Descartes on the Road to Elea

Essence and Formal Causation in Cartesian Physics and Corporeal Metaphysics

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Contents

Preface

In the beginning (or relatively close to it, anyway), there was Aristotle. Aristotle thought that there were four causes, that each of these causes answered a different question, and that a complete explanation would involve all of them. Nowadays, the vast majority of philosophers do not think any of this is correct. Luckily, we realized during the scientific revolution that everything could be explained with mathematically precise physical laws: We started to think less like Aristotle and more like physicists.[1] In this way, philosophy became modern.

I used to think that this familiar story was true. I thought that we were well-rid of Aristotle and his unscientific, anti-physicalist theorizing. Nowadays, though, I do not think any of *this* is correct. I am no longer sure that I grasp what a physical law is, nor do I firmly comprehend how they explain events. I am, however, pretty well convinced that physicalism is false, a vestigial belief that has endured out of inertia and philosophical prejudice long after its justifications were torn down. Above all, I am convinced that the understanding of scientific explanation that I had back when I was actually studying and doing science is all wrong.

The following work is not about what I think about these issues, of course. It is about the underappreciated role played by formal causality in some of the more scientifically-oriented metaphysics of Descartes. In a way, however, what follows is a record of disenchantment.

My historical interests are motivated by my belief that there are issues about which we can learn much from Descartes, his Aristotelian opponents, and some of those writing in his more immediate wake. I think it makes sense to talk about natural kinds with real definitions in

[1] Thus, one of my old undergraduate physics textbooks, *Analytic Mechanics: 7th Edition* by Fowles and Cassiday (2005, 48), confidently asserts that "Aristotle… had frozen the notion of the way the world works for almost 20 centuries… Aristotle failed to extract Newton's laws… from observations of the real world… [because] he observed the world and interpreted its workings in a rather superficial way… quite coincident with… modern people in general (including the typical college student who chooses a curriculum curiously devoid of courses in physics)."

scientific explanations, and so I think there is much to be gained from studying how Descartes and his fellow-travelers wrestled with the philosophical implications of such talk, even if we do not agree with them about what those kinds or their definitions are. Similarly, scientists agree that there are scientific laws, and the way we talk about these laws and the explanations in which they figure owes much to the early moderns in general and Descartes in particular. Perhaps most interestingly, at least to me, we routinely take the goodness of mathematization in science as obvious and uncontroversial despite the serious difficulties that would result from taking this ideal to its logical extreme, as Descartes did more fully and so more fearlessly than most.

These issues drew me to Descartes. What has sustained my interest over the years that I have thought about Cartesianism is his preoccupation with fascinatingly pure logical spaces. Many have thought that physics should be mathematical, for example, but Descartes just outright identifies the physical with the mathematical. Many have thought that nomological explanation and causation are related and central to science, but Descartes just holds the laws of physics to be causal. Others have sought to relate – or to reconcile – theism with a scientific worldview, but Descartes attempts to establish the scientific worldview, with all its "causal" mechanisms and its "physical" laws, via a purely intellectual perception of the divine.

Sometimes, I suspect Descartes is onto something. I think his conception of nomological explanation should be attractive to any essentialist, especially any essentialist who has not developed a reflexive hostility to theism. Oftentimes, however, I think Descartes cannot be right. In such cases, the philosophical merits of studying Descartes spring not from his conclusions but from considering what went wrong when a "great" philosopher made a concerted effort to occupy an interesting point in logical space. This is especially so when that point in logical space remains attractive to many of us as a philosophical or a scientific ideal.

Acknowledgements

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Travis Tanner

Abbreviations and Conventions

I use '§' to refer to sections of this dissertation. I cite this dissertation by section and footnote.

Secondary sources are cited by author, year, page, and footnote.

The following list contains primary sources alongside the conventions I follow and the abbreviations I use when citing them. Fuller information is provided in the bibliography.

APo.	Aristotle. *Posterior Analytics*. Cited by Bekker numbers.
APr.	Aristotle. *Prior Analytics*. Cited by Bekker numbers.
AT	Descartes. *Oeuvres de Descartes*. Cited by volume and page.
BF	Leibniz. *On Body and Force: Against the Cartesians*. Cited by page in *Essays*.
Cat.	Aristotle. *Categories*. Cited by Bekker numbers.
CSM	Descartes. *The Philosophical Writings of Descartes*. Cited by volume and page.
D	Malebranche. *Dialogues on Metaphysics and on Religion*. Cited by dialogue number and page in Jolley and Scott (1997).
DA	Aristotle. *De Anima*. Cited by Bekker numbers.
DC	Aristotle. *De Caelo*. Cited by Bekker numbers.
DG	Anselm. *De Grammatico*. Cited by page number in *The Complete Treatises*.
DK	*Die Fragmente der Vorsokratiker*. Cited by its internal schema and the page number of the corresponding English translation in McKirahan (2010).
DM	Suárez. *Disputationes Metaphysicae.* Cited by book, section, and subsection.
E	Spinoza. *Ethics Demonstrated in Geometrical Order*. Cited by part and axiom (a), definition (d), proposition (p), corollary (c), demonstration (d), and scholium (s).
EE	Aquinas. *De ente et essentia*. Cited by chapter and line.
EHU	Locke. *An Essay Concerning Human Understanding*. Cited by part, chapter, and section.
Elem.	Euclid. *Elements*. Cited by book.
EN	Aristotle. *Nicomachean Ethics*. Cited by Bekker numbers.
Enq.	Hume. *An Enquiry Concerning Human Understanding*. Cited by section and paragraph.
EP	William of Ockham. *Expositio Physicorum.* Cited by internal divisions.
ERCE	Shepherd. *An Essay upon the Relation of Cause and Effect*. Cited by page.
Euth.	Plato. *Euthyphro*. Cited by Stephanus numbers.
GS	Leibniz. *On God and the Soul*. Cited by page in *Essays*.
LE	Euler. *Letters of Euler*. Cited by volume, letter, and page.
Meno	Plato. *Meno*. Cited by Stephanus numbers.
Met.	Aristotle. *Metaphysics*. Cited by Bekker numbers.

Metr. Aristotle. *Meteorology*. Cited by Bekker numbers.

Mon. Leibniz. *Monadology*. Cited by section.

NB Leibniz. *On the Nature of Body and the Laws of Motion*. Cited by page in *Essays*.

NI Leibniz. *On Nature Itself*. Cited by section.

NT Paley. *Natural Theology*. Cited by chapter and paragraph.

OCF Fontenelle. *Oeuvres*. Cited by volume and page.

PA Aquinas. *Expositio libri Posteriorum Analyticorum*. Cited by book and lecture.

PHK Berkeley. *Principles of Human Knowledge*. Cited by part and section.

Phys. Aristotle. *Physics*. Cited by Bekker numbers.

PN Aquinas. *De principiis naturae*. Cited by chapter and line.

PNG Leibniz. *Principles of Nature and Grace, Based on Reason*. Cited by section.

PP Descartes. *Principles of Philosophy*. Cited by part and section.

Pros. Anselm. *Proslogion.* Cited by chapter.

QDA Aquinas. *Quaestiones de Anima.* Cited by article, arguments (arg), on the contrary (sc), I respond that (co), and replies to objections (ad).

QPD Aquinas. *Quaestiones de Potentia Dei*. Cited by question and article.

Rhet. Aristotle. *Rhetoric*. Cited by Bekker numbers.

S Malebranche. *The Search after Truth*. Cited by book, part, and chapter.

Sens. Aristotle. *De Sensu et sensibilibus*. Cited by Bekker numbers.

SCG Aquinas. *Summa Contra Gentiles*. Cited by book and chapter.

ST Aquinas. *Summa Theologica*. Cited by part (I, Ib, II, or III), question (q), article (a), prologue (pr), objections (arg), on the contrary (sc), I respond that (co), and replies to objections (ad).

Symp. Plato. *Symposium*. Cited by Stephanus numbers.

TC Leibniz. *Correspondence with Samuel Clarke*. Cited by letter number and section.

TDB Leibniz. *Correspondence with Bartholomaeus Des Bosses*. Cited by page in *Essays*.

TDV Leibniz. *Correspondence with Burchardus de Volder*. Cited by page in *Essays*.

Top. Aristotle. *Topics*. Cited by Bekker numbers.

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Essence and Formal Causation in Cartesian Physics and Corporeal Metaphysics

Introduction

The following is a study of Cartesian physics and corporeal metaphysics. It has two general themes. First is the Cartesian attempt to erase the distinction between the mathematical and the corporeal – to reduce all material qualities to quantity, to provide mathematically precise physical laws, and to reject "spooky" entities like hylomorphic forms. Second is the continued importance, within Cartesianism, of formal causality. These seemingly disparate strands in Cartesian thought are, I think, intimately connected. What unifies these themes is a single thesis: Formal causal explanations are afoot throughout Cartesian physics and corporeal metaphysics, and their ubiquity is a natural consequence of the Cartesian project of equating the physical with the mathematical. Formal causality is the explanatory mode characteristic of proof in geometry; small wonder, then, if Descartes finds he needs to resort to formal causation in his attempt to work out a physics in which matter is merely geometrical.

The first chapter lays out the background for this Cartesian project. After briefly clarifying some central terminology, it offers a selected history of formal causation in three thinkers whose work looms large in Descartes: Aristotle, St. Thomas Aquinas, and Francisco Suárez. My general thesis is that Aristotelian formal causation was an internally complex notion encompassing a few distinct explanatory modes. The two most important of these are what Suárez terms *physical* and *metaphysical formal causal explanation* in terms of *physical* and *metaphysical forms*, respectively. The basic contrast is between the explanations characteristic of hylomorphic ontology – physical formal causation – and the explanations characteristic of the idealized science depicted in the *Organon* – metaphysical formal causation. Physical formal causation is explanation in terms of the entity united to particular parcels of matter, whereas metaphysical formal causation is explanation from a real definition, or essence. This is the

central upshot of Chapter 1, but there are others. Along the way, I also broach some related topics that will recur in our discussion of Cartesianism. The most important of these topics are the Aristotelian conceptions of materiality and essentiality.

Chapter 2 begins our foray into Cartesianism with a quick discussion of efficient causality and mechanism as Descartes understood them. We next turn to a theological problem: How can God be his own cause? We will find Descartes, perhaps somewhat unexpectedly, appealing to Aristotle's definition of formal causation in the *Organon* to solve this problem: The reason God exists is not his power but his essence, according to Descartes, and it is in this sense that God is *causa sui*. To restate the point in the terminology laid out in Chapter 1, God is his own metaphysical formal cause. This raises the question of the relationship between the Cartesian and Aristotelian notions of formal causation, and much of Chapter 2 is devoted to providing an answer. That answer comes in two main parts. First, Descartes entirely banishes physical formal causation from physics and corporeal metaphysics. Second, he largely endorses metaphysical formal causation from essence. This position is entirely natural for someone, like Descartes, who rejects hylomorphism and grounds his entire philosophical outlook on the intellectual perception of real definitions. Importantly, however, Descartes cannot agree with the Aristotelians regarding the real definition of materiality. In keeping with his project of mathematicising the physical, he differs from Aquinas and Suárez by equating materiality with extension – with geometricity, with quantity – rather than with potentiality.

This basic understanding of Cartesian formal causality in hand, Chapter 2 concludes by both clarifying how that notion relates to Cartesian metaphysics and by taking a first stab at one of the most common objections to interpretative appeals to Cartesian formal causation. The most important metaphysical upshot is the further specification of the Cartesian notions of essence and

substance. This further specification accomplishes two aims: distinguishing the Cartesian view from its Aristotelian predecessors and elucidating what exactly the essences that figure in Cartesian formal causation are. The objection that needs heading off is that Descartes appeals to formal causation only in a very specific context – namely the ontological argument – and so it is a peripheral notion that should not be invoked outside this immediate context. Against this, I argue that it is rash to write off an entire explanatory notion because it is "only" attested in defense of a central argument, especially when one of those attestations is in one of the core texts in the corpus. My full argument against the charge of peripherality is, however, constituted by the fruitful application of formal causality in subsequent chapters.

The first of these fruitful applications is the subject of Chapter 3 – the laws of nature. We begin with a problem: The specification of mathematically precise scientific laws is among the most celebrated and central features of Cartesian science, yet Descartes's explication of these very laws is apparently based on an elementary category mistake. Descartes quite clearly identifies the laws as causal, but this frustrates any attempt to fit the laws into Cartesian ontology, since, whatever they are, the laws surely are not acting on bodies. The law of inertia, for example, is not literally pushing the moon forward along its orbital path. After examining a plethora of proposals according to which the laws are to be understood in terms of efficient causality, I conclude that no such proposal is workable. On the contrary, the only way to make sense of what Descartes says about the laws is to understand him to be invoking formal causality. The laws are true, as Descartes is quite clear, in virtue of certain essential properties, and so explanations from physical laws are explanations from those essential properties. And so, nomological explanation is metaphysical formal causal explanation.

Chapter 4 likewise begins with a problem. Indeed, it begins with what I think is one of the most serious objections to Cartesian corporeal metaphysics. The objection is that there is a corporeal causal power that is required by Cartesian metaphysics, namely impenetrability. One problem with this is that it undercuts any occasionalist interpretation of Cartesian physics, and this is bad trouble given that occasionalism is, as we shall see, what makes it possible for Descartes to account for dynamics without compromising the thoroughgoing mathematization of the physical. Another problem is that impenetrability, so the objection goes, resists reduction to geometrical extension. Put another way, there is a corporeal quality that cannot be reduced to quantity. In response, I undertake a close reading and reconstruction of the argument that Descartes offered to Henry More to show that impenetrability is derivable from extension, and I show that this argument succeeds on the assumption of the equation of mathematical and physical objects. The immediate upshots here are twofold. First, impenetrability is readily reducible to quantity, to extension. Second, bodies do not exclude one another from locations by acting as efficient causes. Rather, the exclusion is a conceptual fact; God cannot create overlapping bodies for the same reason that he cannot create a triangle with four sides, namely the conceptual incoherence of the described state of affairs.

Chapter 5 concludes the positive portion of our study by heading off some further objections and tying up loose ends. One of these objections is of great historical interest, even if it seems disagreeably niche to contemporary eyes: condensation and rarefaction. Like impenetrability, the rarity of bodies was often cited in Renaissance and early modern discourse to show that bodies have irreducibly qualitative features, and so it behooves us to show how Descartes accounted for these phenomena without compromising his geometricization of corporeal objects. As it turns out, the Cartesian account relies upon the conceptual impossibility

of interpenetration, discussed in Chapter 4. The second objection I consider is pointedly raised by Berkeley, and purports to show that occasionalism implies idealism. While Descartes's official objection to idealism is unconvincing, I nevertheless argue that his flippant treatment of the idealist hypothesis belies the deep-seated reasons he can offer against it. The most important reason is that Berkeley presumes that the only explanatory role matter can play is as an efficient cause, yet this is plainly not so for Descartes. On the contrary, we know from our discussion of impenetrability that matter plays a role as a *formal* cause by conceptually precluding colocation. In addition to handling these objections, Chapter 5 also pauses briefly to sketch the Cartesian system as we have come to understand it – as a sustained attempt to eliminate the distinction between the corporeal and the mathematical. One facet of this project is occasionalism in the corporeal domain, which accounts for the forces required by any plausible physics without compromising Cartesian corporeal ontology or Descartes's rejection of Aristotelian causal powers. Another is the systematic application of formal causal explanation from essence in the guise of the canonical laws of physics and the pervasive assumption of corporeal impenetrability.

So far, so good. To this point, our interpretation of Descartes has been largely positive. Chapter 6, however, deals with what I judge to be the fatal flaws in the Cartesian project. There are two such problems, both helpfully broached by Leibniz. The first is that the equation of the physical universe with Euclidean space implies immutability. There is no way, as Leibniz puts it, to gin up genuinely different states by the perpetual substitution of indistinguishables. The second problem relates to the synchronic individuation of bodies. How, that is, can Descartes make sense of the idea that (necessarily uniform) Euclidean space exhibits a particular structure at a particular time? And it must do so, at least if the corpuscularian physics Descartes expounds upon at such great length describes anything real. Indeed, it is unclear that God could even divvy

up matter in a purely mental way, since the Cartesian plenum is directionless, boundaryless, and unending. It has no edges, no center, no way at all, really, of delimiting it even in thought. Jointly, these two problems amount to an argument for (at least an attenuated) Eleaticism: The physical universe exhibits no structure synchronically and does not change over time. Thus, Cartesianism is, like the Aristotelianism it largely supplanted, untenable on ontological grounds.

I conclude with a brief postscript relating the failure of Cartesianism to a contemporary attempt to collapse the distinction between the corporeal and the mathematical. The central defect of Cartesianism is ontological: There is no sense to be made of geometrical structure if there is no entity to exhibit that structure. Put another way, Descartes fails precisely because of his ambition to make do with mathematics alone is ontologically flawed. This is a flaw that is, I think, shared by contemporary ontic structural realists, like James Ladyman and Don Ross, who likewise attempt to argue that mathematical structure alone is ineliminable; that *Every Thing Must Go*. So, while Ladyman and Ross are quick to label many of their opponents as neo-scholastics, I think they themselves deserve the label of neo-Cartesians. And, as we know from our study of Cartesianism, this comparison is not entirely flattering.

Chapter 1

A Selected History of Formal Causation

Précis

Descartes is often read as holding that the only causes are the efficient causes characteristic of both mechanistic physics and the actions of rational agents. This is surprising. Descartes himself explicitly appeals to and endorses a notion of formal causation in articulating and defending one of the central arguments of the *Meditations* – the ontological argument for the existence of God. In this chapter, I offer an abbreviated history of the formal cause up to Descartes, with an eye on those figures and features relevant to the Cartesian position. In the next chapter, I establish that Descartes endorses an austere version of formal causation, a notion which I formulate in light of the history sketched in this one. Thus, the overarching thesis of the first two chapters is that there is a Cartesian notion of formal causation that is distinct from, but also continuous with, the Aristotelian tradition.

I begin in §1 by setting out some central terminology. Then, in §2, I turn to the formal cause in Aristotle, with a focus on hylomorphism and the *Organon*'s ideal of philosophical science. My central thesis in this section is that the notion of formal cause in Aristotle is ambiguous. The ambiguity rests on an elision (inherited from Plato) of explanation from a real definition and from an entity relating to but distinct from matter. In §3, I show how this ambiguity was transformed by St. Thomas Aquinas, who I argue clarifies and makes fully explicit the internal complexity of formal causation. Finally, in §4, I consider Francisco Suárez, whose three-fold notion of form and formal causation is a culmination of the analysis of formal causality via multiple distinct explanatory notions. And, along the way, I discuss some problems endemic to formal causation, as well as how our Aristotelians attempted to deal with them.

1. Essence and modality

Philosophers sometimes explain something by means of an essence, as when some fact about triangles is explained in terms of three-sidedness. The intuitive idea is that an essential property is one which shows up in the definition of a thing or type. Accordingly, essences are sometimes called real definitions, and I will henceforth use those terms interchangeably.

It will be useful to begin by precisifying the notion of essence, as everything that follows concerns it. Let us, therefore, first stipulate that essences are to be understood in terms of essential properties. Let us further stipulate the following definition of an essential property:

β is an essential property of x iff	(i)	β is a modally necessary property of x and
	(ii)	β is an explanatorily basic feature of x.

Condition (i) amounts to the claim that if x ceases to have the property β, it thereby ceases to be the thing it is. Call properties that satisfy (i), *modally necessary properties*. For example, if a triangle ceases to have three sides, then the triangle itself ceases to exist, and so we will say that having three sides is a modally necessary property of triangles. Condition (ii) attempts to restrict essential properties to only those that would appear in a definition. So, for example, while it is a modally necessary property of a triangle that its area be equal to half the product of its base-length and height, this property would not appear in the definition of triangularity, and so, intuitively, it should not count as an essential property. Rather, a triangle is a three-sided Euclidean figure, from which it follows that its area is equal to half the product of its base and height. Thus, three-sidedness seems to be an explanatorily basic property of triangles whereas the relationship between area, base, and height does not. Condition (ii) says that only those properties which are explanatorily basic are essential. Taken together, conditions (i) and (ii) say that just those properties that are both modally necessary and explanatorily basic are essential.

