Thomas Lennon’s *The Battle of the Gods and Giants: The Legacies of Descartes and Gassendi 1655–1715* (Princeton: Princeton University Press, 1993).

¹⁷ As mentioned above, these divisions, and their names, are rather artificial and arbitrary. They are intended not as descriptive names but as convenient, mnemonic devices.

the Aristotelian notions of the regularity of nature and the discrete hierarchy of Being. The latter argument attacks the discrete hierarchy of Being and in addition the scientific relevance of substantial forms with regard to the being of things.

The Argument(s) from Monsters

There are two species of the Argument from Monsters, depending on which of the two types of monsters are appealed to. Some monsters are excessively deformed individuals of a single species. These were cases of birth defects and genetic malformation—“changelings” or Downs Syndrome babies; conjoined twins; dwarfs and giants, hermaphrodites, etc. The other sorts of monsters were chimeras, the offspring of abnormal copulations—the silens and centaurs earlier mentioned; Locke’s rat-cat and drill-human; mandrakes; the demonically spawned Krakow monster; etc.

The Argument from Homeospecific Monsters:

- 1) In the causing of being, substantial forms as the principle of actualization have priority over matter, which is merely the potentiality actualized.
- 2) The substantial form confers specific identity on a creature.
- 3) By conferring specific identity, the substantial form determines the essential properties, and indeed all the internal properties, of the creature.
- 4) Being abstract universals, substantial forms are immutable and incorruptible and ought always to operate in the same way, or at least within a narrow range of “normal.”
- 5) Therefore, it ought to be impossible for a creature that has some essential properties or *propria* constitutive of a species while lacking others or for a creature that could only be caused by a certain substantial form (because it is the offspring of homeospecific parents) to lack the essential properties of that species.
- 6) But homeospecific monsters do exist—some, like changelings, have the *proprium* of humanoid shape but utterly lack the capacity for rational thought and others, like conjoined twins, lack normal humanoid shape though they possess reason clearly enough.
- 7) Therefore, either substantial forms are mutable and corruptible, or they fail to determine a creature’s essential and internal properties, or they fail to have priority over matter in the causing of being.

The Argument from Heterospecific Monsters

- 1) The isomorphism between substantial forms and species entails that no creature can simultaneously partake of two substantial forms.

¹⁸ A paradigmatic presentation of both can be found in Locke’s *An Essay concerning Human Understanding*, ed. Peter Nidditch (Oxford: Clarendon Press, 1975), III.vi.14–18, 448–449.

- 2) Therefore, no creature of mixed parentage can exhibit essential properties or *propria* of both parents; they must be either one or the other or some new, third species educed from the mixture of the one animal's seed and the other's seminal matter. (This is an instance of the general problem of mixtions discussed below.)
- 3) Heterospecific monsters do exist, and they do exhibit marks of both parents, which imply that they are simultaneously partaking of both substantial forms. (Silens and centaurs, remember, have human heads and torsos with equine posteriors and exhibit knowledge and rationality with immoderate appetites and emotional instability.)
- 4) Therefore, there are additional substantial forms corresponding to each species of heterospecific monster, the consequence thereof being that for every two new, distinct species, there appears no principled reason why they couldn't be cross-bred producing yet another species: e.g., cross-breeding a centaur and a human shouldn't produce another centaur on these principles, but a new species of creature closer to human and less horse-like than a centaur, which subverts the notion of the chain of Being being discrete, to say nothing of undermining the supposed immutability and incorruptibility of substantial forms; or alternatively a creature can simultaneously partake of multiple substantial forms.¹⁹

As mentioned above, the Aristotelian has ways of responding to these arguments, the obvious one being to place greater emphasis on the role matter plays in the ontogenetic process, especially designated matter. This is the solution that Francisco Suárez, among others, developed.²⁰ If the seed is specifically identical to the seminal matter receiving it, the failure to properly in-form the matter is alleged lie within the matter itself or during gestation some naturalistic, efficient cause frustrating the seed's process of in-forming. In either case, formal causality is subsumed under material or efficient causality and the priority of the substantial form is lost. In the heterospecific case, the mixing of the heterogeneous seed and seminal matter are either thought to fail to properly mix, in which case why something does in fact result is incomprehensible, or the mixing is just as it should be and there is in fact nothing preternatural or monstrous about offspring. This maneuver, however, serves only to focus the tensions within the Aristotelian conception of substantial forms that the Argument(s) from Monsters were supposed to draw out, the tensions between the priority and activity of the forms and roles matter and circumstance play in the actual causing of beings.