So, a triangle is essentially three-sided but not essentially such that its area is equal to half the product of its base and height. This latter property is instead *merely modally necessary*. Throughout everything that follows, I will understand essentiality in this way.

It should be noted that our understanding of essence is thus stronger than one commonly encountered in contemporary analytic philosophy. For example, Saul Kripke (1972/1981, 42) writes in *Naming and Necessity* that the "question of essential properties… is supposed to be equivalent (and it is equivalent) to the question of identity across possible worlds." In Kripke's usage, then, essential properties are just those properties which a thing cannot lose without ceasing to be the thing that it is – in other words, essential properties are just modally necessary properties. So, Kripke understands essential properties in terms of condition (i) but not condition (ii). This purely modal notion of essentiality is one of the dominant understandings among contemporary analytic philosophers.[2] So, like Kripke, many philosophers today tend to reject condition (ii) even if they are essentialists who accept condition (i).[3]

Why should this be? One powerful argument against condition (ii) is that it introduces arbitrariness. Consider two competing definitions of triangularity. According to one, a triangle is any closed Euclidean figure with three and only three sides. According to the second, a triangle is any closed Euclidean figure with three and only three interior angles. Both these definitions are explanatorily and extensionally adequate, and neither is obviously more explanatorily basic than the other. Indeed, either property may be derived from the other. The choice between them thus looks arbitrary. And, depending on this arbitrary choice, the property of having three sides

[2] On the contemporary modal understanding, see Robertson Ishii and Atkins (2020) and the sources cited therein. Perhaps the most influential critic of essences in 20th century Anglo-American thought was Quine. A short piece that exemplifies his general attitude is "Vagaries of Definition" which can be readily consulted in Quine (1976).
[3] Many, but not all. Important exceptions to the modal understanding of essentiality include two influential papers by Fine (1994; 1995) and the more recent, book-length study of Oderberg (2007).

may or may not turn out essential according to condition (ii). In this case, then, condition (ii) seems to render the distinction between essential and non-essential properties a matter of taste rather than a matter of fact; and this, in turn, robs essentiality of most of its philosophical interest. More generally, the problem for advocates of condition (ii) is encapsulated by the truism that "axioms in one formalization might be theorems in another."[4] Again, the problem is that what is taken to be explanatorily basic is ultimately up to us, at least sometimes, and so condition (ii) implies that what is essential is also up to us, at least sometimes. Advocates of condition (ii) thus face an unattractive choice, for they must either admit that the distinction between essential and non-essential properties is, at least sometimes, unavoidably arbitrary or else find some way to plausibly insist that there is always a matter of fact despite appearances to the contrary.

This problem is serious, but it is not my intention to decisively solve it. Rather, I advance this criticism of condition (ii) for two related reasons. First, all the thinkers with whom we will be principally concerned endorse condition (ii), and so the disagreement on this point between our historical and many contemporary philosophers is worth bearing in mind throughout, as is the objection underlying it. Second, I will briefly highlight the characteristically subtle response offered by Suárez below (§3).

Of course, my own argument for uncritically accepting condition (ii) throughout is anything but subtle – I accept it, provisionally, because it was endorsed by my interlocutors. Illustratively, we will see Descartes argue that impenetrability is not part of the essence of matter even though matter is necessarily impenetrable (§21-24). In particular, Descartes holds that while impenetrability is a modally necessary property of matter, he nevertheless argues that it is not an essential property because it fails to satisfy condition (ii). Aristotle and St. Anselm of Canterbury

[4] Potter (2020, 27) makes the point to raise an analogous objection to Frege's *Begriffsschrift* (1879), illustrating the persistent philosophical difficulties engendered by this particular quirk of formal mathematics.

make similar points about the human capacity for grammatical knowledge (*Top*. 102a18-30; *DG* 8-9),[5] while among later scholastics the stock example of a modally necessary but non-essential property is risibility (e.g., Aquinas, *EE* 4.128-130, 6.95-98, and *PA* 1.10).[6] So, in summation, my endorsement of condition (ii) is predicated on the uniform endorsement of it by my interlocutors, as well as my desire not to quibble with them about it.

This understanding of essence in hand, let us turn to the first of those interlocutors.

2. A Greek notion – Aristotle

The attempted specification of essential properties is one of philosophy's oldest preoccupations. Plato's Socrates is characteristically concerned with the specification of real definitions of things like virtue and piety, and Plato often links this Socratic project with talk of form (e.g., *Meno* 72c and *Euth.* 6d-e). Indeed, Francisco Suárez would later go so far as to argue that it is Plato, not Aristotle, from whom the notion of substantial form is ultimately descended.[7] Even if Suárez is overreaching, there is no doubt that in Plato there is a notion of explanation simultaneously linked with form and definition. Within the Aristotelian tradition, this explanatory notion is called formal causation. Since our path leads ultimately to Descartes via the Christian Aristotelianism of St. Thomas Aquinas and Suárez, let us focus first on Aristotle.[8]

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[5] Shields (2014, 116-124) provides a discussion of the Aristotelian endorsement of condition (ii).

[6] Aristotle calls such properties *idia* (*Cat.* 3a21, 4a10; *Top.* 102a18–30, 134a5–135b6), though the Latin term *propria* is more commonly encountered nowadays. Another term, used by Descartes as well as the scholastics, is *proprium quarto modo*, or "property of the fourth kind" (AT 5.269). There is, however, some reason to think Descartes's usage of this term somewhat idiosyncratic; see Schmaltz (2020, 123-125).

[7] *DM* 15.1.5: "Nevertheless, Aristotle was not the discoverer of the truth concerning the existence of substantial forms. Plato recognized their existence before him…" Suárez has the *Timaeus* especially in mind. One can also detect an awareness of the Platonic ancestry of the substantial form in Aquinas (e.g., *ST* I q84 a1 co; a2 co), though his focus on refuting the Platonic transcendence of form muddles the issue.

[8] Given our focus, the following discussions of Aristotle, Aquinas, and Suárez are all truncated. The role of essence and formal causation in any one of these thinkers would furnish more than enough material for a book-length study. Thus, our aim in this chapter is merely to highlight some common threads running through our Aristotelians, with an emphasis on issues relevant to our pending discussion of Descartes. For further details, the interested reader is

Aristotle sometimes speaks of formal causation as an explanation from essence or real definition, as here:

> 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 octave the relation 2:1, and generally number), and the parts of the definition. (*Phys.* 194b27-29; see also *Met.* 1013a24-b3, 1029b12)

In the *Organon*, the same basic point is made in a passage which Descartes (AT 7.242; quoted below in §7) would later cite approvingly in expounding his own notion of formal causation:

> [W]e think we understand when we know the explanation, and there are four types of explanation… one [of the four types] is what it is to be a thing (*APo.* 94a20-21; see also *APo.* 92b35-37, 96b26-32, *Top*. 101b38, 141b26)

Thus, when we explain something in terms of the essence of a thing, we give a formal causal explanation.[9] Aristotle's example of the octave is exactly to the point: The ratio 2:1 just is part of what it is to be an octave, and so the ratio will figure in the full specification of the essence of the octave.[10] So, when a musician explains why the C-major scale begins and ends with C by appealing to the ratio 2:1, they give a formal causal explanation.

Formal causal explanations from essence are of central importance to Aristotle's conception of philosophical science in the *Organon*.[11] Aristotle's ideal, as rendered in the *Posterior Analytics*, is a deductive system proceeding from essences (e.g., *APo.* 90b25), canonically via first figure syllogisms that capture both the fact and the reason why (*APo.* 79a18-32). An illustrative example of such a body of interconnected demonstrations, though one that

directed to the work of Sirkel (2018) on Aristotle and to Hattab (2009) and Pasnau (2004) for fuller studies of the scholastic notion of form and its relation to early modern mechanism.

[9] Aquinas (*PA* 2.9) puts the point as follows: "One of these [four types of cause] is the *quod quid erat esse*, i.e., the formal cause, which is the completeness of a thing's essence." As we shall see (§3), this implies that for Aquinas the formal cause can involve an indistinct reference to matter, since Aquinas understands essence in the strict sense to involve indistinct reference to matter.

[10] Today we would define the octave in terms of the frequency, *f*, of the original note. Thus, for some integer *n*, the n^{th} octave is given by the formula $2^{n}*f$. This, of course, means that one gets the next octave in the series by multiplying or dividing by 2. So, Aristotle's example is not only to the point, but also correct as far as it goes.

[11] For how this ideal is transformed by the moderns, see Nadler (1998) and Ott (2009, especially ch. 12). I also touch on this material below (§9, §16).

postdates Aristotle, is the *Elements* of Euclid. Aristotle further holds that all such demonstrations ultimately ground out in the first principles of the relevant science, much as all the geometric demonstrations of the *Elements* are ultimately grounded in axioms, postulates, and definitions. These first principles are the essences of the highest order kinds within the relevant scientific domain, and Aristotle insists that these principles are "more familiar than and prior to and explanatory of" the deliverances of the science itself (*APo.* 71b22; see also *Met.* 994b16-19). We are further told that the principles are "non-demonstrable" (*APo.* 72b20) and that they "command belief in and by" themselves (*Top*. 100b20).[12]

The upshot of all this, for present purposes, is that a science is ultimately a deductive structure proceeding from essences, beginning with the highest order kinds and essences and proceeding downward by genus and species. In other words, the paradigmatic explanatory relation in Aristotelian science is formal causal explanation from essence.

The mode of explanation characteristic of the science of the *Organon* is not, however, the only sort of formal causation in Aristotle. Indeed, the notion of a formal causation in terms of some metaphysical entity, a form, inhering in a parcel of matter is perhaps more familiar, characteristic as it is of Aristotle's hylomorphism. As with explanation from real definition, Aristotle's consonance with Plato is evident here. For, while Plato's early dialogues find Socrates characteristically inquiring into the real definition of things, in later dialogues these real definitions become linked with a class of metaphysical entities, the Forms. Illustratively:

> You see, the man who has been thus far guided in matters of Love, who has beheld beautiful things in the right order and correctly, is coming now to the goal of Loving… it

[12] The indemonstrability of first principles immediately engenders serious epistemological difficulties relating to how the first principles themselves are grasped. These difficulties have spawned a literature that is far too vast to catalogue here. See the work of Burnyeat (1981), Irwin (1988), Nussbaum (2001, ch. 8), and Zuppolini (2020) for some approaches to this problem. In any case, Aristotle's view is surely that the principles, the essences of the highest order kinds within a domain, are arrived at via some broadly perceptual process. Irwin is arguably a dissenter to this characterization, but his point is not that perception is irrelevant to the grasping of first principles but rather that grasping the first principles also requires intellection.

> always is and neither comes to be nor passes away… it is not beautiful this way and ugly that way… itself by itself with itself, it is always one in form; and all the other beautiful things share in that… This is what it is to go aright, or be led by another, into the mystery of Love: one goes always upwards for the sake of this Beauty, starting out from beautiful things and using them like rising stairs… and from these lessons he arrives in the end at this lesson, which is learning of this very Beauty, so that in the end he comes to know what it is to be beautiful. (*Symp.* 211a-d)

Here, Plato invokes an explanation of particular beautiful things in terms of one transcendent beautiful thing, the Form of Beauty. Of course, the earlier notion of an explanation from a real definition is not lost: the Form of Beauty provides an account of what it is for particular things to be beautiful, namely participation in the Form of Beauty, and so in some sense the real definition of beauty (at least where non-transcendent things are concerned) is participation in Beauty.[13] Rather, real definitions have been linked with explanation from a Form, conceived as a transcendent metaphysical entity. Though he famously denies the transcendence of form, this same elision is present in Aristotle:

> So from perception there comes memory… and from memory… experience… from experience, or from the whole universal that has come to rest in the soul (the one apart from the many, whatever is one and the same in all those things), there comes a principle of skill and of understanding (*APo.* 100a4-8).

> [W]hen one of the undifferentiated things makes a stand, there is a primitive universal in the mind (for though one perceives the particular, perception is of the universal—e.g. of man but not of Callias the man); again, a stand is made in these, until what has no parts and is universal stands—e.g. *such and such* an animal stands, until animal does… Thus it is clear that it is necessary for us to become familiar with the primitives by induction; for perception too instils the universal in this way (*APo.* 100a15-b5).

Aristotle speaks here of a universal coming to rest in the soul. What is this universal? Aristotle tells us that it is the one apart from the many, that which is the same in distinct things. Let us take a relatively simple case, that of a proper perceptible like color.[14] Suppose there are two red

[13] Further discussion of this material in Plato would take us much too far afield. For such a discussion, see chapters 9, 10, and the appendix to *Plato* by Meinwald (2016).

[14] I deviate from Aristotle's own example because his example is anything but simple. Indeed, it is apparently in tension with the canonical discussions of perception in *De Anima* and *De Sensu* (e.g., *DA* 418a8-20). The trouble is that the form of man would seem to be a coincidental perceptible, and Aristotle says in *De Anima* that one is "not affected" by coincidental perceptibles as such. Still, concerns of consistency must be tempered, as the accounts of

objects. Aristotle says there is something in virtue of which both these objects are red. That something is the form of redness. So, there is something, namely the form of redness, in the first object that does not differ intrinsically from the form of redness in the second object, and it is in virtue of this that both are red. When we perceive such objects as red, what is happening is that a form that does not differ intrinsically (or, equivalently, which differs in number alone) from the form inhering in the objects inheres in the perceiver. In short, then, Aristotle understands perception in terms of form reception. Furthermore, the form of redness provides not just an account of why particular things are red but also of our knowledge of red things and of our understanding of redness itself. It is not difficult to suppose that formal causation must be afoot here, and as in Plato the idea of an explanation from a real definition is linked with an explanation from some entity distinct from but relating to matter.[15]

Significantly, Aristotle's theory of perception as form reception is just an instance of his general hylomorphic account of change. Compare *De Anima* with the *Physics*:

> Perception is the reception of perceptible forms without the matter, as wax receives the seal of a signet ring without the iron or gold… perception is also in each case affected by what has the color or taste or sound, but not insofar as each of these is said to be something, but rather insofar as each is of a certain quality, and corresponding to its *logos*. (*DA* 424a17-24)

> Apart from things being changed, there is no change. For what changes always changes either in substance or quantity or quality or place… In each of these cases everything is in one of two ways… in the case of a particular thing, it has either a form or a privation [of a form] (*Phys.* 200b32-201a5)

De Anima and *De Sensu* are themselves inconsistent. For example, in *De Anima*, Aristotle identifies the elemental composition of the organ of smell as either air or water (*DA* 424b29-425a5), while in *De Sensu* he instead identifies it as fire (*Sens.* 438b16-25). This is a substantive departure from and improvement upon the theory of *De Anima*, as it permits Aristotle to taxonomize the non-tactile sense organs via a preponderance of distinct elements. In any case, while perception is clearly a subject about which Aristotle's thinking evolved, the central role played of form receptivity remained constant, and for our purposes that is the main point.

[15] Though for the sake of brevity I will not delve into it, Aquinas's discussion of essence, intellect, and cognition is also helpful in considering the relationship between these notions in Plato, Aristotle, and Aquinas himself. See *ST* I q84 a1-7. On Aquinas's understanding of Plato in particular, see especially *ST* I q84 a1 co.

Just as perception is explained as the reception of form by the perceiver, in general change will be explained by either the reception or loss of form. This is true of both substantial and accidental change. When a bit of matter loses one substantial form and takes on another, one substance changes into another.[16] This is what happens when a leaf is burned to ash. When a substance, a composite of matter and substantial form, loses one accidental form and takes on another, that substance moves from having one property to another. This is what happens when the green leaf of summer turns to orange in autumn. In general, then, the reception of form by matter leads that matter to be actualized in a characteristic way, and so the having of that characteristic is explicable in terms of the inherence of the relevant form.

The most important upshot of all this for our purposes is that formal causation is an ambiguous notion in Aristotle. On one hand, we have seen formal causation understood as explanation via an essence or real definition in philosophical science. Call this, *metaphysical formal causation* in terms of a *metaphysical form*. On the other hand, we have also seen formal causation understood as explanation in terms of an entity inhering in but distinct from matter. Call this, *physical formal causation* in terms of a *physical form*.[17]

It is a good question why Aristotle dubs both these explanatory notions formal causation. After all, the two are importantly distinct. The metaphysical form is an essence or real definition; in other words, metaphysical formal causation trades in the modally necessary and explanatorily basic properties of a kind. The physical form, by contrast, is an entity inhering in matter. A natural suggestion is that Aristotle is taking talk of physical form to be at least roughly equivalent to talk of properties, and that the distinction between metaphysical and physical

[16] Whether or not Aristotle was committed to substantial forms in the scholastic sense is not uncontroversial. However, since Aquinas (e.g., *ST* I q76 a4) and those writing in his wake tended to read Aristotle as at least implying the existence of such entities, I set this controversy aside without further comment.
[17] As we shall see below (§4), this terminology and basic schema are Suárez's, and I adopt them for that reason.

formal causation is thus of little import.[18] Here is one way to motivate this claim. At least in the case of substantial forms, the physical form is equivalent to the form component of the matter-form composite, that entity which is somehow joined to matter such that a substance, a bonafide thing, exists. In that case, a natural consonance between the two types of formal causation arises from the tight connection between the properties which are essential to a thing and the form in virtue of which that thing exists. For example, rationality and animality are essential properties of human beings, and the form of humanity is a soul characterized by animality and rationality. If talk of physical form is even roughly equivalent to talk of properties, then the physical form of humanity coincides with the properties essential to humanity. In other words, the physical form coincides with the metaphysical form. And, in that case, Aristotle's elision of the two notions is understandable.

This proposal is not, however, ultimately workable. The trouble is that not all forms are substantial forms. Assuming again that we are to take talk of forms as roughly equivalent to talk of properties, the distinction between substantial and accidental forms corresponds to the distinction between essential and accidental properties. This straightforwardly implies that the scope of physical formal causation is significantly wider than that of metaphysical formal causation. Perception is a case in point. In explaining perception of the green grass, the Aristotelian appeals to the reception of a form of green that is intrinsically identical to the form of green in the thing perceived. This is a paradigmatic case of physical formal causation, since the explanation trades in the inherence of physical forms in both perceiver and perceived.

[18] I say "roughly equivalent" partly because of merely modally necessary properties. At least in scholasticism, substantial forms took on a role which Pasnau (2011, 551) likens to an "internal efficient" cause. Merely modally necessary properties are likely candidates for such internal causation. So, it is impossible to generate a set-theoretic mapping from properties to the scholastic forms which they constitute. Furthermore, it arguably shows that it is incorrect to think of scholastic substantial forms as equivalent to sets of properties, at least insofar as such an equivalency undercuts the substantial form's role as internal cause. For further details, see Pasnau (2011, 549-564).

However, the form of green is not essential to anything; no thing, after all, ceases to be what it is simply by ceasing to be green. So, greenness is not a modally necessary property of anything, and it thus always fails to satisfy condition (i) on essentiality. And so, metaphysical formal causation – explanation from essence – is not afoot in this case, though physical formal causation clearly is.[19] More broadly, the point is that metaphysical formal causation concerns essences and so must satisfy conditions (i) and (ii), whereas physical formal causation does not only concern essences and so is not subject to such restrictions.

Later Aristotelians thus inherit an important ambiguity relating to formal causal explanation, namely that Aristotelian formal causation picks out two importantly distinct types of explanation. One response would be to subsume one or the other notion of formal causation to the other. However, the prospects for success along such lines seem dim, since, as we have seen, metaphysical and physical formal causation are both integral to Aristotelian metaphysics and philosophical science but in different and apparently irreducible ways. It is unsurprising, then, to find Aristotle's inheritors sharpening and clarifying the internal complexity of formal causation rather than attempting to eliminate it. For our purposes, the two most important such thinkers are St. Thomas Aquinas and Francisco Suárez. I begin with Aquinas.

3. A medieval notion - Aquinas

In the previous section, we wielded the distinction between substantial and accidental forms to show that the Aristotelian notion of formal causation is importantly ambiguous. In

[19] One intriguing possibility is that Aristotle does not understand essentiality in terms of condition (i), such that for him something can be essential without being modally necessary; Fine (1994, 2), for example, suggests such a reading. This fits some of Aristotle's usual Greek well enough; while it is unnatural to say that the form of green is essential to anything, it is perfectly natural (if not quite idiomatic English) to say that the form of green is what it is to be green. On the various Greek phrases in the Aristotelian corpus usually rendered as 'essence' or a related term in English, see Shields (2014, 119-120). I have the Greek phrase *to ti en einai* especially in mind here. Even if this proposal is correct as Aristotelian exegesis, however, it is something of an historical dead-end, at least for our purposes, since Aquinas, Suárez, and Descartes all clearly endorse condition (i).

tracing that ambiguity forward in time, therefore, it makes sense to begin with a brief discussion of the distinction between substantial and accidental forms among Aristotle's inheritors.