¹⁹ Remember, pluralism does not in itself violate isomorphism because for them the isomorphic principle applies within the stratified levels of soul. This argument, when directed against pluralists, must be understood as attacking their restricted version of isomorphism: the creature simultaneously partakes of two animal souls.

²⁰ See Dennis Des Chene, *Physiologia*, pp. 122–167. “If one could show that their [forms’] so-called powers follow immediate from their *dispositions*, the place of substantial form would become exceedingly precarious. ...once matter is granted not only actual existence, but a characteristic set of properties, an important motive behind the introduction of substantial form disappears. So the Thomists may well have thought. The dangers were not hard to discern. Matter, having been given title to the common properties of bodies, might not be free to declare its independence not only from form, but from God,” (Ibid., p. 151).

The Argument from Nominal Classification

This argument is rooted in our actual practice for identifying and classifying things. Book III chapter vi of Locke's *Essay concerning Human Understanding* is the most familiar place in which it is deployed as an argument against the Scholastics.²¹

- 1) Our identification of every substance is only through the determinate properties it presents to us; we never perceive a substantial form directly; we only ever perceive the internal properties it determines or actualizes in a thing.
- 2) Thus the only basis we have for classifying things as members of species is the resemblance between certain of their properties, special, privileged properties that determine kinds.
- 3) We do in fact classify individual things into species.
- 4) None of a thing's internal properties are presented to us as special or privileged in themselves; considered in themselves they all have, indifferently, the status of "essential" or of "accidental" because they all "flow" from the thing's real essence or substantial form in, as far as we can tell, just the same way.²²
- 5) Therefore, it is we who choose which properties to privilege as "essential" and to accord the power to determine species.
- 6) Therefore, even if real species, species determined by substantial forms, in fact obtain, they are worthless for our practice of natural philosophy; only the nominal species are relevant.
- 7) But the primary reason for postulating substantial forms is that they provide scientific principles for use in the construction of scientific explanations of Nature.

²¹ "That the *Species of Things* to us, are nothing but the ranking them under distinct Names, according to the complex Ideas in us; and not according to precise, distinct, real *Essences* in them, is plain from hence; That we find many of the Individuals that are ranked into one Sort, called by one common Name, and so received as being of one *Species*, have yet Qualities depending on their real Constitutions [i.e. internal properties], as far different one from another, as from others, from which they are accounted to differ *specifically*. ...if Things were distinguished into *Species*, according to their real *Essences*, it would be as impossible to find different Properties in any two individual Substances of the same *Species*, as it is to find different Properties in two Circles, or two equilateral Triangles. That is properly the *Essence* to us, which determines every particular to this or that *Classis*; or, which is the same Thing, to this or that general Name: ... Nor indeed *can we* rank, and *sort Things*, and consequently (which is the end of sorting) denominate them *by their real Essences*, because we know them not. Our faculties carry us no farther towards the knowledge and distinction of Substances, than a Collection of those sensible *Ideas*, which we observe in them; which however made with the greatest diligence and exactness, we are capable of, yet is more remote from the true internal Constitutions, from which those Qualities flow, than, as I said, a Countryman's *Idea* is from the inward contrivance of that famous Clock at *Stratsburg*, whereof he only sees the outward Figure and Motions. ... Those therefore who have been taught, that the several *Species* of Substances had their distinct internal *substantial Forms*; and that it was those *Forms*, which made the distinction of Substances into their true *Species* and *Genera*, were led yet farther out of the way by having their Minds set upon fruitless Enquiries after *substantial Forms*, wholly unintelligible, and whereof we have scarce so much as any obscure, or confused Conception in general," (Locke, *Essay*, III.vi.8–10, 443–445 passim).

²² "Take but away the abstract *Ideas*, by which we sort Individuals, and rank them under common Names, and then the thought of any thing *essential* to any of them, instantly vanishes; we have no notion of the one, without the other; ... All such Patterns and Standards, being quite laid aside, particular Beings, considered barely in themselves, will be found to have all their Qualities equally *essential*; and every thing, in each Individual, will be *essential* to it, or, which is more true, nothing at all," (Locke, *Essay*, III.vi.4–5, pp. 440–442 passim).

- 8) Therefore, even if substantial forms are in fact the true metaphysics, we have little or no reason to postulate them since they play no role in our scientific practice.

Of course the Aristotelian can block this argument by insisting on the difference between the epistemological and the metaphysical: the new philosopher's argument concerns only the identification of substantial forms, not their being. To infer that they do not obtain because we do not, or even cannot, know that they obtain is to commit the *argumentum ad ignorantiam* fallacy. But of course, as Locke or any of the other new philosophers would be happy to point out, such a maneuver invites questions about why we ought to feel compelled to save substantial form? If it's not doing the classificatory work it was supposed to do and it's not able to take on the role it is supposed to in scientific explanations, why bother with it? It had better do something for us philosophically, they would maintain, if we are to be justified in positing it.

B) The Alchemical argument: The argument is the Argument from Mixtions and it concerns the homeometric principle of *totaliter in toto*. A mixtion is a special kind of mixture, a mixture of the strongest sort in which the result of the mixing is a completely new substance rather than some mere blend of the two (or more) mixed ingredients. Such examples come up most frequently in chemical experiments and are identified by the emergence in the mixtion of radically different and new properties, properties that none of the ingredients previously exhibited. The real puzzle here concerns the source for the eduction of the new substantial form and the "corruption" of the older substantial forms of the elements. The puzzle was not new, of course; it goes back to Aristotle's *De generatione et corruptione* I.10.²³ But during the Scientific Revolution it began to be viewed with an additional sense of anxiety.

The Argument from Mixtions

There are two sides to the problem of mixtions, what happens to the substantial forms of the elements (the subduction problem) and where does the mixtion's new substantial form arise from (the eduction problem).

- 1) Mixtions require the physical intermingling of the mixtion's elements to lead to the metaphysical transformation of the mixtion's substantial forms—the subduction of the element's forms and the eduction of the mixtion's.
- 2) There are three options for subduction: a) the destruction of the elemental substantial forms, b) the elemental forms become merely "virtually" contained in the mixtion, or

²³ "Some things are such as to act and others such as to suffer action from them. Moreover, some things—viz. those which have the same matter—reciprocate, i.e. are such as to act upon one another and to suffer action from one another; while other things, viz. agents which have not the same matter as their patients, act without themselves suffering any action. ... When there is a certain equilibrium between the powers [of reciprocating things], then each of them changes, *out of its own nature towards the dominant*; yet [in such mixtions] neither becomes the other, but both become an intermediate with properties common to both. ... [In general,] some things *are potentially* while others *are actually*; the constituents [in a true *mixtion*] can be in a sense and yet not-be. The compound may *be actually* other than the constituents from which it has resulted; nevertheless, each of them may still *be potentially* what it was before they were combined, and both of them may survive undestroyed," (Aristotle, *De generatione et corruptione*, in volume 1 *The Complete Works of Aristotle*, I.10, 328^a19–31 and 327^b23–26, pp. 536–537).

- c) the remission of the elemental forms (the elemental forms exist in the mixtion, but their powers are reduced or remitted).
- 3) Option a) is precluded by Aristotle himself—“The compound may *be actually* other than the constituents from which it has resulted; nevertheless, each of them may still *be potentially* what it was before they were combined, and both of them may survive undestroyed.”
 - 4) Option b) seems to violate the central notion of a substantial form (how can a form exist in a substance without in-forming it?) and is utterly mysterious (what is “virtual” containment?²⁴).
 - 5) Option c) seems to entail that the elemental forms are mutable by the merely physical process of intermingling.
 - 6) Therefore, the subduction of elemental forms undercuts the priority of substantial forms.
 - 7) There are three options for the eduction of the mixtion’s new form—a) it appears *ex nihilo* when the elements are physically intermingled, b) it emanates from one or more of the elemental forms, or c) it emanates from the matter of the elements.²⁵
 - 8) Option a) is rejected on the grounds of the Law of Non-being.
 - 9) Option b) is rejected on the grounds that forms cannot contain one another (due to the discrete hierarchy of Being) and that it undermines the priority of forms by making its activity dependent on the efficient cause of the physical process of intermingling.
 - 10) Option c) is rejected on the grounds that it undercuts the priority of form over matter.