The canonical treatment of the substantial-accidental distinction in medieval Aristotelianism is probably that of St. Thomas Aquinas. Characteristically, Aquinas takes his cue from Aristotle, specifically from the distinction in the *Physics* between coming to be *simpliciter* and coming to be a particular kind of entity. Here is the relevant passage from Aristotle:

> Things are said to come to be in different ways. In some cases we do not use the expression 'come to be', but 'come to be so-and-so'. Only substances are said to come to be without qualification… It is plain that all these are cases of coming to be from some underlying thing… Plainly then, if there are causes and principles which constitute natural objects and from which they primarily are or have come to be – have come to be, I mean, what each is said to be in its substance, not what each is accidentally – plainly, I say, everything comes to be from both subject and form. (*Phys*. 190a31-b20)

Partly, this is simply an articulation of the hylomorphic theory of change as applied to the specific context of coming to be. It is also one of the passages that led Aquinas and other Aristotelians into a viper's nest of disputes regarding prime matter. What is important for us, however, is not prime matter but the distinction between two notions of coming to be. Aquinas links these notions to the distinction between substantial and accidental form:

> And because generation is motion [*motus*] to a form, there are two sorts of generation corresponding to two sorts of form. Unconditional generation corresponds to a substantial form; generation in a certain respect corresponds to an accidental form. For when a substantial form is introduced, something is said to come to be unconditionally. But when an accidental form is introduced… something [is said] to become *this*. (*PN* 1.47-54)

The distinction here is between the generation of a substance and a substance coming to have or to lack some non-essential property. So, Aquinas elaborates, when a human soul informs some matter, we have a case of unconditional generation by means of a substantial form (namely, the human soul), whereas when this same human becomes white, we have a case of conditional generation by means of an accidental form (*PN* 1.54-57).

Incidentally, there is here some metaphysical motivation for the connection between essentiality and explanatory basicness as embodied in condition (ii). Clearly, accidental forms are less explanatorily basic than substantial forms, because only substantial forms explain unqualified cases of generation. Indeed, explanations from accidental forms presuppose generation via a substantial form. Aquinas emphasizes this point:

> But the reason that what is in potentiality to accidental being is called 'a subject' is that accidents are said to be in a subject, and that a substantial form is not in a subject… a subject is that which does not have being from that which comes [to it]; rather, it has complete existence *per se*… matter has being from something that comes to it, because of itself it has incomplete being. So, speaking absolutely, form gives being to matter. But a subject to an accident [gives being]. (*PN* 1.24-36; see also *EE* 6.24-59, *ST* I q76 a4 co)

The distinction here is that an accidental form inheres in a pre-existing substance, whereas a substantial form is that in virtue of which a substance exists at all. So, in explanations from the inherence of accidental forms, one must at minimum reference and presuppose that a substantial form is united to matter. And so, there is an obvious sense in which explanations from substantial forms are more basic than explanations from accidental forms. Assuming again a rough correspondence between forms and properties, this means that there is an obvious sense in which explanations from essential properties are more basic than those from accidental properties, which is all condition (ii) ultimately says.

To return to the matter at hand, Aquinas clearly envisages the substantial form as united to matter and as central to formal causal explanations, and so clearly endorses what we have termed physical formal causation (e.g., *PN* 3.43-54). We have seen that, in Aristotle, formal causation is ambiguous between this mode of explanation and metaphysical formal causation, or explanation from essence. In Aquinas, by contrast, there is a clear distinction between essence and physical forms and thus between metaphysical and physical formal causation. This is

because Aquinas understands essence – at least in the case of the composite substances with which we are concerned – to involve not only form but also matter:

> In the case of composite substances, then, form and matter is familiar… However, it cannot be said that either one of them alone is called the essence. Indeed, it is obvious that the matter alone of a thing is not the essence… neither can only the form of a composite substance be called its essence, although some philosophers try to assert this. For it is clear… that the essence is what is signified by the definition of a thing. But the definition of natural substances contains not only the form but also the matter, for otherwise natural and mathematical definitions would not differ… Therefore it is clear that the essence of a composite substance includes both matter and form. (*EE* 2.1-26)

We will eventually return (§38) to Aquinas's intriguing comment regarding the relationship between mathematical and natural definitions in considering the Cartesian attempt to annihilate any such distinction by equating corporeal with mathematical objects.[20] For now, however, two related matters require immediate attention. The first is the consequences, vis-à-vis formal causation, of understanding essence to involve not only form but also matter. The second is the relationship between essence and form within philosophical science.

We have already alluded to the first consequence of Aquinas's understanding of essence, namely that it motivates the contrast between metaphysical and physical formal causation. Roughly, Aquinas's idea is that the physical form is the form component of a form-matter composite, whereas essence somehow involves both form and matter. It is therefore obvious that there is a distinction to be made between explanations from physical forms and from essences, since only the latter may invoke matter. It is less obvious how to understand the way in which matter is included in metaphysical form, understood as the essence or set of essential properties of a thing. Part of the trouble relates to generality, for it seems that 'rational animal' is in some sense both the essence of human beings in general and of all particular humans. In the former case, it is difficult to see how matter could be included in the essence except in a general way. In

[20] Cf. Aristotle's contrast between the curved and the snub in the *Physics* (194a5; see also, Aquinas *EE* 6.139-155).

the case of particular humans, two options seem live. The first is that the matter invoked is highly determinate, in virtue of just being that bit of matter that is presently informed. We can set this possibility aside, however, as Aquinas rejects it out of hand (*EE* 2.80-84). The alternative is that matter is included in a more abstract way, perhaps by means of a functional type.

Aquinas's treatment of these matters is subtle, turning as it does on introducing different senses of essence:

> Thus it is clear, then, that the name 'human being' and the name 'humanity' signify the essence of human being, but in diverse ways… The name 'human being' signifies it as a whole, namely insofar as it does not exclude the designation of matter but contains it implicitly and indistinctly… Hence the name 'human being' is predicated of individuals. The name 'humanity,' however, signifies the essence of human being as a part, since it contains in its signification only that which belongs to human being *qua* human being, and excludes any designation of matter. Accordingly, the name 'humanity' is not predicated of individual human beings. (*EE* 2.293-305; see also *EE* 2.66-85)

The upshot here is that there is a distinction to be drawn between a more and a less strict sense of essence. In the strict sense, essence pertains to the union between substantial form and matter in a substance. So, in the strict sense, 'Socrates is a rational animal' and 'Socrates is a human being' both express that Socrates is a composite of substantial form and requisite matter. However, the particular bit of matter presently involved in this union is not essential – Socrates might have lost a limb in the Peloponnesian War without ceasing to be human – and so the invocation of matter is indistinct, in that it does not and cannot refer to any particular parcel of matter. Again, the most natural way of taking this is as referring to a functional type.

Less strictly, however, we could refer to the properties in virtue of which a human being is a human being; that is, we could refer to essential properties without the indistinct reference to matter. While less strict, this is nevertheless a natural usage. For one thing, in the case of simple corporeal substances, the contribution of matter expresses little more than the fact that the

substance in question is composite.[21] Moreover, this looser usage of essence is required if one is to speak of physical substantial form as essential, since, as the form component of the form-matter composite, physical forms do not and cannot involve matter even indistinctly. And such talk is necessary, at least insofar as this bit of Thomistic metaphysics is presented as orthodox Aristotelianism, since, as we have seen, Aristotle sometimes talks this way.

We thus arrive at a contrast between metaphysical and physical forms that engenders a contrast between physical and metaphysical formal causation. Roughly, the contrast is between explanations from a form united with matter in a composite substance and explanations from the essence characteristic of a substance or kind. Since the former notion trades only in physical forms, it cannot involve matter, whereas the latter notion invokes the essence which, in the case of composite substances, involves an indistinct reference to matter. And, as we have seen, Aquinas explicitly cites senses of 'essence' that pertains to both modes of explanation – one which corresponds to the physical substantial form and one which corresponds to the metaphysical form. This, among other things, allows Aquinas to whole-heartedly endorse Aristotle's definition of the formal cause in terms of essence in the *Physics* and *Posterior Analytics* while nevertheless distinguishing between metaphysical and physical formal causation much more carefully and much more explicitly than Aristotle himself. In this way, Aquinas preserves – but clarifies – the dual notion of formal causation that he inherited from Aristotle.

Finally, one further element in Aquinas's articulation of the formal cause demands our attention, one that echoes the *Posterior Analytics*'s preoccupation with real definition in philosophical science. We have seen that Aristotle's ideal of a philosophical science is a chain of metaphysical formal causal explanations relating the highest order kinds to more determinate

[21] And, in the case of complex substances, made up of certain types of matter, etcetera. See *EE* 2.81-84.

ones by means of ever more determinate essences, proceeding downward by genus and species. Aquinas begins the third chapter of *De ente et essentia* by relating all of this to his account of essence:

> Having seen what is signified by the name 'essence' in the case of composite substances, it should be seen how it is related to the account of the genus and species and differentia. However… it is impossible for the account of the universal (genus or species) to be suitable to the essence in that it is signified in the manner of a part, e.g., by the name 'humanity'… Hence… the account of the genus or species is suitable to the essence in that it is signified in the manner of a whole, e.g., by the name 'man' or 'animal,' insofar as it implicitly and indistinctly contains the whole that is the individual. (*EE* 3.1-25)

The sense of essence at stake with respect to genus and species is thus the strict sense, the one containing indistinct reference to matter. In the case of complex substances, this means that the essence at stake in philosophical science contains indistinct references to substances taken as matter, as bone is both substance in its own right and matter with respect to a human being. In the case of simple substance, prime matter will instead be invoked. However, in either case the reference is to matter in a general way, and so in our terminology metaphysical formal causal explanations are afoot throughout idealized philosophical science as Aquinas conceives it. This is part and parcel of Aquinas's Aristotelianism, for Aristotle himself argues explicitly in the *Organon* that there can be no scientific understanding of particulars, and it is particulars that are at stake in physical formal causal explanations (*APo.* 81b6-9; see also *EN* 1142a11-25).[22]

On Aquinas's view as on Aristotle's, then, metaphysical formal causal explanations are paradigmatic within philosophical science. Genus and species are related to one another by metaphysical formal causal explanations relating more and less complex essences to one another. This relating is accomplished by means of differentiae, as Aquinas explains:

[22] Matters are less simple than I make them out to be here, though for present purposes such complexities may be safely ignored. On some such complexities, see the study of Devereux (1986). Unfortunately, Aquinas is too concerned in his commentary on the *Posterior Analytics* by the apparently problematic mathematical case to say anything regarding this point about particulars and scientific understanding; see *PA* 1.30.

> [The] genus, species, and differentia are related proportionately to the matter and the form and the composite in nature, even though they are not the same as the latter. For the genus is not the matter, but derived from the matter as signifying the whole. Nor is the differentia the form, but derived from the form as signifying the whole… the genus signifies some form, yet not determinately this or that form, which the differentia expresses determinately… Hence the Commentator says that… the genus is called one by the commonness of the signified form. Accordingly, it is clear that through the addition of the differentia – since it removes the indeterminateness that was the cause of the unity of the genus – what remains are species that are diverse in essence. (*EE* 2.195-243; the reference to Averroës is to *Metaphysics* 5.14)

So, the essence of the genus specifies a metaphysical form in a general way by means of certain characteristic properties, while the essence of a subordinate species determines that general metaphysical form via some characteristic property, or differentia. So, for example, the genus *animal* is characterized by a certain metaphysical form corresponding to the appetitive and nutritive soul but which is indeterminate with respect to rationality, whereas the metaphysical form of the more determinate species *human* further specifies that the soul in question is rational. The relationship between metaphysical form and differentia thus seems to be straightforward: The differentiae just are whatever properties are essential to the species but not to the genus.

Here, however, we must return to an earlier difficulty. We noted in §1 that understanding essentiality as Aquinas does seems to render the choice of essential properties arbitrary. It is natural to put this objection to Aquinas in terms of differentiae. Consider the genus *closed Euclidean figure* and suppose for the sake of argument that there is an agreed upon essence of that genus. Aquinas says that this genus is made more determinate via some differentia. Suppose we wish to proceed down to the species *triangle*. We may, as our temperament dictates, select either 'having three and only three interior angles' or 'having three and only three sides' as our differentia. Since the differentia are those properties essential to the species but not to the genus, we may thus select either of the corresponding properties as essential. Furthermore, since these properties are derivable from one another, condition (ii) in our definition of essentiality says that

at most one of these features is essential because at most one of them is explanatorily basic. Again, however, the choice of which to treat as such appears entirely arbitrary. So, it seems that Aquinas must say that both the choice of differentia and of the essence of the species is an arbitrary choice of the inquirer. Put another way, the specification of the metaphysical form in philosophical science is, at least sometimes, a matter of taste rather than a matter of fact. Moreover, any arbitrariness in the metaphysical form appears doomed to infect physical formal causation as well, given the aforementioned tight link between the physical substantial form and the corresponding metaphysical form. This is immediately disastrous, since the idea that the characteristics of physical forms – which are after all objective entities existing independently of us – depend upon our arbitrary choice as inquirers is ludicrous.

This problem cuts deep. At minimum, what is needed is some way of severing the disastrous propagation of arbitrariness down to the physical form, and perhaps Aquinas has the resources to do so.[23] For now, however, let us return to our main theme of the development of the notion of formal causation by turning to Suárez. As we shall see, Suárez recognizes yet another type of form and thus yet another type of formal causal explanation. Among other things, this further notion of formal causation allows Suárez to address the problem of arbitrariness we have just raised for Aquinas. Suárez's notion of the formal cause is also the one against which the Cartesian position is best understood.[24] Let us, therefore, turn to Suárez's *Disputationes Metaphysicae*.

[23] As we shall see, Suárez's solution turns on the various ways the mind can abstract. Aquinas too sometimes recognizes that abstraction can occur in different ways (e.g., *ST* I q85 a1 ad1). This or some other strategy may suffice to extricate Aquinas (or, failing that, a fairly orthodox Thomist) from the present difficulty, though pursuing the matter falls outside the scope of the present work.

[24] The importance of Suárez in understanding Descartes has long been recognized. For an overview of why, see the first two chapters of *Cartesian Metaphysics* by Secada (2000a).

4. A scholastic notion – Suárez

As in our discussion of Aquinas, let us begin by considering how the Aristotelian distinction between substantial and accidental form manifests in Suárez, with an eye on those features relevant to the ambiguity in the Aristotelian and Thomist accounts of formal causation. Suárez understands the substantial form as a partial substance, paradigmatically the human soul and generally that "which can be united to matter in such a way that it composes with it a substance that is whole and *per se* one" (*DM* 15.1.6). In other words, Suárez understands the substantial form as the non-material component of hylomorphic substance, much as Aristotle and Aquinas had before him. So, Suárez also understands the substantial form as a physical form, and so explanations from the inherence of substantial forms will be physical formal causal explanations in our terminology. Though, in fact, the terminology is not our own, but is rather borrowed from Suárez's discussion of the same subject (*DM* 15.11.1-24). Indeed, our definition of physical formal causation as an explanation from the union of a form with matter from which it is really distinct is Suárez's own.

It is also from Suárez that our definition of the metaphysical form is borrowed. In keeping with what is by now a familiar pattern, Suárez equates the metaphysical form with the essence of a thing:

> The metaphysical form is the whole essence of a thing. It must, therefore, first be said that the properly metaphysical form of the whole is nothing else than the whole essence of a substantial thing which we also call the entire nature of a thing… It does not differ from the physical form, however, except insofar as the form of the whole expresses the whole nature composed of matter and form, while the physical form only expresses the formal part. (*DM* 15.11.3)

This is all largely familiar from Aquinas. The physical form is that which is inhering in matter, while the metaphysical form is the essence of a composite substance. As in Aquinas, the reference to matter in the metaphysical form is stressed by Suárez in distinguishing the two. To a

large extent, then, Suárez preserves Aquinas's distinction between metaphysical and physical formal causation, as well as his way of marking that distinction.

A more novel feature of Suárez's account is his stressing that the metaphysical form does not exercise formal causality properly so-called. In his view, "proper formal causality… consists in actualizing some subject" (*DM* 15.11.7; see also 15.6.6-7). He subsequently argues that the metaphysical form does not and cannot do this, since the metaphysical form of composite substances involves matter (*DM* 15.11.7).[25] As Helen Hattab (2009, 54) observes, this "betrays the extent to which the substantial form [and, we might add, physical form generally] had come to be equated with a certain causal role in physics." Suárez's point is that the metaphysical form cannot exercise formal causality because unlike the physical form it cannot bring what was in potentiality into actuality (cf. Aquinas, *PN* 4.100). Indeed, Suárez goes so far as to claim that the metaphysical form is a form "only by analogy and by a certain metaphor" (*DM* 15.11.1). As we shall see (§32), this same basic thought underlies Descartes's incorrect but understandable comment to Regius that Aristotelians posited substantial forms "solely to account for the proper actions of natural things" (AT 3.506).

This feature of Suárez's account is noteworthy in light of the centrality of metaphysical formal causation to philosophical science in Aristotle and Aquinas. One can perhaps detect in Suárez a relatively early example of discomfort with using causal language in a fully Aristotelian way. Such discomfort would have been exacerbated for Suárez given his emphasis on efficient causes, which he understands as principles "from which the effect flows forth, or on which it depends, by means of an action" (*DM* 17.1.6). If so, then any dispute here between Suárez and Aquinas may be merely terminological, with both sides admitting the centrality of explanations

[25] In the same passage, he makes an analogous point about non-composite substance, namely God and angels, such that the point is a perfectly general one, though for our purposes this is neither here nor there.

from essence and disagreeing only about whether such explanations are best described as causal. If this is right, then already in Suárez one can detect what Walter Ott (2009, 110) has called the "trial separation" and eventual "permanent divorce" of causation and explanation in the Western philosophical tradition.[26] Bowing to the usage of Descartes himself (e.g., AT 5.546), however, I will continue to use causal language to describe explanations from metaphysical forms throughout. Nevertheless, Suárez's reticence about such usage should be borne in mind as an early example of a general trend in philosophical language that is, I think, largely responsible for the eventual disappearance of talk of formal causation despite the continued philosophical interest in explanations from essence.

Leaving aside for now the metaphysical form, we come to Suárez's introduction of the *logical form*.[27] The ancestor of the logical form is Aquinas's notion of a differentia; roughly put, Suárez conceives of the logical form as that which defines a substance as belonging to this or that species (*DM* 15.11.12). The introduction of this third type of form brings with it a third form of formal causation, namely explanation from the logical form. Call this, *logical formal causation*. In light of our earlier discussion of Thomistic differentiae, one would expect logical formal causation to simply amount to explanation from those properties essential to a species but not the relevant genus. This makes what Suárez actually says quite striking:

> [The] physical substantial form is not multiplied in the same composite… but this [logical] form can be multiplied. For the genera of the same thing can be many, and the differences can also. In fact, though the definition seems to contain and explicate the whole essence of the thing, it can, nevertheless, be multiple… The reason for this difference… [is that] really distinct physical forms are so related that each constitutes a perfect and complete species of substance, and their composition must be real and physical… But this… difference… does not produce a real composition, nor is it

[26] It can be detected even earlier; see, for example, William of Ockham (*EP* 2.11). Nevertheless, the imminent overthrow of Aristotelian physics and corporeal metaphysics – in which the rejection of Aristotelian causation figures prominently – in Suárez's immediate wake makes his reticence especially interesting historically.
[27] Actually, Suárez subsumes the logical form to the metaphysical, writing that the logical form is the "metaphysical form according to reason" (*DM* 15.11.12). Still, it will be helpful for us to keep the two notions distinct, as Suárez himself typically does in practice.

> distinguished from another difference except by the division and abstraction of the mind. Our mind, however, can divide and abstract the same thing in various ways, and for this reason it can conceive many predicates of genus and difference in the same thing. Hence, a plurality of essential differences does not preclude essential unity and composition from genus and difference. (*DM* 15.11.18)

Suárez has in view the challenge we earlier raised for Aquinas, namely that the arbitrariness endemic to differentiae – what Suárez would call logical forms – ultimately infects metaphysical and physical forms. Suárez's response is that the arbitrariness does not propagate to the physical form but is instead restricted to our manner of thinking about physical forms via their logical counterparts. As he says, the logical but not the physical form can be multiplied, and this because the logical but not the physical form depends upon our mental activity, particularly abstraction. So, Suárez understands the logical form not only in terms of those properties essential to the species but not the genus, but also in terms of how we think about the relevant metaphysical forms. Thus, the variability or arbitrariness characteristic of logical formal causation is due to our manner of thinking, and so it does not imply any variability or arbitrariness in the corresponding physical forms. In this way, the arbitrariness which, in Aquinas, seemed doomed to propagate from differentiae to metaphysical and physical forms is confined by Suárez to the logical form.

By insulating the physical form from the arbitrariness endemic to the logical form, Suárez not only solves Aquinas's problem but also offers another defense of understanding essences in terms of condition (ii). The chief objection which we raised for condition (ii) was that explanatory basicness is, at least sometimes, up to us. Together with the natural assumption that the features that are essential to a thing are not up to us, this seemed to force a rejection of (ii) and adoption of a purely modal notion of essentiality. If Suárez is right, however, this argument fails. Suárez would argue that the example of the apparently arbitrary choice between using three-sidedness or the possession of three and only three interior angles to differentiate the species *triangle* from the genus *closed Euclidean figure* shows only that we may think about the

metaphysical form of triangularity in two different ways; that is, via two distinct logical forms. It does not, however, show that what it is to be a triangle is up to us. This is because only the logical form depends upon our mental activity, and it from our mental activity that the arbitrariness springs.

Furthermore, and quite apart from our specific concern about arbitrariness, Suárez thinks he must admit a multiplicity of logical forms simply due to the abundance of potentially overlapping genera. Consider the species *human being*. Most commonly, this species is understood as a specification of the genus *animal* by means of the logical form *rational*. This is not, however, the only genus of which *human being* is a species. Consider, illustratively, the genus *spiritual beings* that includes not only human beings but all the hosts of heaven and hell. We might then define the species *human being* by means of the logical form *necessarily embodied*. Again, the logical form is clearly pluralistic, whereas the physical form clearly is not: The logical form is just tracking different ways that we can profitably think about the objective physical form.

On Suárez's view, then, the formal cause is understood as a three-fold notion, though the first notion is primary. These notions are as follows:

Physical	Explanation from a form, an entity inhering in matter in a composite substance. Plays a central explanatory role in physical explanations by explaining the actualization of a subject.
Metaphysical	Explanation from essence. Does not explain the actualization of a subject, but rather expresses the whole nature, including both form and (indistinctly) matter in composite substances.
Logical	Explanation from differentia. Depends upon how we choose to abstract and think about the unity of matter and physical form in a composite substance, as well as the relation of species to distinct genera.

Suárez can thus be said to address the ambiguity he inherited from Aristotle in two ways. First, like Aquinas before him, he makes explicit the internal division by clearly articulating the

distinction between physical and metaphysical forms and associated modes of explanation. Indeed, he does Aquinas one better by identifying something like Aquinas's notion of differentia as a third type of form, which he then uses to fence in the arbitrariness and plurality concerns that menace the Thomistic account. Second, he designates physical formal causation as the primary notion of formal causation. This primary notion is connected with physical forms and their explanatory role in Aristotelian physics, thus associating "real" formal causation with both hylomorphism and the activity of substantial and other physical forms.

Given his time, place, and influence, the work of Suárez looms large in the background of Descartes's work. Importantly, one root of Descartes's reticence towards the language of formal causation is the association between the primary notion of formal causation in Suárez and such tenets of scholasticism as hylomorphism and substantial form. Still, the careful reader of Suárez – and for that matter of Thomas and Aristotle – would have recognized that formal causation was not and had never been exhausted by such scholastic machinery. Indeed, I shall argue below that the Cartesian notion of formal causation is best understood as clearing away some of the scholastic cobwebs that had gathered around one of Aristotle's own core notions of formal causation, namely explanation from essence. Descartes, in effect, eliminates the Aristotelian ambiguity by jettisoning physical formal causation altogether, something that was impossible for thinkers like Aquinas and Suárez who were committed to preserving Aristotle's basic corporeal ontology. Descartes, by contrast, saw the rejection of hylomorphism as a positive good, and so he was free to streamline the formal cause by rejecting the part of it that was parasitic on that ontology, namely physical formal causation. As a result, Cartesian formal causation is exhausted by metaphysical formal causation, or explanation from essence. Further, the Cartesian notion of essence is itself streamlined in an important respect, since Descartes did not (and cannot) require

the indistinct reference to matter characteristic of the strict sense of essence in Aquinas and Suárez.

All this, however, puts the cart before the horse. After all, the scholarship on Descartes's causal theory tends to either neglect or entirely omit formal causation. So, the next chapter begins and ends with arguments for the existence and importance of Cartesian formal causation. In-between, that notion is articulated in terms of both Descartes's own corporeal ontology and conception of philosophical science, as well as those of his Aristotelian predecessors.

Chapter 2

Cartesian Formal Causation

Précis

Thus far, we have traced an ambiguity between physical and metaphysical formal causation in Aristotelianism. In this chapter, we shall see that Descartes resolves that ambiguity by rejecting physical formal causation root and branch. This rejection goes hand in hand with his rejection of hylomorphism, and Cartesian formal causation thus reflects a deep break with the Aristotelian tradition. Still, that break should not be overstated: Descartes approvingly cites Aristotle's definition of formal causation in the *Organon* in defending his own conception of formal causality as explanation from essence. In other words, Descartes rejects physical but endorses metaphysical formal causation, which he defines in an avowedly Aristotelian manner. Cartesian formal causation is thus not only distinct from but also continuous with the Aristotelian tradition.

The task before us is twofold. First, we must complete our selected history of formal causation by articulating the Cartesian notion in light of its predecessors. This is the primary aim of the present chapter. Second, we must establish that Cartesian formal causation is an important mode of explanation within Cartesian physics and corporeal metaphysics. The first step towards this end is taken in §11, wherein I argue against the supposed peripherality of Cartesian formal causation. My full argument for the importance of Cartesian formal causation is, however, constituted by its fruitful application in the chapters that follow.

5. Efficient causation

Emphasizing the early modern rejection of the full Aristotelian causal theory is a scholarly commonplace. Illustratively:

> According to a standard narrative of the history of philosophy, Descartes's theory of causation marks a sharp break from past conceptions of causality. In particular, this story has it that Descartes set out on a new path by replacing the four Aristotelian causes prominent in scholastic natural philosophy with the efficient causes required for his new mechanistic physics.[28]

So, the standard narrative is that the early moderns reject non-efficient causes and that Descartes is one of the chief architects of this revolution. This narrative has much to recommend it. For one thing, it jibes with Descartes's well-known rejection of physical forms and his enthusiastic embrace of microphysical explanations. For another, it places Cartesianism into the broader context of the scientific revolution by emphasizing its mechanistic, mathematical, and materialistic aspects. Despite these laudable features, however, the standard narrative is ultimately doomed. For our purposes, its chief defect is the implication that Descartes has no place in a study concerned with formal rather than efficient causation.[29] Our first task must, therefore, be to distinguish formal and efficient causation as explanatory notions in Descartes.

Descartes never explicitly defines efficient causation, an unfortunate omission given the degree to which his scientific work is permeated by such explanations. Presumably, however, his understanding of efficient causation is informed by two sources: scholasticism and mechanism. This presumption partly rests on the truism that Descartes is best understood in light of

[28] Schmaltz (2008a, 217). Schmaltz, to be clear, does not endorse this narrative therein.

[29] An implicit endorsement of this narrative is evinced by the lack of discussions of formal causation within Cartesian studies, though the vastness of this literature precludes an exhaustive catalogue of it. Prominent studies of Cartesian metaphysics which make either no or practically no mention of formal causation include Bennett (2001), Carriero (2009), Pasnau (2011), and Schmaltz (2020). Studies of Cartesian natural philosophy which make either no or practically no mention of formal causation include Des Chene (1996), Garber (1992), Gaukroger (2002), Slowik (2002), and Ott (2009). Two notable exceptions are the discussions of Flage and Bonnen (1997), (1999) and Schmitter (1996), though the latter focuses on mental phenomena and thus falls outside our purview. Cartesian formal causation is also occasionally mentioned in studies of Spinoza, as it is for example by Hübner (2015).

scholasticism, the *ancien régime* that the canonical early moderns variously revolted against and appropriated. As for mechanism, Descartes was dubbed "the great Master of this Mechanical Hypothesis" by Henry More (1653, 44), and himself wrote that "the mechanics now current is nothing but a part of the true physics" (AT 1.421). Let us, therefore, begin by considering efficient causation in scholasticism and early modern mechanism, since we have good reason to suspect that doing so will shed light on Descartes's own conception of efficient causality.[30]

With respect to scholasticism, we may be quite brief. Previously, we encountered Suárez's definition of efficient causation as principles "from which the effect flows forth, or on which it depends, by means of an action" (*DM* 17.1.6). This nicely encapsulates the general Aristotelian understanding, which is variously linked with notions like action, motion, agency, and power (e.g.: Aristotle, *Phys.* 194b30-32, *APo.* 94a24, *Met.* 1013a24-b3, 1029b12; Aquinas, *PN* 3.14-15, 4.98-99, *ST* I q82 a4 co). The scholastic notion is best understood in those terms. So, the scholastic conception of efficient causation is explanation from action, motion, agency, and the exercise of causal power.

As for mechanistic physics, the tight link between efficient causation and early modern mechanism is well-known. Antonia LoLordo (2011, 663), for example, observes that the thesis that "causes are efficient causes… is characteristic of seventeenth-century mechanism" generally. Seventeenth-century mechanism was itself characterized by one of its most influential practitioners, Robert Boyle (1661, 4-5), as follows:

> I consider'd that the Atomical and Cartesian Hypotheses, though they differ'd in some Material points from one another, yet in opposition to the Peripatetick and other vulgar Doctrines they might be look'd upon as one Philosophy… especially for this Reason, That both parties agree in deducing all the Phenomena of Nature form Matter and local Motion; I esteem'd that notwithstanding those things wherein the Atomists and the

[30] Longer discussions of efficient causation which I have found helpful include Ott (2009, 1-80) and Schmaltz (2014b). For a history of the notion throughout the Western tradition, see the essays collected in Schmaltz (2014a). For an enlightening historical overview of early modern mechanism, see Roux (2017).

> Cartesians differ'd, they might be thought to agree in the main… I sometimes… term it the Mechanical Hypothesis or Philosophy.

Though Descartes would surely have balked at the suggestion that Cartesians and atomists were defending a single philosophy (*PP* 4.202), Boyle's point is clear enough: Mechanism is the thesis that natural phenomena are explicable via matter and motion alone, and Cartesianism was a major strain of mechanism in Boyle's day. Furthermore, Boyle is surely right to cast Descartes as a paradigmatic mechanist. Consider Descartes's reply to a critic of the *Discourse on Method*:

> If my philosophy seems to be 'crass'… because, like mechanics, it considers shapes and sizes and motions, he [Libert Froidmont, a Belgian theologian and professor of philosophy to whom Descartes had sent a copy of the *Discourse*] is condemning what seems to me its most praiseworthy feature, of which I am particularly proud… So, if he despises my style of philosophy because it is like mechanics, it is the same to me as if he despised it for being true (AT 1.420-421).

This is as clear an endorsement of mechanism as one could wish. And, of course, if mechanism is the thesis that all natural events are explicable via matter and motion, then efficient causation is surely the preeminent mechanistic causal notion and surely amounts to explanations in terms of causal power, motive force, and the like.[31]

Taking mechanism and scholasticism as guides, then, efficient causation is explanation from action, motion, power, and agency. Earlier, we suggested that Descartes could be expected to largely conform to the understanding of efficient causation in mechanism and scholasticism. And, indeed, he does, variously linking efficient causation with God's creative activity and power (AT 1.151, 7.237, 7.374-5, 7.435-6), generation and production (AT 3.274, 7.40-1, 7.108, 7.236, 7.238, 7.240), and volitions (AT 7.436). It is also surely correct to take references to creative power, production, and volition elsewhere to be implicit references to efficient causation

[31] Antonia LoLordo pointed out to me that mechanism suggests that material causation will also be preeminent: After all, mechanism deals in both matter and motion. The importance of material causation is, however, decisively undercut by Descartes's equation of matter and extension – material causation loses most of its interest when every object is made of the same material. Still, Descartes does avail himself of an elemental theory, and it would be interesting to see how much sense could be made of that theory in terms of material causation.

– for example, the primary cause of motion in the physical universe is associated by Descartes with both a volition and divine creation, and so it is surely best understood as the primary *efficient* cause of motion (*PP* 2.36).

Let us stipulate that we will henceforth use *causal activity* as a catch-all term for generation, production, volitions, the exercise of causal power generally, and so on. We may then summarize the foregoing by saying that Cartesian efficient causation is explanation from causal activity. The question of whether Descartes recognized non-efficient causes, then, is the question of whether there is a Cartesian notion of cause that does not amount to an explanation from causal activity. *Contra* the standard narrative, the answer is yes.

6. *Causa sui* – The ontological argument

Consider the following passage from the *Objections and Replies*:

> There are some who attend only to the literal and strict meaning of the phrase 'efficient cause'... They do not see that there is any place for another kind of cause analogous to an efficient cause (AT 7.109).

Descartes speaks here of a notion of cause analogous to, and therefore distinct from, the efficient. He returns to this theme later in the *Replies* in response to Antoine Arnauld's percipient observation that God cannot be his own efficient cause:

> M. Arnauld says that it is 'a hard saying, and indeed false' to suggest that God is the efficient cause of himself; but I actually denied that suggestion... For in saying that God 'in a sense' stands in the same relation as an efficient cause, I made it clear that I did not suppose he was the same as an efficient cause... In every passage where I made a comparison between the formal cause, or reason derived from God's essence... and the efficient cause... I always took care to make it explicitly clear that the two kinds of cause are different… Hence I can readily admit everything my critic puts forward to prove that God is not the efficient cause of himself and that he does not preserve himself by any positive influx [*influxum positivum*] or by continuously re-creating himself (AT 7.235-237; see also AT 5.546).[32]

[32] For present purposes, the standard English translation of this passage and its context (CSM 2.165) is somewhat unhelpful, as it uses 'power' to translate both *potentia* and *influxus*. Presumably, however, *influxus* denotes not

The basic dialectic here is as follows. Descartes has argued that God is his own cause (AT 7.108, 7.40-41). Arnauld objects that God cannot be his own efficient cause, and so, if God is *causa sui*, the causation at issue cannot be efficient causation. In response, Descartes concedes to Arnauld that God cannot be his own efficient cause. That is, Descartes concedes that God cannot be his own cause in virtue of his causal activity.[33] Rather, the reason God exists is his essence; God is *causa sui* in that he is his own formal cause.[34]

Now, in saying that God is his own formal cause, Descartes is invoking a variant of St. Anselm's ontological argument (*Pros.* 2-4). Roughly, his idea is that necessary existence pertains to the essence of God, and it is this which explains God's existence (AT 7.65-68, 7.166-7). It will be convenient, while on the subject of the ontological argument, to use it to broach some broader points that will remain important throughout everything that follows.

To begin, it should be noted that the resurrection of the ontological argument is one of the more divisive aspects of Cartesianism. While the ontological argument does not lack for contemporary defenders, on the whole Jonathan Bennett's (2001, 122) characterization of the argument as "notorious… sterile and boring" is probably more representative of contemporary attitudes.[35] Bennett, indeed, seems to view the Cartesian resurrection of the argument as a

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power but a specific exercise thereof, probably related to the physical influx theory in general and/or Suárez's *influxus physicus* in particular (*DM* 17.2.6). A helpful discussion of these topics is that of O'Neill (1993).

[33] Contrast Carriero (2009). Riffing off Descartes's geometrical analogy (AT 7.239, 241, 245), Carriero (2009, 220) writes that "just as you might think of a circle as an infinite version of a regular polygon, you might think of the formal or essential cause of God's existence as the infinite version of an efficient cause." This makes it sound like the formal cause is akin to an infinite number of infinitesimal efficient causes. But what Descartes is doing with the circle analogy is explaining why the analogy to efficient causation is harmless and useful. He is not giving an account of formal causation. When he wants to do that, he consistently refers to essence (AT 7.240-243; 5.546).

[34] This exchange is interesting beyond its immediate application in Cartesian studies. For example, Spinoza and Descartes are in broad agreement here (cf. AT 7.162 and 7.166-7 with E1d1 and E1p11d), and this suggests that Spinoza must also make room for formal causation. It has been ably argued that Spinoza does just that; in addition to Hübner (2015), see Carraud (2002), Martin (2018), and Viljanen (2007), (2008), (2011).

[35] The literature on the argument, in all its forms, is enormous. The seminal contemporary defense is that of Plantinga (1979). Helpful discussions of the Cartesian ontological argument include those of Carriero (2009, 168-222) and Secada (2000a, 148-182). To mention but one further discussion, Lewis (1970, 175) argues in an intriguing

particularly unfortunate event in philosophical history. Perhaps it was, but it was also perfectly natural for someone with Descartes's Platonic philosophical temperament.

The key point is that the ontological argument is unlike other familiar arguments for the existence of God, notably the Thomistic ways, in proceeding from the intellectual grasp of the divine essence. In this respect, the ontological proof resembles proofs from geometrical natures in mathematics, a point which Descartes himself emphasizes and which no doubt appealed to him deeply. Aquinas had criticized this very inference on the grounds that the divine essence is beyond our ken (*ST* I, q2, a1, co). This is sensible from Aquinas's perspective, since he holds, with Aristotle, that one comes to know the nature of a thing by encountering it sensorially. Obviously, we do not directly encounter God in this way; we come to know him only indirectly via his effects. So, Aquinas concludes, we cannot come to know the nature of God except through his effects. And so, Aquinas holds that although it is true that necessary existence pertains to God more or less as St. Anselm and Descartes require (*ST* I, q3, a4; *EE* 5.1-44), this fact is not graspable in the requisite way (*ST* I, q2, a2, ad3). The dispute between Descartes and Aquinas thus turns on whether knowledge of God's nature must be acquired empirically.

My purpose is not to resolve this dispute. My purpose is to point out that the dispute turns on whether human beings can grasp essences in a purely intellectual manner. Aquinas does not think we can, and so rightly concludes from this that the ontological argument is idle. Descartes thinks we can, and so rightly concludes from this that the ontological argument is sound. Thus, the Cartesian, like the Platonist, ultimately relies upon purely intellectual insight into the real natures of things. The ontological argument makes this clear in a specific case, but the point is

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early paper that the argument "turns out to have two principal nonmodal translations. One is valid; the other has credible premises; the difference between the two is subtle. No wonder the argument has never been decisively refuted; no wonder it has never convinced the infidel." Regardless of the correctness of Lewis's criticism, his characterization of the argument's history certainly rings true.

perfectly general. Illustratively, Descartes holds that one's grasp of the nature of a substance is achieved either prior to or simultaneous with one's knowledge that said substance exists (AT 2.273, 7.107-8; cf. Aristotle, *APo.* 92b4-6; Aquinas, *PA* 2.6; Suárez, *DM* 29.2.1). Given the obvious justificatory role played by sensation in knowledge of existence, Descartes is defending the view that one can know the nature of a substance without encountering that substance sensorially.[36] In other words, Descartes holds that the essential properties of a substance are as graspable by the armchair philosopher as by the experimental scientist – indeed, Descartes repeatedly insists that overreliance on the senses is the main cause of ignorance with respect to the real natures of things (e.g., AT 7.17-8, 7.172). There is thus surely an intimate connection between formal causal explanations from essence and Platonic intellectualism in Descartes's thought, for it is crucial that the essences grounding all such explanations are grasped in this way. In other words, Cartesian formal causation invariably resembles the ontological argument and mathematical demonstrations by proceeding from an intellectual grasp of a real definition to some further feature of the substance defined. This point should be borne in mind throughout.