The Scholastic response to this problem was similar to the Scholastic response to the Argument(s) from Monsters—to place increasing emphases on the role matter plays and the

²⁴ The usual sense is merely causal—*a* is virtually contained in *b* means that *b* has the power to cause *a*. The motivation for this is retaining the commitment to the principle that like causes like, a motivation that is itself rooted in a commitment to the Law of Non-being (*ex nihilo nihil fit*). So, to say that the mixtion’s substantial form is virtually contained in the element’s substantial forms (one of them; all of them; their interaction?) is to say simply that the elements properly mixed have the power to produce a new substantial form. But this is trivial, a mere restatement of the phenomena to be explained. Ditto for the appeal that the elemental substantial forms are virtually contained in the mixtion (which, for many mixtions is empirically false; the mixing process cannot always be reversed). If it is to be understood in any more full-blooded way, it is not obvious what that is.

²⁵ “the substantial form is a thing distinct from matter. Therefore either it is something before its generation or it is nothing. If it is something, it is, therefore, a substantial form [what else would it be?] before it comes to be since substantial forms are indivisible. ... This, however, is impossible because there would then be no substantial generation. ... But if the other alternative is chosen, namely, that before generation the form is nothing, it follows that a form comes to be out of nothing, which is contrary to the axiom of the philosophers: *Nothing comes to be out of nothing*. Nor is it satisfactory to respond that it is not the form which comes to be but the composite, while the composite comes to be from matter, and thus there is nothing that comes to be out of nothing. This is, I say, not satisfactory because this reply consist more in words and in a manner of speaking than in reality. For the form really did not exist before generation, and afterwards it does exist because the composite does not come to be except insofar as it is composed out of matter and form; it is not, however, composed except out of real entities. Therefore, the substantial form came to be. Finally, this reply does not suffice because when the whole composite is corrupted, the form truly ceased to exist and passes into nothing; for it was something before and afterwards it is nothing. Therefore, when the whole begins to be, the form also comes to be,” (Francisco Suárez, *On the Formal Cause of Substance: Metaphysical Disputation XV*, trans. John Kronen and Jeremiah Reedy [Milwaukee: Marquette University Press, 2000], p. 44 [my emendations]).

physical nature of the processes of subduction and eduction, *forma educiture a materia*. Suárez, as usual, provides the best example of this Scholastic solution.²⁶ The twist here is the role played by divine concurrence: God must contribute some of His creative power for the form to be educated lest the Law of Non-being be violated and He must preserve the subdued form lest their immutability be similarly compromised. To many of the new philosophers, such strong concurrentism smacks of miraculous intervention, of course, but such an objection to the solution is not insurmountable depending on how one understands the relation between concurrentism and the law of nature.²⁷

C: Corpuscularian assaults: This attack does not involve an argument so much as a reconceptualization of the two classical theses—the Causal Likeness Principle²⁸ and the Law of Non-being. The early moderns gradually dissolved these constraints on causal explanations, coming to accept and expand on the sorts of explanations for phenomena provided by mechanistic principles and corpuscularianism. This trend is seen in the movement from Descartes (who retained strong commitments to these causal theses within the largest ambit) to Locke (whose suggestion that mind might think considerably shrank the domain the Cartesian allotted these theses) to Hume (who rejected both completely).