Two questions are pressing at this juncture. The first is what, precisely, is wrong with supposing God to be his own efficient cause. After all, it is this that prompts Descartes into an appeal to formal causality, and so, in answering this question, we can reasonably expect to learn some important differences between efficient and formal causality as he conceives them. The second question is the role of essence in formal causal explanation, and how exactly this refutes Arnauld's objection. I treat the first question directly, and the second in the next section.

So, why do Descartes and Arnauld agree that God cannot be his own efficient cause? Arnauld's initial motivation is that efficient causes are temporally prior to their effects (AT

[36] For a detailed discussion of this dispute, see the first chapter of Secada (2000a).

7.210). His worry, therefore, is that God cannot be his own efficient cause without, absurdly, already existing. Descartes replies that "a cause need not be prior in time" to its effect because "the notion of a cause is applicable only during the time when it is producing its effect" (AT 7.240). The real trouble, Descartes thinks, is that "the notion of an efficient cause requires that it be distinct from its effect" (AT 7.243). It is worth asking why Descartes is confident that this principle is true, but first the principle itself needs clarifying. What, after all, is the distinction at issue? Elsewhere, Descartes holds there to be three types of distinction: real, modal, and conceptual (*PP* 1.60-62). Now, Descartes is obviously thinking that whatever distinction is at issue in his exchange with Arnauld does not obtain between God and his causal activity. This means that the distinction must be a real distinction. Here is why. First, God is undeniably distinct from his causal activity conceptually, and so this cannot be the sort of distinction that he and Arnauld have in mind. As for the modal possibility, one of Descartes's paradigmatic examples of a modal distinction is that between "recollection and the mind" (*PP* 1.61); that is, between an action and the substance performing it. The case of God's causal activity and God himself is analogous, and so a modal distinction also clearly obtains in that case as well.[37] The only distinction that clearly does not obtain is a real distinction, or a distinction between substances. And so, Descartes apparently holds that an efficient cause must be really distinct from its effect.

That Descartes and Arnauld are so ready to endorse this principle is puzzling. One wellspring of their confidence is the principle's pedigree, as it has precedent in both Suárez and Aristotle (*DM* 15.6.7; *Met.* 1019a15-20). Even so, the principle appears plainly false. Consider

[37] Throughout, I ignore complications resulting from divine simplicity. My grounds for this are (i) Descartes is clearly willing to apply the general principle that a substance cannot be its own efficient cause to God, even if terms like 'substance' and 'mode' cannot apply univocally to divine and non-divine substances and (ii) Descartes clearly cannot take divine simplicity to obliterate the distinction between God's causal activity and his essence.

that I can easily cause numerous changes to myself; I can, for example, conjure up a mental image via an act of will. In such a case, we clearly have an efficient cause (my volition) that is not really distinct from the effect (the idea), since both are modes of the same substance (my mind). Such cases show the principle under discussion to be false, at least if taken in a perfectly general way. But what is at issue in the exchange with Arnauld is the efficient cause of the existence of a substance, rather than efficient causation generally, and so it is natural to restrict the principle to such contexts. The idea is then that the efficient cause of the existence of a substance must be really distinct from it. This is far more plausible; indeed, it is plausibly axiomatic. Since, in Cartesian parlance, the activity of a thing and the thing itself are merely modally distinct, the principle may be put like this: That a substance exists at all cannot be explained by one of its modes. Saying otherwise runs afoul not of temporal but of ontological priority, since modes are ontologically parasitic on substances and not vice-versa.[38]

This principle in hand, we can appreciate that the problem raised by God's status as *causa sui* is an ontological problem – it absurdly requires that a substance ontologically depend upon one of its own modes. Taking God's self-causation "in terms of the essence or formal cause" (AT 7.243) solves this problem, since the restriction to really distinct causes is both unnecessary and inappropriate in the case of formal causation. Again, the restriction is predicated on the ontologically parasitic relationship between an action and the substance of which it is a mode, but formal causation trades in essential properties rather than causal activity. Thus, Descartes rightly does not consider formal causes to be subject to the same restriction as efficient causes: There is no ontological problem with saying that something is its own formal cause. Arnauld is therefore right to point out that God cannot be his own efficient cause, but this does

[38] Of course, this principle does not run afoul of the fact that some of my actions explain my *continuing* to exist.

not undercut Descartes's actual position, namely that God exists because of his essence. Arnauld only thought he was objecting to Descartes because he, like contemporary advocates of the standard narrative, mistakenly assumed that Descartes's references to causation must refer to efficient causation. But that was not and cannot have been Descartes's intent in this case. The authentic Cartesian position is that God is his own formal cause; that is, the explanation for God's existence is the divine essence.

7. Essence and power

What, then, is the relationship between formal causation, essence, and the causal activity characteristic of efficient causality? This question is not as straightforward as it might seem. Karolina Hübner (2015, 210), for example, has argued that Descartes's conception of formal causation "does not entail any curbing of productive power or efficacy" and that "the sole difference between efficient and formal causal relations lies… in the possibility and impossibility of their relata being identical." On Hübner's view, then, formal no less than efficient causes are explanations from causal activity. She observes that Descartes consistently stresses an analogy between the positive power of the efficient cause and the formal cause of God's existence; as she puts it, Descartes "never backs down from" the language of power. Moreover, she is surely correct that Descartes is concerned throughout the exchange with Arnauld to stress an analogy between God's self-causation and efficient causality, thereby gesturing at some unifying notion of cause common to both. Yet, if she is right, it is difficult to understand Descartes's repeated insistence on understanding formal causation in terms of essence alone. Indeed, it is difficult to grasp what the difference between efficient and formal causation is.

I think that the exchange with Arnauld shows that Cartesian formal causation cannot be understood as explanation from causal activity. Thus, I disagree with the view that the "difference between efficient and formal causes does not entail any curbing of productive power or efficacy." On the contrary, that is the crux of the distinction. One key piece of evidence that this is the case is that allowing causal power to figure in formal causation would land Descartes back in exactly the same hot water as before: Arnauld's objection could simply be resurrected in the context of formal causation. Granted, Descartes holds that only efficient causes must be really distinct from their effects. However, appealing to this dictum now gets things the wrong way around, for, as we have seen, the restriction to really distinct causes is appropriate just because efficient causes concern causal activity, such as the exercise of causal power. The heart of Arnauld's objection is that explaining the existence of God via divine causal activity absurdly makes the existence of a substance dependent on one of its modes, and this problem cannot be ameliorated simply by stipulating that some such activity constitutes formal rather than efficient causality. Again, Descartes's solution to the problem raised by Arnauld is to make God his own formal cause, but if formal causes were understood in terms of the exercise of productive power, then formal causes should, like efficient causes, be restricted to really distinct effects and for exactly the same reason: They would be ontologically problematic otherwise. On the assumption that Descartes's reply to Arnauld is at all to the point, then, the distinction between efficient and formal causation must be a distinction between explanations from the exercise of causal power and explanations from something other than the exercise of power. Descartes makes it perfectly clear what this 'something other than' causal activity is: It is essence.

In short, then, Cartesian formal causation is simply explanation from essence, and the distinction between formal and efficient causation is the distinction between explanations from

essential properties and explanations from causal activity, including the exercise of causal power. Again, Descartes consistently and clearly stresses this point:

> Hence, when we ask whether something can give itself existence, this must be taken to be the same as asking whether the nature or essence of something is such that it does not need an efficient cause in order to exist (AT VII 240).
>
> [I used] the analogy of an efficient cause to explain features which fact belong to a formal cause, that is, to the very essence of God (AT VII 241).
>
> In taking the whole essence of a thing to be its formal cause in this context, I am simply following in the footsteps of Aristotle (AT VII 242; citing *APo.* 94a20-1).
>
> "God is the cause of himself." Several people in the past misinterpreted this phrase, and hence it would appear to require some such explanation: "For something to be the cause of itself is for it to exist through itself, and to have no other cause than its own essence, which may be called a formal cause." (AT V 546)
>
> [T]he answer to the question why God exists should be given not in terms of an efficient cause in the strict sense, but simply in terms of the essence or formal cause of the thing (AT VII 243).

Strikingly, all these passages show Descartes endorsing what Suárez termed metaphysical formal causation. Indeed, Descartes plays against type by framing his own position as a simple embrace of an Aristotelian definition – Aristotle's in the *Posterior Analytics*, to be precise. In this way, Cartesian formal causation is plainly and avowedly continuous with Aristotelianism.

Of course, Cartesian formal causation is also importantly discontinuous with its Aristotelian counterparts. Most obviously, Descartes's rejection of physical forms entails an equally decisive rejection of physical formal causation, and this was, as we have seen, the core notion of formal causation for Suárez. Still, the careful reader of Suárez - and for that matter of Aristotle and St. Thomas - would recognize that formal causation was not and had never been exhausted by explanations from physical forms. It is consistent to endorse metaphysical formal causation while rejecting physical forms, and this is precisely what Descartes does.

Descartes thus eliminates the ambiguity inherent in Aristotelian formal causation by jettisoning physical formal causation altogether, something that was impossible for thinkers like Suárez who were committed to preserving Aristotle's hylomorphism. Descartes, conversely, rejected the ontology of hylomorphism and its physical forms, and he so was free to streamline the formal cause by rejecting the part of it that was parasitic on that ontology. As a result, Cartesian formal causation is exhausted by metaphysical formal causation, or explanation from essence.

To return, now, to our main line of argument, we have shown that, *contra* a standard narrative in the history of philosophy, there is a Cartesian notion of formal causation. Of course, that there is a Cartesian notion of formal causation raises the question of whether that notion is at work in contexts other than the ontological argument. This question is made pressing by both the notion's potentially broad applicability, as well as by Descartes's reluctance to declare himself openly even in the case of the ontological argument, at least prior to being coerced by Arnauld. Before putting the Cartesian notion of formal causation to work, however, we first must say more fully both what it is and what it is not. It is to those two tasks that I now turn.

8. Against physical formal causation

That Descartes endorsed a notion of formal causation is obvious. However, as we have already alluded to, it is equally obvious that Descartes's notion is not equivalent to its Aristotelian counterparts. This divergence stems from a larger metaphysical break, namely Descartes's rejection of hylomorphism. According to this venerable Aristotelian doctrine, all corporeal substances are composites of matter and form, with matter associated with potentiality and form with actuality. Descartes breaks with this doctrine in two ways. Most obviously, he banishes physical forms from physics. Less obviously – but just as importantly –, Descartes

reconceptualizes materiality, which he associates not with potentiality but with geometry. Taken together, Descartes's rejection of both physical form and Aristotelian matter ensures that he cannot endorse any of the three scholastic notions of formal causation wholesale.

The case of physical formal causation is interpretatively simple and philosophically rich. Illustrative of Descartes's attitude is his dismissal of physical forms as "images flitting through the air" in the *Optics* (AT 6.85). Elsewhere, he fulminates against explanations from physical forms on the grounds that they explain "that which is obscure through that which is more obscure" (AT 3.507). The invocation of physical forms in physics was anathema to him, and on this point, Descartes is a model of consistency (e.g., AT 2.200, 2.367, 3.420-421, 3.500-507, 6.239, 7.82, 7.249-255, 7.442-443, 8B.25-26, 11.9-10, 11.40, and *PP* 4.198-199).

The rejection of physical forms entails the rejection of physical formal causation, which in turn resolves the ambiguity central to formal causation – albeit in varied forms – in Aristotle, Aquinas, and Suárez. This raises three issues. First, there is the question of why Descartes breaks so radically with tradition. We will deal with this issue directly. Second, the rejection of physical forms requires revising the traditional understanding of corporeal substantiality. Third, the rejection of physical forms requires some alternative means of performing the explanatory work traditionally done by such entities. I postpone discussion of these latter issues, however, since they require articulating Descartes's alternative conceptions of substance and essence. In fact, we will not fully grapple with them until the final chapter of this work, wherein we will discover that the Cartesian research program in physics is, like the Aristotelianism it supplanted, untenable in virtue of its ontology (§35-36).

First, however, Descartes's rejection of physical forms demands our attention. This rejection was predicated on at least three distinct philosophical complaints. The first is a charge

of obscurity (e.g., AT 3.500, AT 7.253-255, *PP* 4.198). The second is a charge of explanatory impotence (e.g., AT 2.200, 3.507). The third, and perhaps most intriguing, is an argument that physical formal causation entails panpsychism (AT 7.440-442). I treat these complaints in turn.

The trouble with the obscurity charge is that the charge is itself obscure. At one extreme, the thought is that physical forms are literally incoherent objects, like square-circles. This, however, is not a promising line of attack, as there does not seem to be anything outright contradictory about hylomorphism, at least in outline. Admittedly, specific versions of hylomorphism might entail contradictions, perhaps via invoking notoriously problematic entities like prime matter. Descartes, however, is generally concerned with Aristotelianism in a very broad sense. Usually, his line is that the basic schema of hylomorphism is itself obscure, and at that level, at least, it is difficult to see how outright incoherence is in the offing.

Still, if the obscurity criticism is meant to be anything other than a non-starter, it must be outright incoherence that is at stake. The alternative is weakening the notion of obscurity to something less than incoherence, and that strategy is doomed. The General Theory of Relativity is quite a bit more obscure than the fact that the planets orbit the Sun, but this is very obviously neither here nor there with respect to whether GTR is a good explanation of planetary orbits. The point is even more obvious with respect to the four-dimensional spacetime GTR invokes in offering such an explanation, for surely the topology of a four-dimensional manifold is more obscure to most of us than a planet orbiting a star. This highlights another problem: There is no uniquely correct means of ranking degrees of obscurity. Perhaps some physicists actually find Minkowski spacetime less obscure than an apple falling from a tree. If so, this is just a fact about their idiosyncratic psychology and is irrelevant to whether Minkowski spacetime figures in the

best explanation of the phenomena.[39] In general, there is no reason to think that the explanans must be less obscure than the explanandum, except in the limiting case of incoherence. So, the obscurity objection cuts ice only in that limiting case. Yet, it is precisely in that limiting case that Descartes's charge of obscurity is least convincing.

It should be noted, if only briefly, that there is one further gloss that might be given to the obscurity charge. Sometimes, Descartes and other anti-Aristotelian polemicists seem to mean only that they personally find the notion of a physical form inscrutable (AT 3.367). This, however, is interesting only as intellectual autobiography and rhetoric. I can therefore see no reading on which the obscurity charge is particularly worrying for the hylomorphist.

The criticism regarding explanatory power is more promising. Above (§2), our paradigmatic example of physical formal causation was explaining the greenness of grass and the perception thereof via the form of green. This does have an unmistakable air of vacuity about it. To use one of Descartes's favorite examples (AT 2.485, 3.649-650, 6.236, 7.83, 11.7-8), explaining why the stove is hot in terms of a physical form of heat is pointless, because the entire notion of the form of heat is exhausted by its being the explanation of the relevant phenomena. So conceived, physical forms do not provide an explanation so much as reify the lack of one.[40]

Any Aristotelian reply this charge of explanatory impotence will turn on a detailed articulation of the nature and explanatory role of physical forms. Unfortunately, this makes

[39] It does not. The Minkowski metric is the mathematical structure appropriate to the Special Theory of Relativity. The structure appropriate to GTR is instead a pseudo-Riemannian metric with a Lorentzian signature. Still, spacetime is approximately Minkowskian locally (given the Einstein equivalence principle), and so explanations of local phenomena, such as free-falling fruit, generally treat actual spacetime as if it were Minkowskian.

The fact that this footnote is probably obscure to most non-specialists is, incidentally, my point in a nutshell.

[40] Descartes often puts this criticism more pragmatically – as he did in an open letter to Voetius in May 1643 (AT 8B.26; see also AT 3.492, 6.239, 11.9) –, such that the upshot is that physical forms are simply not needed to explain the relevant phenomena. In that case, the criticism turns on the purported success and parsimonious character of the Cartesian alternative.

evaluating the success of Descartes's criticism a herculean task – much too vast, at any rate, for us to attempt here. The problem is the overwhelming diversity of Aristotelian positions on offer.[41] There is, I think, evidence of the entropy of victory in later Aristotelianism – having largely triumphed over those who disputed the basic tenets of hylomorphism, the Aristotelians were free to indulge in disputes amongst themselves regarding relative minutiae, such as the precise nature and role of the physical form. Whatever its etiology, this diversity makes cataloguing Aristotelian attitudes on such subjects extremely labor-intensive. So, it is understandable that Descartes does not do so, even if, as in the case of the charge of explanatory impotence, this sometimes lends his criticisms an air of superficiality.

Perhaps Descartes's most immediately potent objection to physical forms is that by populating the corporeal realm with them, the Aristotelian populates it with little souls:

> I observed that heaviness and hardness… consist solely in the motions of bodies… and the configuration and situation of their parts. Since these opinions were completely different from those which I had previously held regarding physical things, I began to consider what had led me to take a different view before… in the case of those very things that I supposed to be corporeal, the ideas or concepts which I formed were frequently such as to refer to minds rather than bodies. For example, I conceived of heaviness [*gravitas*] as if it were some sort of real quality, which inhered in solid bodies… I thought that heaviness carried bodies towards the center of the earth as if it had some knowledge of the center within itself. For this surely could not happen without knowledge, and there can be no knowledge except in a mind. (AT 7.440-442)

Call this, *the little souls argument*.[42] The crucial attack relates to the directedness of corporeal activity. Suppose a flyball is falling into a centerfielder's glove. The Aristotelian says that this occurs because a physical form of heaviness is inhering in the baseball. Suppose this is so. Why, then, does the baseball move in the direction that it does? Presumably, because the form of

[41] The 10th, 24th, and 25th chapters of Pasnau (2011) are a good introduction to this diversity, as is the more recent but more narrowly focused discussion of Hattab (2019).
[42] Malebranche (*D* 7, 110-111) gives a pointed version of this argument. For a defense of the Aristotelians against it, see Des Chene (1996, ch. 6). For a contemporary analogue, see Mumford (1999, 221). For a study with an eye on both historical and contemporary concerns, see Ott (2021), (2022).

heaviness determines it to move thus and so. But how does the form of heaviness determine that it should fall into the fielder's glove rather than into the stands? Descartes argues that the physical form must be flying the baseball much as a pilot flies an airplane, but that this cannot be so unless the physical form, like the pilot, is capable of intentional action. But that is clearly intolerable.[43] For one thing, it seemingly implies an especially virulent strain of panpsychism according to which every heavy body literally knows where the earth is and aims at it. Even if one refuses to admit that intentionality implies mentality, there is still the problem of how the directedness of causal activity is to be explained.[44] It is not easy to offer such an explanation that would be both plausible and friendly to Aristotelianism. And, unlike the criticism relating to explanatory power, the little souls argument is not straightforwardly stymied by Aristotelian diversity. This is because it argues from a paradigmatic function of physical forms – a basic tenet of Aristotelianism in its myriad forms – to the claim that physical forms must be understood in a clearly unacceptable way, and so targets Aristotelianism writ large.

Descartes himself requires a response to the concerns animating the little souls argument, of course. He, no less than the Aristotelian, must explain how it is that the baseball winds up aiming at the centerfielder's glove. As I argue below (§26, §31), Cartesian physics is best understood in occasionalist terms. So, Descartes thinks that the baseball is, in fact, aimed at the

[43] Perhaps the clearest early modern dissenter from this verdict is Margaret Cavendish in her *Observations upon Experimental Philosophy*. Indeed, what for Descartes is a *modus tollens* is for her a *modus ponens*. Descartes infers from the directedness of corporeal activity that bodies themselves cannot be responsible, since this would imply some level of awareness on the part of bodies. Cavendish, conversely, infers from the directedness of corporeal activity that bodies *do* have some rudimentary awareness, since otherwise bodies would be impotent. The dispute probably turns on whether the total impotence of bodies or a rudimentary variety of panpsychism is the more unpalatable hypothesis. On Cavendish's metaphysics, see the study of Detlefsen (2007). The Cavendish-Descartes dispute should, by the by, be of renewed interest, given recent interest in panpsychism among contemporary metaphysicians, on which see Goff et. al. (2021) and the sources cited therein.