Cartesian rejection of biological soul, the distinction between primary and secondary qualities, and Locke's infamous suggestion that matter might think are noteworthy milestones on the path away from causal likeness. To take only the most familiar example, the non-resemblance of the ideas of secondary qualities: Socrates' whiteness is an idea or appearance that is produced in me by some power in his body. This power is certainly in Socrates' body, but not in the way we naively take it to be. That power is the complex property of Socrates' skin's texture and solidity's capacity for reflecting particles of light with certain ranges of speed and/or spin. These reflected particles of light then enter a causal relation transferring motion to the perceiver's eyes, optic nerves, and finally brain. Now, in Descartes this causal relation implies that all ideas of secondary qualities are innate ideas occasioned by these distinctive motions in the pineal gland (because he maintains causal likeness).²⁹ But in Locke this causal relation led

²⁶ Suárez, *On the Formal Cause of Substance*, pp. 73–75 and 107–110.

²⁷ The danger in developing such solutions is, of course, vacuousness: if to say that “God concurs with the eduction or subduction of the form from matter arranged thus-and-so” means merely that it is a law of Nature, then is no explanatory gain and so no reason to prevent materialists from reducing the eduction or subduction of form to the merely mechanical interaction of matter. The vacuousness of this response appears all the more when it is motivated solely by attempts to preserve theses the other anti-Aristotelian arguments already made doubtful, the priority of forms over matter and accidents (Empiricist arguments) and the Law of Non-being (Corpuscularian assaults—see below).

²⁸ R. J. Hankinson termed it the Principle of Causal Synonymy—“The idea that an agent which produces some particular property must itself exhibit the property in question: if an agent *A* is causally responsible for some property *F* holding of *B*, then *A* must itself possess *F*, and make *B F* in virtue of its *F*-ness,” (R. J. Hankinson, appendix to *Cause and Explanation in Ancient Greek Thought* [Oxford: Clarendon Press, 1998], p. 449).

²⁹ “Nothing reaches our mind from external objects through the sense organs except certain corporeal motions, as our author himself asserts in article nineteen, in accordance with my own principles. But neither the motions themselves nor the figures arising from them are conceived by us exactly as they occur in the sense organs, as I have explained at length in my *Optics*. Hence it follows that the very ideas of the motions themselves and of the figures are innate in us. The ideas of pain, colours, sounds and the like must be all the more innate if, on the occasion of

not to innatism but to a sort of emergentism as instituted by God. In Locke it is simply a law of Nature that when a brain's animal spirits are moving in a certain way, the mind connected to that brain has the idea of white. God can simply institute this causal relation because He is omnipotent. But the key notion here is emergentism.

Locke, and other corpuscularianism, were opening up a new kind of explanation. Reductionism and emergentism differ in what they are doing to their *explanadums*, of course, but there is a similar logic in how each is eliminating or segregating those properties. In both cases, some natural phenomena is associated with another, more metaphysically basic phenomena. These correlations are the explanatory engines behind both trends. When the idea of white (the emergent property) is correlated with certain motions in the brain's animal spirits (the basal properties), we take that to be a relative explanation for the idea of white. The difficult thing is the transition from a merely relative explanation to a (prima facie) absolute explanation. Now, I don't think that there is any "reason" within the *explanans* itself that we can point to as justifying or securing that transition—and that I think is the key to the whole idea of emergentism! The transition lies not in the "improvement" of the *explanans* such that it satisfies theoretical constraints like causal likeness and the Law of Non-being, but rather it lies in our rejection of those principles as necessary, or even desirable, for acceptable explanations. We begin to perceive the basic correlation itself as explanatorily significant, not as a sign for a stronger metaphysical relation but as constitutive of that relation itself. I want to be very clear about this—this transition, to early modern thinkers, was not a reaction of skeptical despair or frustration at failing to find otherwise "satisfactory" explanations (indeed far from that, the motivation was the alleged ease with which "satisfactory" explanations could be constructed on Scholastic grounds!); rather it was viewed instead as the maturing of our thinking about causality and the recognition of that the values of our philosophical youth (much like the hedonistic values of our teenage years) were themselves the sources of our dissatisfactions with natural philosophy despite their apparent fulfillment of our desires to know Nature.

Two observations follow from these four early modern arguments against formal causality. One is the pressure towards the physicalization of substantial forms. As formal causality was pressed more and more toward the material, the objects allegedly driving that power also needed to be made more and more material.³⁰ This process of physicalization more or

certain corporeal motions, our mind is to be capable of representing them to itself, for there is no similarity between these ideas and the corporeal motions. Is it possible to imagine anything more absurd than that all the common notions within our mind arise from such motions and cannot exist without them? I would like our author to tell me what the corporeal motion is that is capable of forming some common notion to the effect that 'things which are equal to a third thing are equal to each other', or any other he cares to take. For all such motions are particular, whereas the common notions are universal and bear no affinity with, or relation to, the motions," (Descartes, *Comments on a Certain Broadsheet*, in volume 1 of *The Philosophical Writings of Descartes*, trans. John Cottingham, Robert Stoothoff, and Dugald Murdoch [Cambridge: Cambridge University Press, 1985], pp. 304–305).

³⁰ Norma Emerton described this process as the "spatialization" of substantial form (Norma Emerton, *The Scientific Reinterpretation of Form* [Ithaca: Cornell University Press, 1984], pp. 48–75) and Robert Pasnau has recently spoken of their "concretization" (Robert Pasnau, "Form, Substance, and Mechanism," *The Philosophical Review* 113[2004]: pp. 31–88). I prefer the term "physicalization" though it is no more obvious or elegant than Emerton's and Pasnau's.

less involved the conflation of substantial form with essence and essence with essential properties. Thus, the substantial form of soul went from being conceived as that which conferred life onto an animal to the living of the animal to, finally, those biological processes that we thought were constitutive of or necessary for the continuance of living. The partaking or participation relation was similarly physicalized to be nothing more than the exemplification of those necessary properties and the idea that these properties were in any strong sense universals was also lost (since the material and the physical are, ipso facto, particular). The second is how this pressure towards physicalization, which the later Scholastics themselves accepted, entailed the truncation of the explanatory power of any appeal to substantial forms. Because not just the separateness of the substantial form was lost but also its priority over the material, any appeals to the substantial form as the basis for the conferral of essential properties was trivialized. There was no and could not be any explanatory gain in appealing to the substantial form over and above the physical object exemplifying a sort of property in a particular way simply because the substantial form literally was that property. This then, in the end, reversed the traditional scientific order of Aristotelianism from a top-down to a bottom-up model. Traditionally, scientific explanations moved from the top—the abstract substantial form—down to the material particular: why x is f is explained by x partaking in F , where F is some form grounding f and conferring f 's being onto objects by virtue of its own exemplification of F . The physicalization of forms, by emphasizing the role matter itself played in the generation of things, placed the explanatory priority on matter instead of forms. Thus the door to the bottom-down approaches of reductionism and emergentism were opened.

III: What Were and What Could Be Substantial Forms

What, if anything, do these observations tell us about what substantial forms were conceived to be prior to the Scientific Revolution and what they could be conceived to be afterwards? The first thing I want to say is that substantial forms are *determinables*, but in a special way. I suspect that what most of us think of when we hear the word “determinable” is a certain sort of property, a generic property of some sort (being colored, living, being corporeal, etc.). When talking about Scholastic substantial forms, however, that’s problematic, as we earlier saw. That conception of determinable as determinable property misleads because Scholastic determinables could not be properties. The determinable gives or accords generic properties to the substance (Socrates is living by virtue of partaking of the form of life); the determinable thus cannot be identified with or constituted by the property in question. This is due to their priority within the top-down schema for scientific explanations. Thus, insofar as a Scholastic form was a determinable, it had to be some sort of non-individual, determinable object or being or entity—whatever that might involve! Quite frankly, it is here that my cognitive powers utterly fail me. If we cannot understand substantial forms as a determinable property, then we are forced to understanding it as a determinable object—a substance of a sort, we might say—but I am by no means comfortable or satisfied with this idea of a sort as an entity or substance. The points we’ve already canvassed entail that this sortal substance cannot be a special part of the ordinary substances I face everyday nor that it is even remotely like them in regards to its substantivity. Determinable beings do not exemplify determinate properties in the same way that primary

substances do and so cannot simply be substances like them differing only in the properties they exemplify. Indeed, it seems as if determinable beings cannot even be conceived as exemplifying determinable properties in any way lest Third Man style regress result. And I don't see any other kind of property that they could reasonably be conceived as exemplifying. Thus it seems as if they are substances of which no genuine property may ever be truly predicated, a very strange sort of substance it seems to me, given the supposedly close relationship between being a substance and being a subject of predication.