[44] Ott (2022) associates this with contemporary responses to the problem of physical intentionality, such as those of Place (1999, 231) and Molnar (2003, 70-71). This is association is apt, but the basic argumentative strategy is, of course, far older. Consider the following from Aquinas (*PN* 3.20-24): "And we should know that, although everything that acts… tends toward an end, nevertheless it does not follow that everything that acts cognizes the end or deliberates about the end."

fielder's glove by the intentional action of a rational agent, namely God. Opponents of the occasionalist interpretation of Cartesian physics will instead have recourse to the regularities enforced by the laws of motion and the directedness of the initial act of divine creation, but they still must make sense of the directedness of whatever causal activity they attribute to Cartesian bodies. This highlights that the little souls argument is not just an argument against physical forms; it is an argument against corporeal causal powers. That Descartes gives such an argument is therefore some evidence against attributing to him a view that involves such powers.

Such were Descartes's criticisms of physical forms. They are of varying philosophical merit and interest, but, in any case, his rejection of physical forms is obvious and consistent, and, for the purposes of articulating Cartesian formal causation, that is the main point. Let us, therefore, turn our attention to the less clear-cut metaphysical and logical formal causation.

9. Metaphysical and logical formal causation

On the subject of metaphysical formal causation, there is much common ground between Descartes and the Aristotelians, and this consonance is entirely self-conscious on Descartes's part. Indeed, Descartes just cites Aristotle in defending his conception of formal causation:

> In taking the whole essence of a thing to be its formal cause in this context, I am simply following the footsteps of Aristotle. For in the *Posterior Analytics*, Book 2, Chapter 11, Aristotle passes over the material cause, and calls the first kind of *aitia*, or cause, *to ti en einai* or the formal cause [*causam formalem*] as it is typically rendered in philosophical Latin. (AT 7.242; the citation of Aristotle is to *APo.* 94a20-21)

Descartes takes his understanding to "follow in the footsteps" of Aristotle's official definition of formal causation as explanation from essence. Cartesian formal causation is therefore surely a species of metaphysical formal causation. Importantly, however, this does not mean that there is complete agreement between Descartes and the Aristotelians regarding metaphysical formal causality. There is not and cannot be. At least since Aquinas (§3), the distinction between

metaphysical and physical forms had been associated with the indistinct reference to matter in the former, but Cartesian metaphysics precludes this understanding of the metaphysical form. Descartes, of course, has no need to appeal to matter to distinguish metaphysical from physical forms as Aquinas had done, since on his view there are no such things. More importantly, he cannot allow materiality to be linked with essentiality, since Cartesian matter is itself a substance with a particular essence. So, while Descartes and later Aristotelians agree regarding the characterization of metaphysical formal causation, they disagree about the characterization of the metaphysical form; they agree that metaphysical formal causation is explanation from essence but not about what essences are like. In the next section, therefore, we will deal more fully with the Cartesian conception of essence.

Before doing so, however, let us consider the logical form. As we have seen, this notion was associated with the genus-species structure of Aristotelian science. Obviously, however, Descartes's own conception of philosophical science is quite different, most obviously and influentially through an emphasis on quantitative laws of nature.[45] So, while the ideal of Aristotelian science consisted of relating the essences of higher and lower kinds via differentiae or logical forms, Cartesian science characteristically subsumes particular phenomena under general kinematic laws (*PP* 2.45-53). Since this is so, one would expect logical formal causation to be central to Aristotelian but not Cartesian science. In other words, since Cartesian science is not centrally concerned with differentiating species, the logical form is robbed of its *raison d'etre*. Small wonder, then, if Descartes ignores the notion.

[45] More on this below §12-17. For a study of the Cartesian laws of nature and their subsequent influence, see Ott (2009). For detailed studies of Cartesian physics and related philosophical issues, see Shea (1991), Garber (1992), Des Chene (1996), Gaukroger (2002), and Slowik (2002). On Descartes's earlier scientific work, see especially Schuster (2013). For an argument for the centrality of Descartes to the rise of nomological explanation in science, see Milton (1998); for criticism, see Lehoux (2006). For a study of the Cartesian laws with an eye on related theological concerns, see Osler (1985).

Actually, however, this is only partly true. Trivially, of course, one can cast Cartesian ontology into a genus-species structure if one wishes to do so. For example, the celestial matter of cosmological vortices is distinguished by Descartes from other types of matter via its characteristic geometrical properties (*PP* 3.52). So, one could say that celestial matter is a species of the material genus, a species distinguished via properties characteristic of celestial matter but not of matter *simpliciter*. In other words, one could speak of the logical form of celestial matter, and so also for all other types of Cartesian matter.[46]

Even so, however, it is probably correct to say that the logical form is absent from Cartesianism, or, at least, has atrophied to the brink of non-existence. Importantly, Descartes shows no awareness of the problems of arbitrariness which the logical form is employed to solve in the *Disputationes Metaphysicae*. This is unsurprising, given that Descartes's intellectualism defangs such problems. Descartes thinks that we have direct intellectual access to the real natures of things via innate ideas, the reliability of which is ensured by divine trustworthiness. So, it is not as though two ideal Cartesian inquirers would disagree about essences, because God has given such inquirers the correct innate ideas and a reliable intellectual faculty.

Matters are less straightforward for the empiricist, and this is a point Descartes could be expected to cite against them. The empiricist's problem is that there seems to be no reason to think that an empirical investigation will yield the uniquely correct set of kinds and essences within any given domain. On the contrary, it seems likely that two scientists could both do nothing wrong yet end up with competing, empirically adequate accounts, of which, at best, only one will be correct. It is trivial to supply such parallel accounts. For instance, one could imagine a dispute about whether some kind belongs to some genus or whether it is the sole member of a

[46] A helpful study of the Cartesian elemental theory is Lynes (1982). On celestial matter and its role in Cartesian cosmology, see the studies of Aiton (1972) and Gaukroger (2000), (2002, 135-160).

sufficiently similar, distinct genus; the question of whether viruses are alive provides just such a case in ecology. Such parallel theories do not disagree about any observable, nor do either flounder in terms of explanatory adequacy. How, then, are we to know that we have cut reality at the joints? This is a difficult problem. Indeed, it is possible to motivate the Lockean distinction between nominal and real essences along such lines (*EHU* 3.3.15-19). Locke's contention that we must content ourselves with the nominal essences of corporeal substances in natural philosophy constitutes a response to the problem, since empirical science no longer deals in the uniquely correct essences of corporeal substances (*EHU* 3.6.12-20). Or, less sympathetically, it is a skeptical admission of defeat, yet, even if so, it is difficult to see how Locke could avoid it. More generally, such epistemological difficulties are one source of pressure buoying the rise of nominalism among early modern – and contemporary – empiricists.[47]

Cartesian real essentialism faces no such pressure, because at the ground floor of Cartesianism are essences perceived intellectually rather than empirically. Furthermore, since Cartesian formal causal explanations are explanations from essence, they too are intellectually rather than empirically grounded. Consequently, insofar as Cartesian physics hangs on such explanations, it is an intellectual rather than an empirical science.

In any case, the main point at this juncture is that Descartes always defines formal causation in terms of the metaphysical form, or essence, and shows little awareness of either the logical form or the difficulties it was typically employed to solve. And understandably so, given

[47] I suspect that Aristotle can extricate himself from this problem via his direct perceptual realism. The idea is that two ideal inquirers will not ultimately disagree because perception is of the very form instantiated in the perceived object. The fly in the ointment is Aristotle's contention in *De Anima* and *De Sensu* that the forms corresponding to the higher order essences are coincidental perceptibles that are not literally perceived, but against this must be set Aristotle's own examples of what is perceived and winds up in the soul in *Posterior Analytics* 2.19; see §2, fn. 13. Even if I am right and this solution is workable, however, it is of no use to modern empiricists, who pretty uniformly reject Aristotle's direct realism. As for the Cartesian theory of perception and rejection of Aristotelian direct realism, see Ott (2017). Again, however, Descartes's intellectualism insulates him from the epistemological difficulty at hand, and so his rejection of direct realism is in that respect harmless.

that Descartes's intellectualism largely insulates him from such problems. Accordingly, I set the logical form aside.

Descartes's negative reaction to scholastic formal causation can thus be summed up as follows. First, he rejects physical formal causation within the corporeal domain. Second, he shows little interest in either the logical form or the difficulties it is meant to solve. Third and finally, while he endorses metaphysical formal causation, he cannot endorse the characterization of the metaphysical form favored by Aquinas and Suárez. Nevertheless, this contrast should not be overstated. Descartes can be rightly said to have preserved – even restored to its original prominence – the Aristotelian notion of metaphysical formal causation, even as he derisively dismissed Aristotelian physical forms. Strikingly, insofar as explanation from essence is the official understanding of formal causation in Aristotle's own writings, Descartes is more faithful to Aristotle on this point than his Aristotelian opponents.

10. Formal causation and Cartesian metaphysics

At this point, we have established that Cartesian formal causation is best understood as a species of metaphysical formal causation, or explanation from essence. This is an important continuity with Aristotelianism, but we have also seen that Descartes cannot endorse the analysis of metaphysical form – or essence – favored by Aquinas and Suárez, owing to the involvement of materiality in the latter. This discontinuity arises from the Cartesian conceptions of essence and materiality, which differ markedly from their Aristotelian correlates. These conceptions are themselves related to the basic Cartesian ontological categories of substance, mode, and attribute. All these aspects of Cartesian metaphysics thus require our attention.

Recall (§1) that our working conception of essence is in terms of properties that are (i) modally necessary and (ii) explanatorily basic. We have already seen that this understanding is

an apt characterization of Aristotelian essences, and the same is true of their Cartesian counterparts. Illustratively, Descartes writes that he understands "nothing without which something can exist to be included in its essence" (AT 7.219). In other words, essential properties are modally necessary properties. And, as noted above (§1), Descartes's endorsement of condition (ii) is evinced by his distinguishing essential properties from merely modally necessary properties. Perhaps the clearest instance of this distinction is Descartes's contention – in reply to Henry More – that impenetrability is a modally necessary but non-essential property of matter, since impenetrability follows from (and therefore is not even partly constitutive of) the material essence (AT 5.342). So, Descartes's basic notion of essence conforms to our established understanding in terms of modally necessary and explanatorily basic properties.

How, then, does this basic notion of essentiality relate to Cartesian ontology, specifically the fundamental categories of substance, attribute, and mode? How, indeed, does Descartes understand those categories?

The Cartesian understanding of substance contains two distinct strands, though both are attempts at capturing the intuitive notion of ontological fundamentality. The first is *existential independence* – a substance depends on nothing else to exist (AT 7.226). Strictly, existential independence implies monism, since, as Spinoza later emphasized (E1p14), God alone is existentially independent. Descartes's solution, if it can be called that, is to speak of created substances as those things which depend only on God for their existence (*PP* 1.51-52; AT 7.14).[48] The second strand is that a substance is that in which properties inhere but which does not itself inhere in anything else (AT 7.161). This is reminiscent of the Aristotelian identification

[48] The most philosophically satisfying rendering of the contrast between Descartes's dualism and Spinoza's monism is that of Bennett (1965), though he accomplishes this only by reconceptualizing the question at issue. For my part, I suspect that the core notion of substance for Descartes is just that of an irreducible, ontologically basic thing and that what I term the "two strands" in the Cartesian notion are simply useful ways of fleshing this out in certain contexts.

of substances with the ultimate subjects of predication (*Cat.* 2a13-15). Whether these two strands pick out coextensive sets is a good question, but Descartes must be thinking that they do.[49]

Modes, by contrast, have less reality than substances (AT 7.165, 7.185). This is naturally taken in terms of existential dependence – substances can exist without any particular mode, but a mode cannot exist without the corresponding substance. It may also be taken in terms of predication, since we may say of a substance that it exemplifies a mode but not vice-versa.

What about attributes? Probably the most helpful passage in deciphering this Cartesian category is the following:

> But we employ the term *mode* when we are thinking of a substance as being affected or modified… when we are simply thinking in a more general way of what is in a substance, we use the term *attribute*. Hence we do not, strictly speaking, say that there are modes… in God, but simply attributes, since in the case of God any variation is unintelligible. And even in the case of created things, that which they never have in another way – for example existence or duration in a thing which exists and endures – should be called not a… mode but an attribute. (*PP* 1.56)

One key upshot of this passage, which Descartes stresses more fully in *Comments on a Certain Broadsheet* (AT 8B.347-351), is that it is a mistake to equate modes and attributes. To use a mathematical metaphor, modes are the values which an attribute happens to have.[50] For example, shape is an attribute of corporeal substance, while a spherical shape is a mode. Further, corporeal substances cannot cease to have a shape without ceasing to exist, whereas they can exist without being spherical. The cash-value of all this is that a substance does not change in terms of its

[49] For further discussion of this tension in the Cartesian notion of substance, see Secada (2000a, pp. 183-204), Bennett (2001, 133-135), and Pasnau (2011, 135-158). Pasnau (2011, 102-108) also provides a succinct but instructive account of the scholastic roots of the tension.

[50] This way of cashing out the distinction assumes that there cannot be a mode without a corresponding attribute. This assumption is natural; it is also apparently vouchsafed by Descartes contention, quoted in the next paragraph, that all the properties of a substances may be referred to its principal attribute. Nevertheless, the assumption is substantive. It commits the Cartesian to denying, for example, that a thing can both have a specific depth and be capable of existing without depth, but this is hardly obvious.

attributes but only in terms of its modes. Somewhat unfortunately from a terminological perspective, this means that attributes – but not modes – deal in modally necessary properties.

Since this is so, we should expect to find essences under the category of attribute rather than mode. And, indeed, that is what we find: "the extension itself – the subject of these modes – is not a mode of the corporeal substance, but an attribute which constitutes its natural essence" (AT 8B.348-349). The essence of a substance is its principal attribute, for "each substance has one principal property which constitutes is nature and essence, and to which all its other properties are referred [*ad quam aliae omnes referuntur*]" (*PP* 1.53). Essences, *qua* attributes, are thus modally necessary. Descartes distinguishes essences from other attributes by saying that the other properties of a substance are "referred to" the principal attribute. This is an appeal to explanatory basicness. So, again, we find Descartes understanding essentiality in terms of modal necessity and explanatory basicness – in terms of conditions (i) and (ii).

Notably, this metaphysical machinery further illuminates what, precisely, is wrong with the supposition that God is his own efficient cause, the thesis discussed above (§6) in introducing Cartesian formal causation. We now know that it is characteristic of Cartesian metaphysics that substances are existentially independent of their modes. Let *S* be any substance and *M* be any possible mode of *S*. If so, then *S* is existentially independent of *M* because, possibly, *S* exists and *M* does not exist. Conversely, *M* is existentially dependent on *S* because, necessarily, if *M* exists, then *S* exists. Descartes and Arnauld are after an explanation of God's necessary existence. So, let *S* be God and *M* be any exercise of his creative power. Then, possibly, God exists and no exercise of his creative power exists. In other words, God could and would exist even were he eternally idle. This means that the fact that God's necessary existence cannot be explained by God *qua* efficient cause is just a special case of the more general fact that necessary

properties of a substance cannot be explained by modes of that very substance, since modes are by definition contingent rather than necessary. To explain necessary properties of a substance, one should instead look to its attributes, which is precisely what Descartes does in appealing to formal causation, or explanation from principal attribute. This also reveals that taking the formal causal explanation of God's necessary existence as an explanation from the exercise of God's power amounts to a category mistake.

Furthermore, that "all… other properties" of a substance "are referred" to the essence of that substance suggests that Cartesian metaphysics is shot through with formal causation of the kind explicitly appealed to in the context of the ontological argument. After all, whatever precisely is meant by "are referred to" surely has explanatory import, and so all the properties of a substance are at least partly explicable in terms of the essence of that substance.[51] So, all properties of a substance are subject to formal causal explanation. This is an important result, and one at odds with the dearth of discussions of Cartesian formal causation in the secondary literature.

Of course, none of this precludes an important role for efficient causation within Cartesianism.[52] Nor does it mean that the formal causal explanations to which all properties of a substance are subject are particularly interesting. Crucially, formal causation does not appear to explain why a substance has the modes that it does. For example, formal causation explains that a material object has some shape, but this is consistent with formal causation being irrelevant to

[51] A more literal translation of the relevant passage is "to which all others are carried back." One possible gloss is that all the properties of a substance are grounded in its essence. So, for example, that matter has depth is grounded in the fact that matter is essentially extended. And so on.

[52] Perhaps *pace* Flage and Bonnen (1997, 842), who write that "apart from God's action in creating and sustaining the world and acts of human will, all Cartesian causes are formal." This is too strong. Or, rather, it is too quick, since the conclusion follows on the assumption of occasionalism. If Descartes was an occasionalist in the corporeal domain, as I shall argue he was, then Flage and Bonnen are correct, but only because "apart from God's action in creating and sustaining the world" is just another way of saying "apart from all efficient causes relevant to physics." This gloss robs the thesis of its shock value if not its importance. More on Flage and Bonnen below (§17).

the explanation of why it has the specific shape that it does. In other words, formal causation clearly explains why matter has certain attributes (e.g., shape), but this is consistent with it playing no further role in explaining material modes (e.g., sphericality). But if formal causation does not figure at all in explanations of specific modes, then formal causation's relevance to Cartesian physics is restricted to such trivialities as that all material objects must have some size. Thus, the importance of formal causation to Cartesian physics is debatable.[53] One extremely interesting possibility is that formal causation could ground restrictions on the range of possible modes an object can exemplify under given conditions. This, in turn, would explain why certain physical regularities obtain: It would explain why bodies take on predictable classes of modes under given circumstances. This is highly suggestive of explanation from scientific law, and indeed I shall argue below that Cartesian nomological explanations are best understood in this way, as formal casual explanations from essence (§16).

To return, however, to the matter at hand, we have so far established that Cartesian essences are modally necessary and explanatorily basic attributes and characterized Cartesian substances as the existentially independent ultimate subjects of predication. What is now wanted, therefore, is some accounting of the relationship between substances and their essences.

The most salient feature of the relationship between a Cartesian substance and its essence is that they are merely conceptually distinct (*PP* 1.62, 2.8-12). That is, the distinction between a substance and its essence consists simply in how we think about the same underlying thing, a thesis not dissimilar from the scholastic contrast between the *per se* unity of the physical form and the protean logical form. Now, the essence of Cartesian matter is extension. This means that

[53] Illustratively, Schmaltz (2008a, 60-61) confines his discussion of formal causation in Descartes to such trivialities as "this extended thing has some shape or other" and so finds Cartesian formal causation largely uninteresting. That he does find it uninteresting is evinced by the brevity of his discussion.

the merely conceptual distinction between substance and essence implies an identification of geometrical and material objects. That is, Cartesian material objects just are geometrical objects, because both material and geometrical objects have all and only those properties characteristic of extended objects, namely size, shape, and movement (e.g., AT 7.71, 7.78; *PP* 1.53, 2.10-12). In this way, Cartesianism obviates the distinction between the mathematical and the material.

Consequently (and jarringly), the Cartesian universe does not contain anything that the Aristotelian would recognize as matter. Aristotelian prime matter was conceived as the pure potentiality underlying basic, simple substances. The Cartesian universe is devoid of any such entity (AT 11.35-36). More generally, Aristotelians linked materiality with potentiality. This, too, Descartes rejects. In its place, he substitutes merely extended substance, which he readily admits is not really distinct from the associated essence of extension. To express the point in our usual idiom, Cartesian matter is identified with a particular metaphysical form. This would have been unthinkable to our Aristotelians, and their concerns are not entirely misplaced. The identification of materiality with geometry threatens a family of ontological difficulties, some of which I discuss below (§33-36). The Aristotelian diagnosis of the problem would be that the Cartesian universe is constituted by metaphysical form but is devoid of matter that is informed; more neutrally, the root problem is that Descartes identifies matter with geometry despite there being nothing in the Cartesian universe to exhibit geometrical structure. In slogan form, the problem is that there is structure without stuff that is structured.[54]

[54] Perhaps the most natural suggestion on Descartes's behalf is that space itself exhibits geometrical structure. I suspect this suggestion illicitly relies on the intuition that space is a container in which matter exists. But this is Newton's view, not Descartes's; in fact, Cartesian space is merely conceptually distinct from matter and thus from the metaphysical form of extension (*PP* 2.10-11). So, space does not furnish the Cartesian with a distinct entity but with another way of conceiving of the same underlying thing. Below (§35-36), I build on this fact and an argument from Leibniz to show that the supposition that Cartesian space exhibits particular structures is unworkable.