Of course one could make them out, qua determinables, as *ficta*, abstract ideas representing types of substances by virtue of reflecting the wholly determinable property to an intellect. If they were made out to be *ficta* in our minds, then the problems of their relevance for natural philosophy and their priority would have to be faced. If, on the other hand, they were made out to be *ficta* in God's mind, then their relevance for the human activity of natural philosophy would be an issue, given that few would allow us to claim to know the contents of God's mind. In fact, the question of why would God choose to create in the rather awkward, multiple-stage way that the commitment to divine *ficta* would seem to imply would then loom large? Why would God create by first thinking of the highest determinable (say, body) and then the next (living) and then the next (animal) and then the next (human) until He finally thinks of all of the determinate properties constituting Adam? Why not just create Adam in a single cognitive act? "Et Deus ait: Faciamus hominem ad imaginem et similitudinem nostrum ... Et factum est ita."³¹ We may be made in God's image, but, moreover, the doctrine that God's infinite cognitions are anything like ours, especially in their reliance on abstract *ficta*, seems rather dubious.

The inherent obscurity of the ontological status of substantial forms, combined with the pressures the practice of natural philosophy placed on them make the property conception of substantial forms the most natural one. Thus the usual understanding that the substantial form of, say, humanity is the determinable property of being human, i.e. the properties of being an animal conjoined with the property of being rational. In itself, this transition from *something* determinable that gives substances determinable properties to the determinable properties of substances themselves is no big deal, so long as the top-down explanatory schema remains intact. Unfortunately for the Aristotelians that could not remain thanks to the rise of divine voluntarism in the wake of the Condemnations of the thirteenth century, especially Étienne Tempier's Paris condemnation of 1277. By emphasizing divine omnipotence, the condemnation of 1277 was, among other things, intended to remove allegedly metaphysical hindrances to the exemplification of God's power. There are a cluster of condemned propositions that ultimately point to the rejection of causal likeness and the Law of Non-being:

(38) That God was not able to make prime matter save through the mediation of a heavenly body;

³¹ See also: "Formavit igitur Dominus Deus hominem de limo terrae, et inspiravit in faciem eius spiraculum vitae, et factus est homo in animam viventem."

- (43) That the first principle could not be the cause of diverse products here below without the mediation of other causes, in as much as nothing that transforms, transforms in diverse ways without itself being transformed;
- (55) That the first cause cannot produce something other than itself, because every difference between maker and made is through matter;
- (63) That God cannot produce the effect of a secondary cause without the secondary cause itself;
- (98) That the world is eternal because that which has a nature by which it is able to exist for the whole future has a nature by which it was able to exist in the whole past.³²

The logic of this transition is relatively clear.

- 1) We are committed to God being the cause for the material universe despite God containing in Himself nothing like matter.
- 2) Therefore, causal likeness does not apply to God and His creative acts.
- 3) Becoming in the physical universe requires the role of substantial forms to preserve causal likeness in the natural realm.
- 4) In certain cases of becoming (mixtions, embryological development), the education of substantial forms from matter, assisted by God of course, is required for the becoming to proceed in accordance with the newly instituted substantial form.
- 5) God could produce the effect of a secondary cause independently of the secondary cause.
- 6) Therefore, God could assist matter by producing the effects of the substantial form in matter—substantivity, unity, and actualization—independently of substantial form.
- 7) Again, God could produce the effect of a secondary cause independently of the secondary cause.
- 8) Therefore, God could assist matter, rather than via a particular ad hoc volition, via an act of general willing that matter in such-and-such a configuration will, as a matter of fact, have thus-and-so properties. In other words, God makes the physical, intermingling relation between the two elements in the mixtion to constitute the entire causal relation, as a law of nature.
- 9) Therefore, causal likeness need not apply to matter and material things.