In one respect, then, Descartes heralds the rising mathematical paradigm of physical science. However, from another perspective, Cartesian ontology is a radical rejection of materiality, which should caution against any reading of Descartes which too quickly emphasizes his place in the rise of materialistic science.[55] Indeed, much of the enduring philosophical interest of the Cartesian position comes from its purity, taking as it does the ideal of mathematical physics to its utmost extreme. Cartesianism is a sustained attempt to obviate the distinction between the material and the mathematical, and so in studying it there is much to learn about advantages gained and difficulties engendered by such an ontology. And such ontologies are by no means relegated to the dustbin of history, as the recent rise of ontic structural realism attests.[56]

Let us pause here to take stock. Thus far, the main upshots of this chapter are fourfold. The first is simply that there is a Cartesian notion of formal causation, as established by his appeal to that notion in defense of the ontological argument. The second is that this notion is continuous with its Aristotelian predecessors. Indeed, it is not inaccurate to characterize Cartesian formal causation as an austere reconceptualization of the Aristotelian formal cause in terms of metaphysical formal causation alone. But, third, the Cartesian notion is also importantly discontinuous with its Aristotelian counterparts. Most obviously, Descartes's emphatic rejection of hylomorphism and physical forms entails an equally decisive rejection of physical formal causation. Just as importantly, Descartes understands materiality in terms of geometry rather than potentiality, and so his notion of metaphysical form necessarily differs from that of Aquinas and Suárez. Fourth and finally, the Cartesian notion, while undeniably attested, is of debatable scientific interest, depending on its utility in explanations of particular bodily modes. If,

[55] Such readings are not uncommon. Clarke (1982) is an enthusiastic example, and the underlying impulse is detectable even in more sober studies like Gaukroger (1995).
[56] See *Every Thing Must Go* by Ladyman et. al. (2007). By way of postscript, I suggest that Descartes is the ancestor of this view and hint that some of the problems with Cartesian ontology have propagated down to its descendant.

however, formal causation is interpretively and philosophically fruitful, as I think it is, then we may expect to make significant headway on issues that have stymied scholars who have neglected it. Before turning to such fruitful applications, however, it will be useful to deal with the natural objection that Cartesian formal causation is a peripheral notion that should not be applied outside its immediate context of the ontological argument. Let us, therefore, put our shoulders to the wheel.

11. The argument for peripherality

Cartesian formal causation is both clearly attested in the corpus and of potentially wide application. Why, then, has it not attracted more scholarly attention? Part of the problem is surely that while the evidence is clear-cut, it is also thin on the ground. This suggests an argument for peripherality. Here is how it might go: Descartes explicitly speaks of formal causation only in a desperate attempt to save the central but otherwise doomed ontological argument; therefore, the notion is peripheral, *ad hoc*, and best ignored outside its immediate context. Moreover, it is surely telling that, in the *Principles*, Descartes does not invoke formal causation at all.

This argument is not convincing. An immediate problem with it is that it ignores the weightiness of Descartes's explicit discussion of formal causation. That discussion could hardly be weightier. It is in the *Objections and Replies*, which (along with the *Meditations* proper) surely represents Descartes's mature metaphysical views as well as any text. Descartes's correspondence is replete with careful revisions to and discussions of it, evidence of his taking care to present his views in exactly the correct light within it.[57] The importance of the text in Descartes's own mind is also clearly attested in the *Preface to the Reader* (AT 7.10). And, for

[57] The letter to Mersenne of 21 January 1641 (AT 3.282-285) is illustrative in this regard. As, indeed, is much of the philosophical correspondence of this period, beginning and ending roughly with letters to Mersenne on 31 December 1640 (AT 3.271-276) and 17 November 1641 (AT 3.448-450).

good measure, Descartes also stresses its importance in the *Synopsis* (AT 7.14). It is therefore irrefutably rash to write off an entire causal notion as peripheral just because Descartes explicitly mentions it only in the *Objections and Replies*. This is especially so given that his interlocutor in the relevant passage is not an empiricist like Gassendi or Hobbes, towards whom he could be curt and dismissive, but Arnauld, whom Descartes respected both personally and intellectually. That the argument he is defending is of central importance to his entire project in the *Meditations* is also, of course, relevant. So, again, one could hardly hope for a weightier discussion within the Cartesian corpus.

This alone, I think, defangs any straightforward argument that formal causation is a peripheral notion. To this could be added that Descartes is likely loath to talk of formal causes explicitly because he is at pains to distance himself from Aristotelian physical forms, which as we have seen Descartes does emphatically reject in physics. This point would perhaps have been of special importance to him in the *Principles of Philosophy*, which was intended as something near a textbook.[58] After all, it would hardly do to invite confusion about his views with loose talk of formal causes in such a text, given the inevitable and profoundly unpalatable connotations such talk would have for his intended audience.

Indeed, I argue below that the notion of formal causation is central to understanding the *Principles* despite the fact that it is not explicitly mentioned within it. For example, I argue in the next chapter that while Descartes could not help but identify the laws of motion as secondary causes, he elects to simply identify explanations from the laws as causal and as flowing from the divine essence, thereby presenting the substance of his view that nomological explanations involve formal causality while avoiding any potentially misleading talk of form (§16). The point

[58] An especially clear indication of this can be consulted at AT 8.577. For further details, see the thorough discussion of Gaukroger (2002), 32-63.

is that, rhetorically, the best strategy may have been to appeal to formal causation without pointing out that this is what is being done. So, while using the less prominent notion of cause without explicitly identifying it as such strikes the contemporary reader as obscurantist, Descartes could reasonably have taken the contrary view. Given his audience and his aims, explicit talk of formal causation would probably have invited more confusion than it avoided.

In any case, the interpretive and philosophical utility of understanding Descartes to implicitly appeal to formal causation speaks for itself, and so it is to such fruitful applications that I now turn.

Chapter 3

The Laws of Nature

Précis

We have seen that Cartesian formal causation is explanation from essence, where essences are understood in terms of modal necessity, explanatory basicness, and as principal attributes that are merely conceptually distinct from the substances so-defined. The main lingering question, at this point, is whether or not such explanations are important or trivial within Cartesian physics and corporeal metaphysics. The best argument for the importance of Cartesian formal causation would be its fruitful application in those contexts. The task before us is therefore to put the explanatory notion we have worked so hard to uncover to work. The general argument of this and subsequent chapters is that implicit appeals to formal causation illuminate otherwise intractable issues, and that this constitutes good evidence that Descartes is making those appeals. This is not to say that formal causation is a panacea for the all the ills of Cartesianism. Far from it: Sometimes, formal causation is illuminating because it clarifies what is going wrong.

I begin, however, with a more positive case: nomological explanation. In his canonical discussion of the laws of nature in the *Principles of Philosophy*, Descartes holds the laws to be causes, such that nomological explanation is causal explanation. This looks like a simple category mistake: Whatever they are, the Cartesian laws surely are not the right sort of entity to do causal work. How, then, can Descartes so confidently affirm that they are? I argue that Descartes does not mean to attribute causal activity to the laws. Instead, he means to say that explanations from the laws of nature are explanations from essence. The laws of nature are thus causes in the same way that God is *causa sui*: Nomological explanations are formal causal explanations. In particular, I argue that the Cartesian laws are true propositions – or facts – that are true in virtue of certain essential properties, paradigmatically of God, and that nomological explanation occurs when these truths are used to explain particular events.

12. A category mistake

Above (§9), we cited a scientific paradigm shift in explaining Descartes's disinterest in the logical form. In brief, this was a shift from the Aristotelian project of establishing a hierarchy of genus and species to the Cartesian scientist's occupation of subsuming phenomena under general kinematic laws. In so doing, however, Descartes incurs a new explanatory burden: He must provide an account both of what the laws are and of the nature of nomological explanation in physics. In this section, I raise a *prima facie* objection according to which Descartes cannot give satisfactory answers to these questions. This objection is that while Descartes's answer to how the laws play their explanatory role – the laws are causes – gives the appearance of clarity, it also frustrates the attempt to fit the laws into Cartesian ontology. Several approaches to this problem are on offer in the literature, each associated with positions in two related disputes. The first of these disputes concerns Descartes's occasionalism. The second concerns whether Descartes conceives of the laws as a top-down imposition from God or as resulting, in a bottom-up fashion, from the exercise of corporeal causal powers. We shall examine each of these proposals in subsequent sections, before showing that understanding Cartesian nomological explanation as formal causation is a far more attractive solution.

Let us begin by getting some key text on the table. The crucial passage relating to the causal role of the laws is the following:

> [After considering the] nature of motion, we must look at is cause. This is in fact twofold: first, there is the universal and primary cause – the general cause of all the motions in the world; and second there is the particular cause which produces in an individual piece of matter some motion which it previously lacked. Now as far as the general cause is concerned, it seems clear to me that this is none other than God himself. In the beginning he created matter, along with its motion and rest… From God's immutability we can also know certain rules or laws of nature, which are the secondary and particular causes of the various motions we see in particular bodies (*PP* 2.36-37).

What we have here is, first, a division of labor between primary and secondary causes. This is scholastic jargon.[59] From context, however, it is clear that Descartes wields it to solve a particular problem, namely the need to explain the diversity in the creation of an immutable God. God's role as primary cause of motion is clearly his eternal creative act, and this raises the problem of how to square an immutable creator with the diachronic diversity of his creation. Descartes aims to solve this problem via the invocation of secondary causes. Secondary causes, in Descartes's usage, are thus whatever accounts for the diversity of creation without sinning against divine immutability. While the scholastics would have identified the powers of bodies as fulfilling this role, Descartes instead points to the laws of nature.

This response is not immediately satisfying, since the laws themselves are just as unchanging as God's creative act. Descartes must therefore be thinking that the initial conditions of the universe were diverse and that these initial conditions together with the laws jointly ensures diversity over time. As Descartes puts it, "God preserves the world by the selfsame action and in accordance with the selfsame laws as when he created it, [but] the motion which he preserves is not something permanently fixed in given pieces of matter" (*PP* 2.42). So, the creator's immutability is rendered consistent with the diversity of his creation via the secondary causes of motion, namely the laws, which cause diverse motions to emerge over time despite the constancy of God's creative act *qua* primary cause.

What, then, are the laws themselves? And how do they accomplish their task as secondary causes? Clearly, the laws can explain particulars – when one asks for an explanation of the behavior of a particular body, the Cartesian scientist characteristically provides a

[59] For other treatments of this issue in Descartes, see Hattab (2000), Ott (2009, 52-56), and Schmaltz (2011). Important *loci classici* for the scholastic distinction include the discussions of Aquinas (*SCG* 3.67; *ST* I q105 a5), though he is animated more by concern that creaturely causes appear superfluous than by what concerns Descartes, namely the tension between divine immutability and the evident diversity of his creation over time.

nomological explanation. Now, since the laws are secondary causes, they obviously must enjoy an ontological status consistent with causality. The question, then, is how to render consistent the laws' ontological status with their explanatory function. The precisification of the causality of the laws is thus of paramount importance.

As we know, Cartesianism furnishes two options for how to proceed here: efficient and formal causation. We have also already seen that God's role as primary cause of motion is best understood as efficient causality, since this role amounts to his eternal creative act (§5). Perhaps, then, the laws should be understood in terms of efficient causation as well.

So, suppose that the laws of motion are secondary *efficient* causes. This is to suppose an answer to the question of the explanatory role of the laws: Nomological explanation is explanation from causal activity. On this supposition, what sense can be made of the ontological status of the laws? Not much – attributing causal activity to the laws is just a category mistake. To see this, consider the following simple example. Suppose a scientist ignites a Bunsen burner, heating an enclosed quantity of hydrogen gas. Several features of this scenario plausibly do causal work: the fire, the hydrogen molecules, the scientist, and so on. It would, however, be ridiculous to suggest that among these causal actors is Boyle's law itself: Boyle's law is not lying-in wait to act on hydrogen molecules to ensure a proper ratio between temperature and pressure. Simply put, the laws are of the wrong ontological type to do causal work.[60]

One dissenting voice, however, bears mentioning. In two intriguing papers, Helen Hattab (2000; 2007) argues that the laws themselves are genuinely causal. While admitting that God, not

[60] This is also apparently the verdict among contemporary metaphysicians. The contemporary literature furnishes a plethora of positions, running the gamut from the neo-Humean best systems analysis of Lewis (1973) to the universals-grounded realism of Armstrong (1983); Carroll (2020) provides a good overview. Significantly, one proposal that is not seriously entertained within this literature is that the laws are causally active. I suspect this is because the proposal entails the category mistake just outlined.

the laws, is the ultimate source of the relevant causal activity, Hattab (2000, 111) points out that this need not imply that the laws are not secondary causes, as "secondary causes need not be the ultimate sources of the forces that cause an effect." Even so, our initial difficulty remains. It is one thing to claim, as Hattab (2007, 64) does, that Descartes takes the laws "to function in an analogous manner to the forms [to] which the Jesuits" appealed; it is quite another to render this position comprehensible.

To see whether it is comprehensible requires clarifying the ontological status of laws. Hattab (2007, 67; 2000, 116) is somewhat cagey on this point, remarking that the laws "arise from a combination of the basic structure of matter and God's immutable will" and that they are not substances. Assume this is so. Still, it remains mysterious how such non-substantial entities could serve as causes, as Hattab (2007, 76) herself almost acknowledges: "It is still an open question whether Descartes could accord some secondary *activity* [emphasis mine] to the laws" of motion. The difficulty is still that non-substantial entities grounded in the divine will and nature of bodies cannot *act* on bodies, even in an attenuated sense; they cannot contact anything, nor can they act via their non-existent will. So, the laws cannot be efficient causes, even in an attenuated (e.g., an instrumental) sense.

Since understanding the laws as efficient causes is a category mistake, the proposal that the laws are efficient causes is a non-starter. However, this does not necessarily defeat the proposal that the secondary causality of the laws be understood via efficient causality. Rather, it suggests that the laws must be shorthand for some other more appropriate entity. In which case, the pressing question is: Shorthand for what?

How one answers this question is a function of where one stands on two related disputes. The first dispute concerns the extent to which Cartesian bodies are endowed with causal powers.

One prominent reading interprets Descartes as an occasionalist according to whom God is the only genuine cause.[61] Opposed to this view are a variety of readings according to which God concurs with the powers of bodies.[62] Recently, Tad Schmaltz (2008a) has offered yet another interpretation, according to which Descartes thinks that God's role is limited to conserving bodies and their powers. These positions neatly map into two camps: Those that hold bodies have causal powers and those that do not. These rival camps naturally suggest different articulations of the laws. Following Ott (2009, 5-6), we can distinguish between top-down and bottom-up conceptions. According to the former, laws literally govern events; in the Cartesian context, this is naturally taken in terms of divine activity, and so the top-down analysis of the laws harmonizes with the occasionalist interpretation of Cartesian physics. The alternative is taking the laws to supervene somehow on particular matters of fact. It is quite natural to understand this in terms of corporeal causal powers, and so concurrentist and conservationist readings suggest a bottom-up analysis of the laws.

What we have, then, are two natural positions that share the assumption that the causality of the laws is to be understood as efficient causation. The first denies that bodies have causal powers and understands the laws as shorthand for divine volitions – top-down occasionalism. The second holds that bodies have causal powers and understands the laws in terms of those powers – bottom-up concurrentism and conservationism. The task of the next three sections is to interrogate these positions regarding the ontological status and explanatory role of the laws. I begin with the concurrentist interpretation.

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[61] Proponents of this reading include Hatfield (1979), Garber (1993), and Ott (2009). Note that, here and throughout, the occasionalism attributed to Descartes concerns the corporeal domain only.

[62] Proponents of this reading include Della Rocca (1999), Pessin (2003), and Platt (2011a), (2011b). Others who are often identified with the concurrentist reading fit less neatly. For example, Des Chene (1996) is sometimes cited in this context, but he (1996, p. 341) also holds that the distinction between divine creation and concurrence in Descartes is "refashioned to suit a physical world without causal powers." It is at best unclear that this does not just amount to occasionalism spiced with verbal ambiguity.

13. Against concurrentism

The basic thrust of concurrentism is that both God and creatures cause particular phenomenon. In the corporeal domain, this means that both God and bodies are causally active. So, a concurrentist holds that both God and Mount Vesuvius caused the destruction of Pompeii, that both God and tectonic plates caused the breakup of Pangea, and so on.

Concurrentism is a historically prominent position. For example, St. Thomas argues that creatures are secondary causes and thus "are the instrument of the divine power [*virtutis*] of operating" (*QPD* 3.7). The metaphor of an instrument is helpful.[63] A creaturely cause is like a hammer which both contributes to the driving of a nail but cannot do so unless swung. Similarly, a creaturely cause contributes to the bringing about of an effect but cannot do so unless God concurs with it. Aquinas is thinking that God concurs partly by conserving creation (*ST* I q104 a1 co) and partly by "endow[ing]… [creation] with the power to act" (*ST* I q105 a5 co), such that "one and the same action… [proceeds] from a first and second agent" (*ST* I q105 a5 ad2).

Much therefore turns on the possibility of God endowing corporeal things with causal powers. Later Cartesians certainly rejected this possibility. Malebranche, for one, argued that since there must but cannot be a necessary connection between a genuine corporeal cause and its effect, there cannot be any genuine corporeal causes. His argument relies on the claim that a "true cause… is one such that the mind perceives a necessary connection between it and its effect" (*S* 6.2.3). Malebranche holds that the divine will alone passes this test – for all *p* other than a divine volition and for all *q* distinct from *p*, God can make it the case that *p* obtains and *q*

[63] Helpful, but potentially misleading; see Suárez, *DM* 17.2.17. The basic worry is that it is a mistake to just identify secondary, creaturely causality with instrumental causality. This point should be borne in mind throughout.

does not. Corporeal things are unable to serve as true causes because they are a subset of non-divine things, none of which may serve as true causes.[64]

Descartes did not endorse the radical occasionalism of Malebranche. Created minds, for example, are clearly capable of causing their own mental states, which Malebranche-style occasionalism disallows.[65] Of course, there is room in logical space to hold that finite minds are omnipotent with respect to their own mental states or some subset thereof, but I cannot imagine that this is Descartes's position, given that it would imply that God himself could not prevent the relevant mental states from obtaining: Surely, after all, God could frustrate my attempt to conjure up an image in my mind. Thus, I think that Descartes would reject Malebranche's argument as unsound. Perhaps, therefore, there is no obstacle to taking him to hold, with Aquinas and against Malebranche, that God endows corporeal as well as mental things with the capacity for causal activity. Let us provisionally assume that this concurrentist interpretation is tenable. On that assumption, can sense be made of the causality of the laws?

In outline, matters appear straightforward. If bodies have powers, then the exercise of these powers will give rise to regularities. So, the laws may be taken as shorthand for the causal activity of bodies, the regularities that arise from this activity, or both. Such a concurrentist reading sees Cartesian physics as continuous with Aristotelianism: Aquinas and Suárez could have spoken of laws in this way.[66] For example, an Aristotelian could lay down as a physical law

[64] This is the oft-discussed *no necessary connection argument*. For our purposes, the argument is of only incidental interest. From a broader perspective, however, it is one of the more important arguments in the Western tradition, cropping up in medieval thinkers like al-Ghazâlî as well as moderns like Malebranche and Hume (*Enq.* 4.16). A classic study of its early modern manifestation is that of Nadler (1996); for a sustained look at al-Ghazâlî's work on causality, see Griffel (2009, 147-173); for more on Malebranchean occasionalism, see the studies of Nadler (1993a; 2010), Jolley (2002; 2019), and Ott (2008; 2009, 91-111).

[65] The contrary supposition makes nonsense of much of the *Passions of the Soul* (e.g., AT 11.342). It is also significant that in the *Meditations* the divine will "does not seem any greater than mine when considered as will in the essential and strict sense" (AT 7.57); the discussion of Garber (1992, 300-305) is helpful here.

[66] Significantly, contemporary advocates of Aristotelian or neo-Aristotelian powers often do speak in these terms; see the 8th chapter of Ott (2022) for a helpful overview of this literature.

that fire burns paper in the presence of air, since this is simply a consequence of the regular activity of physical form with which God regularly concurs.

This, however, cannot be Descartes's view. The central place of physical forms within our Aristotelian analogue is, of course, an immediate red flag – Descartes has no truck with such explanations. The issue can also be approached more obliquely via Aquinas's usage of '*lex*':

> Law is a rule and measure of acts according to which something is induced or restrained from acting [*lex quaedam regula est et mensura actuum, secundum quam inducitur aliquis ad agendum, vel ab agendo retrahitur*]… Consequently, law is something pertaining to reason (Ib q90 a1 co).