The key step in this transition from a top-down to a bottom-up explanatory schema is (6).³³ Here we are face to face only with the differences between the material objects before the change and after the change. It makes no real difference in how we understand the process whether we adopt what we might call methodological miraculism (the belief that God constantly assists matter's

³² This translation is taken from Bosley and Tweedale's reader, *Basic Issues in Medieval Philosophy* (Peterborough: Broadview, 1997), pp. 52–55. The original number of the proposition is used, not Bosley and Tweedale's.

³³ One might argue that the key is step (8) and I'd be very sympathetic to that argument. But the issue, being about the direction from whence natural philosophy's explanatory force derives, is primarily epistemological, and if the cause is God's inscrutable will, for us all that epistemically matters to us is the state of the matter being assisted.

operations via particular ad hoc volitions) or methodological nomologism (the belief that God bestows on matter the power to operate in some law-like fashion via a general act of will).

What does matter, and why step (6) is the key, is that here we've lost the object that used to ground our understanding of determinable properties. Now we must build up those properties for ourselves from collections of primary substances. In other words, we must identify a resemblance between substances and use that resemblance to come to know the determinable. It is the opposite of what Plato maintained in the *Phaedo* regarding our knowledge of equals: "Do they [equal things] seem to us to be equal in the same sense as what is Equal itself? Is there some deficiency in their being such as the Equal, or is there not? A considerable deficiency, he [Simmius] said. Whenever someone, on seeing something, realizes that that which he now sees wants to be like some other reality but falls short and cannot be like that other since it is inferior, do we agree that the one who thinks this must have prior knowledge of that to which he says it is like, but deficiently so? [Simmius] Necessarily. ... We must then possess knowledge of the Equal before that time when we first saw the equal objects and realized that all these objects strive to be like the Equal but are deficient in this."³⁴ As a result, we lose real essences and are stuck with merely nominal ones. Because our conception of determinables must be built up *by us, by our selecting* which of a primary substance's properties to privilege as "essential" or "necessary," we must concede that all categorization and indeed all explanation within natural philosophy can only be bottom-up, explanations beginning with the nature of matter and taking as basic the powers of material things.

In the end, this is what prevents the reintroduction of substantial forms to contemporary science. It's not that we cannot find things that are in some sense analogous to the older conception of substantial forms, non-mechanical forces and structures being the most obvious analogues. The problem is that in reintroducing these things as substantial forms, these sorts of entities (or aspects of entities) are nevertheless understood only from the bottom and are fitted into a bottom-up explanatory schema. In other words, the crux of the problem with attempts to reintroduce substantial forms, as I see it, are that the point behind their demise was missed. A reintroduction of something analogous to them does not bring them back because their main top-down explanatory function cannot be replicated within the bottom-up practice of modern science.

Let me end with a brief illustration, the case of humanity. Suppose that we want to reintroduce the substantial form humanity as a certain kind of DNA sequence, or a humanoid shape conjoined with a certain brain organization or having an certain IQ. We understand the determinable only via comparisons between individual animals, some having and some lacking these features, based on our preconceived notions of their resemblances or lack thereof. Thus, at best we can develop only some vaguely or arbitrary drawn range of exemplified characteristics— is, for example, an IQ of 70 sufficient to constitute a human as opposed to some distinct, non-human animal? 69? 68? Or some other IQ? What organic malformations in brain structure are

³⁴ Plato, *Phaedo*, in *Plato: The Complete Works*, ed. John M. Cooper (Indianapolis: Hackett, 1997), 74d–75a, p. 65.

compatible with being human? As we slide down the continuum of brain structures towards bonobos and chimps, where does the rigid boundary between the species lie? For the new philosophers of the Scientific Revolution, the failure to non-arbitrarily answer these questions was a sign that the conceptions of structures we possess could not operate as formal causes, and so could not actually be substantial forms. Of course, if one likes the sound of that name and wishes to retain it, so be it. Few early modern philosophers were interested in quibbles about the use of a particular word, just so long as those who wished to reintroduce it realize that they are doing so equivocally and that modern scientific practice does not permit them to function as formal causes, which was the classical purpose of and reason for positing substantial forms.