This bears more than a passing resemblance to Descartes's *Principles*, wherein laws are similarly identified with rules and wielded in explaining particular events. The crucial difference is that Descartes does not follow Aquinas in reserving '*lex*' for rational entities: Aquinas does not speak of physical laws because for him '*lex*' has mental connotations. Indeed, this same association led Robert Boyle to take Descartes's talk of physical laws as plainly metaphorical; Boyle (1686, 41-42), no less than Aquinas, thinks it "plain that nothing but an intellectual being can be properly capable of receiving and acting by a *law*."

Boyle is certainly right that Descartes does not mean to commit himself to panpsychism. On the contrary, Descartes seeks to convict hylomorphists of this very position by arguing that forms must be minds in order to perform their explanatory role (AT 7.440-442). So, whatever his position on the ontological status of the laws, Descartes does not reintroduce the Thomistic association with mentality. The problem with the concurrentist interpretation, however, is that it is difficult to see how it can avoid doing just that. How, after all, can the requisite causal powers be accommodated within Descartes's spartan corporeal ontology without reintroducing the physical forms that, Descartes thinks, doom the Aristotelian powers theory?

In response to this difficulty, Andrew Platt (2011b, 871) has argued that the relevant causal powers are a function of certain "intrinsic properties of particular bodies" that are not inconsistent with Cartesian metaphysics. Underlying this strategy is his (2011b, 852) discerning observation that "bodies [can] have causal powers only if causal powers are modes of extension." Fair enough. In further fairness, Descartes does speak of the power (or force) of bodies in relation to paradigmatic corporeal modes. Illustratively:

> [W]hat is in motion has some power [*vim*] of persisting in its motion, i.e., of continuing to move with the same speed in the same direction. An estimate of this last power must depend firstly on the size of the body… secondly on speed (*PP* 2.43).

It is tempting to read this passage, as Platt does, as attributing causal activity to bodies. And, if causal powers are grounded in intrinsic properties such as size and motion, then why must bodies lack causal powers? Size and motion are, after all, attributes of extension.[67]

The problem with this reading is that does not fit the text of the *Principles*. Granted, Descartes speaks therein of the *vis* of bodies, as the above passage attests, but just prior to that passage this *vis* is given a gloss that belies Platt's reading:

> We must be careful to note what it is that constitutes the power [*vis*] of any given body to act on… another body. This power consists simply in the fact that everything tends, so far as it can, to persist in the same state, as posited in our first law. (*PP* 2.43)

The first law, in turn, says that a body persists in its current state unless there is an external reason for it to deviate from it, which Descartes claims is knowable from consideration of the divine nature, especially immutability (*PP* 2.37). The most natural reading of the first law – and thus of the *vis* of bodies – is as shorthand for divine immutability and creation. The reason bodies behave inertially is the immutability and simplicity of "the workings of God" in creating and

[67] Actually, motion is problematic for Descartes in this context, as in so many others. *Principles* 2.28 tells us that motion, strictly speaking, is "to be referred solely to the bodies which are contiguous with the body in motion" (see also *PP* 2.25). So, Cartesian motion is relational in some sense of the term. For present purposes, however, it is enough to note that Descartes clearly thinks motion is a mode of the moved; he explicitly affirms this at both *Principles* 2.27 and 2.36. More on motion below (§24).

sustaining the material universe "by the selfsame action and in accordance with the selfsame laws as when he created it" (*PP* 2.42). Here, as elsewhere, two and only two things are straightforwardly held to be efficacious: God and the laws. The *vis* of bodies, by contrast, looks entirely parasitic on the laws. Indeed, that is the purport of *Principles* 2.43: It is a warning not to take the *vis* of bodies to be anything other than what is "laid down" in the first law.

Of course, in considering motive force (*vis*) one winds up talking of modes of extension like size. After all, motion is a function of size. Now, Descartes holds both motion and the associated force to depend on size and speed, which begs the question of the relationship between motion and force. Edward Slowik (2002, 58), I think, gets to the heart of the matter:

> [F]orce constitutes a kind of "byproduct" or consequence of the motion of extended substance… [it] should probably be deemed an apparent or phenomenal property of bodies, and not a property actually harbored within extension… The phenomenon of force, consequently, is simply the visible or experiential effect of the *ways bodies behave,* a pattern of action that is characterized mathematically as the product of their speed and size (and a judgment that leaves aside the question of its ultimate foundation – i.e., God).

By speaking of force, that is, Descartes is not attributing causal activity to extension. He is instead offering a mathematical description of the behavior of bodies in terms of their modes, but it is God's activity that is causing and directing that behavior. Platt's alternative supposition must be that bodies are somehow directing themselves, saddling Descartes with the problem of explaining how purely geometrical objects direct themselves in particular directions at particular times. I see no way out of this predicament that does not run afoul of the little souls argument.

One further textual point. As Platt (2011b, 865) rightly notes, Descartes's prose in *Principles* 2.37 is strictly consistent with his holding the laws *and something else* to be secondary causes. This ambiguity stems from Latin's lack of articles: The passage can thus be translated either with or without a definite article, with an attendant difference in meaning. I think context and philosophical considerations militate in favor of the definite article whereas

Platt does not. In effect, Platt is reading Descartes as neglecting to mention the other secondary causes. That would be a strange omission, however. *Contra* Platt (2011b, 865), the passage does not merely serve Descartes as a "transition to his discussion of his three laws of motion." In the first place, this is not the avowed motive – Descartes states in the opening sentences of *Principles* 2.36 that his aim is to give an account of the causes of motion:

> After this consideration of the nature of motion, we must look at its cause. This is in fact twofold: first, there is the universal and primary cause... second there is the particular cause which produces in an individual piece of matter some motion it previously lacked (*PP* 2.36)

It would be incredible, given this professed aim, if Descartes did not intend to provide at least a cursory listing of the secondary and particular causes. So, I disagree with Platt's (2011b, 865) contention that "the immediate context" of *PP* 2.37 "does not give us any reason to read it" as specifying the laws as the only secondary causes. On the contrary, Descartes transitions to talk of the laws of nature precisely because they are *the* secondary and particular causes of motion.

So, for diverse reasons, I find Platt's reading problematic. Even setting all these problems aside, however, the laws still cannot be mere shorthand for the causal powers of particular bodies, as Platt (2011b, 870-871) himself notes:

> God's action fixes certain laws of nature, and these laws of nature partly determine the behavior of the natural world… The full explanation of a given natural motion (in the order of secondary causes) includes facts about the nature of body in general, the laws of motion, and the intrinsic properties of bodies.

So, Platt thinks the secondary causes of motion include laws, the essence of body, and the intrinsic properties of bodies. This implies that the efficacy of the laws is distinct from the efficacy of bodies. How, then, are we to understand the laws? Platt (2011a, fn. 68) writes that they are "a direct result of God's act of continual re-creation." He thus understands the laws as shorthand for the divine will. So, surprisingly, Platt concurs with his occasionalist opponents, at

least insofar as the causal role of the laws is concerned. And so, his rendering of the laws stands or falls with its occasionalist competitors, discussed below (§15).

So much, then, for Platt's interpretation. Let us consider one further concurrentist reading in detail, namely that of Michael Della Rocca (1999, 67):

> Since… God's action of moving bodies in conformity with his immutability bestows a certain tendency on a body, we can see God's causal activity here as bestowing a certain nature on a body. Because, as we have also seen, what changes in motion a body causes are a function of the body's nature, we can see that God's activity in bestowing a certain nature on a body also bestows on it certain causal powers.

The proposal is that God *qua* cause of the essence of body can endow bodies with causal powers. Indeed, Della Rocca (1999, 68) argues that the contrary supposition is an illegitimate (or, at least, un-Cartesian) limitation on divine power. These corporeal powers, he (1999, 59-60) further explains, are to be understood in terms of counterfactual tendencies grounded in a body's geometrical nature and God.

We should begin by clearing away some potential distractions associated with the creation of essences. To begin, the occasionalist interpretation does not deny that God *could* have endowed creation with causal powers: Finite minds are, after all, thus endowed. The thought is rather that such a creation could not be Cartesian matter, on pain of incoherence. Matters are, however, complicated by Descartes's voluntarism regarding the eternal truths (AT 1.145, 1.149, 7.432, 7.436), which raises the specter that conceptual incoherence is itself contingent on God's creative activity.[68] In the present context, however, this is a useless muddle. It invites us to consider the possibility that the eternal truths could be – perhaps even are – different than we suppose them to be. Only by such means could voluntarism undermine our confidence that an incoherent proposition is false. Descartes, rightly, rejects this sort of argument:

[68] Classic discussions of this complex issue include those of Frankfurt (1977), Curley (1984), and Bennett (1994).

> It is also no objection for someone to make out that such [clear and distinct] truths might appear false to God or an angel. For the evident clarity of our perceptions does not allow us to listen to anyone who makes up this kind of story (AT 7.146).

Now, this is not to say that Descartes's divine voluntarism is always philosophically idle. But it does mean that we cannot treat it as grounds to undermine our confidence that conceptually incoherent propositions are false. In so doing, we would simply be falling prey to something like the evil God hypothesis that Descartes rejects as grounds for even "very slight… metaphysical" doubt in the *Meditations* (AT 7.36, 7.52).

This muddle dispensed with, two questions bear asking. The first is whether the counterfactual tendencies identified by Della Rocca are plausible candidates for *corporeal* causal powers. The second is how these tendencies function within nomological explanation.

Let us begin with the first question. I take it as given that if *x* is a causal power of *Y*, then *x* is a property of *Y*. So, are the tendencies Della Rocca identifies properties of bodies? Della Rocca thinks that they are in virtue of somehow being built into the nature of bodies. Is this plausible philosophically? Or, failing that, as an interpretation of Descartes?

The answer, to both questions, is no. The problem, in both cases, is that Descartes is emphatic that bodies are merely extended things. Platt, in defending his concurrentism, took his challenge to be articulating corporeal power in terms of extension and its modes, and in this he was exactly correct. The root problem with describing Della Rocca's powers as corporeal is that there is no way of cashing them out in terms of extension. Take, for example, the inertial tendency. Can we explain this in purely geometrical terms? And, even if such an explanation were forthcoming, could it square with the derivation of inertia from divine immutability? These questions cannot be satisfactorily answered because the disposition in question is nothing above and beyond a description of how God creates the world over time. Illustratively, one could know all the modes that a body exemplifies at a given time and still be ignorant of its inertial tendency,

because that tendency does not describe any of those corporeal modes. Rather, it describes how God acts given what corporeal modes obtain.

Onwards, therefore, to our second question: How do Della Rocca's powers function within nomological explanation? Counterfactual tendencies, unsurprisingly, lend themselves to a bottom-up conception of the laws. It is therefore surprising to find Della Rocca (1999, 56) saying something quite different: "the laws of nature are simply manifestations of the immutability" of God. So, like Platt, Della Rocca endorses an occasionalist conception of the laws despite defending the concurrentist interpretation of Descartes.

That both our exemplars of concurrentism avoid giving the natural, bottom-up analysis of the laws suggests a deeper problem with that reading. At minimum, it highlights that the textual evidence simply resists the natural concurrentist story about the laws. Descartes does not view the laws as supervening on particulars. On the contrary, he thinks of the laws as somehow governing events. Any purely bottom-up analysis is destined to get this the wrong way round.

Still, before turning to occasionalism, we should examine one final interpretation that turns on the invocation of corporeal causal powers: mere conservationism.

14. Against mere conservationism

The mere conservationist reading is idiosyncratic: To the best of my knowledge, Tad Schmaltz (2008a) is its only defender. Nevertheless, it offers an intriguing way of grounding Cartesian causal powers in their historical context without casting Descartes as a concurrentist in the Thomistic or Aristotelian mold, and so it is worth our attention.

The case for conservationism is partly negative: According to Schmaltz, the alternative occasionalist interpretation is unworkable and unmotivated. Let us treat these accusations in turn.

Schmaltz's (2008a, 116) argument against the workability of occasionalism turns on "the implication in Descartes that the various forces for acting and for resisting can change through time… [while] nothing in God can be subject to change." This is an inference to the falsity of occasionalism from the variability of physical forces: If physical forces are divine volitions, then God must, *per impossibile*, change over time. This, however, is not true. All it shows is that occasionalism implies that God eternally wills a complex volition whose conjuncts are temporally indexed.[69]

So much for the charge of unworkability. Schmaltz's (2008a, 116) charge that occasionalism is undermotivated goes like this: "the claim that Descartes in fact drew this conclusion [that bodily features could not be principles of action] is often based less on the textual evidence than on intuitions about what his identification of body with extension requires." This is a puzzling tack; as Desmond Clarke (1989, 129) puts it, it is surely strong evidence for the occasionalist interpretation that it is "a natural development of fundamental assumptions which are at least implicit in Descartes's system." So, I think Schmaltz's criticism must be that a lack of textual evidence defeats this philosophical evidence. Yet, we have already encountered textual evidence for the occasionalist interpretation, such as the relationship between the *vis* of bodies and the first law of motion. However one adjudicates theoretical virtues, the negative case for mere conservationism looks unlikely to triumph.

In short, the negative arguments for mere conservationism are unconvincing. It must, therefore, stand on its own philosophical and exegetical merits. Historically, Schmaltz (2008a, 20) traces mere conservationism to the work of Durandus of Saint Pourçain, a 14th century Dominican critic of Aquinas:

[69] Ott (2009, 102-103) makes an analogous point regarding Malebranche's analysis of physical laws.

> What he [Durandus] cannot accept, however, is Thomas's view that the claim that God acts immediately in all actions of secondary causes is compatible with the attribution of real efficacy to those causes. For Durandus, the only acceptable alternative is the "mere conservationist" position that God contributes only the creation and continued conservation of a secondary cause to the production of an effect by that cause.

So, *pace* Aquinas, Durandus thinks that divine concurrence undermines belief in the efficacy of material objects. Why? One compelling argument is that divine concurrence renders creaturely contributions superfluous: Total overdetermination is entailed by concurrentism but wastes divine effort. For, the concurrentist holds, creaturely causes cannot bring about any effect without divine aid, whereas God can bring about any effect without creatures.

On pain of occasionalism, what is wanted is some restriction on divine activity such that a sphere of influence is carved out for creatures. In this vein, Durandus argues that God preserves his creation, which otherwise acts without his aid. For example, God creates and conserves the Sun, but it is the Sun itself which causes light and warmth. So, while for Aquinas creaturely causes were like so many hammers created and swung by God, for Durandus creatures are like automated machines that God creates and allows to function properly.

The merits of Durandus as against Aquinas need not detain us. However effective as a critique of Thomism, mere conservationism is untenable as an interpretation of Cartesianism. As with concurrentism, its chief defect that it is not possible to fit the requisite causal powers into Descartes's geometrical ontology. Specifically, conservationism *qua* Cartesian requires that purely geometrical objects alter one another's motion by means of some force, but Cartesian corporeal metaphysics makes meeting this requirement impossible.

Schmaltz (2008a, 117-118) proposes, building on the work of Geroult (1980) and Gabbey (1980), that this force is to be understood as "various modes of bodily duration" that material but not "purely geometrical" objects possess "simply in virtue of possessing… extra-mental"

existence.[70] A little later, Schmaltz (2008a, p. 119) elaborates that motive force is "the strength of duration" and is "only rationally distinct from the features of motion and rest that possess that sort of duration." I confess that I find this proposal largely inscrutable. Duration is an attribute of substance (*PP* 1.55-56), one that extends "to all classes of things" (*PP* 1.48; see also AT 3.665, 5.193). Yet, Descartes surely does not imply thereby that all classes of things possess motive force. So, Schmaltz's thought must be that merely existing gives rise, uniquely in the case of extension, to motive force, without contravening Descartes's geometrical ontology or falling victim to his criticisms of the directedness of the activity of physical forms. Despite Schmaltz's exegetical heroics and subtle philosophical analysis, trying to make sense of all this ultimately feels like being led down the garden path.

I suspect the underlying problem is an assumption that matter *just cannot be* purely mathematical. Perhaps this is sound philosophy; as Cartesian exegesis, however, it is an error with an impressive pedigree. To motivate this diagnosis, consider how Schmaltz (2008a, 119) defends his conception of force by ascribing the appearance that "force is not intrinsic to these [corporeal] modes" to the fact that "the modes themselves can be considered abstractly as purely mathematical objects, the nature of which is exhausted by their geometrical and kinematic properties." Revealingly, this implies that Schmaltz is thinking that the nature of corporeal modes, considered concretely, *just cannot be* exhausted by their geometrical and kinematic properties. Matter *just cannot be* geometry. In this way, Schmaltz is the heir of Descartes's interlocutors, such as Henry More, who just could not accept the identification of mathematical and material objects.[71] Descartes's response to such perplexity was to stress that he really meant

[70] Schmaltz is thus thinking of geometrical things as universals, or abstract ideas. In this connection, Descartes's nominalism regarding universals must be brought to bear, further complicating the issue (*PP* 1.58-59).
[71] To cite one further example, Flage and Bonnen (1999, 88) trumpet that, on their view, Descartes's equation of materiality and geometry turns out to be "only a slight exaggeration" as if this is a surprising virtue of their reading.

what he said clearly and repeatedly in central texts, namely that the essence of matter is geometric extension and geometric extension alone (AT 3.475, 3.665, 5.52, 5.193, 5.221, 5.268-272, 7.71, 7.161, 11.35-36; *PP* 1.53). Our response to Schmaltz should be the same. Cartesian bodies are geometrical objects – full stop.[72]

Still, suppose for the sake of argument that, somehow, all these criticisms were met. What, then, of the laws? Schmaltz (2008a, 124) writes that the laws "merely reflect the natures of what God has created." This suggests, tantalizingly, that the causality of the laws is explicable via essential properties. This would cast nomological explanation as a subset of Cartesian formal causation as Schmaltz (2008a, 59-61) has accurately – if regrettably briefly – articulated it. Unfortunately, prior to making this comment, he (2008a, 124) makes another which undercuts it: "The laws are particular causes, moreover, in the sense that they reflect the nature of the inclinations and forces that are themselves the particular and secondary causes of changes in motions." So, the laws are just shorthand for the efficient causality of material objects after all. We have seen and rejected this view already; there is no need to further belabor the point.

15. Against occasionalism

Occasionalism, for our purposes, is the thesis that God is the only genuine cause in the corporeal domain. Bodies, by contrast, are merely the occasions on which God acts. The laws of nature, then, express the orderliness of divine activity and are themselves causal only in that they are shorthand for divine activity. This provides a rough understanding of the ontology of the laws, but the details need spelling out. The most obvious way forward is to understand the laws

[72] Of course, this is not to deny the existence of the mental entities Schmalz terms "pure geometrical" objects. However, what we have here is not a distinction between geometrical and material objects, but a distinction between those objects and mental representations thereof.

as second-order volitions by which God regulates his creative activity from the top down. So, let us begin by considering the prospects for success along those lines.

This basic proposal is that God wills himself to follow certain rules. Take Descartes's first law as an example:

> The first of these laws is that each thing, insofar as it is simple and undivided, always remains in the same state, as far as it can, and never changes except as a result of external causes [*causis externis*]. (*PP* 2.37)

This is halfway to the classical law of inertia – a body in motion will remain in that state of motion unless forced to deviate from it by an external cause.[73] For the occasionalist, of course, the only possible genuine external cause is God. Thus, '*causis externis*' can only mean that distinct bodies occupy a location such that God alters the motions of other bodies. This looks like an unmotivated assumption of corporeal impenetrability; it is not because Descartes holds impenetrability to follow conceptually from the corporeal nature, extension.[74] Intriguingly, this suggests that the laws are functions of extension as well as the divine nature. In any case, it is clear that by '*causis externis*' must be meant external occasional causes of this kind. This in mind, here is a possible rendering of the volition that our occasionalist proposal identifies with the first law:

> For all bodies, *b*, if there does not exist at t_n an *x* such that (i) *x* is a body, (ii) *x* is not identical to *b* or to any part or mode of *b*, and (iii) *x* is an occasional cause for an alteration of the motion of *b*, then I will create the motion of *b* at t_n such that it is identical to the motion of *b* at t_{n-1}.

Here, (i) rules incorporeal causes out of bounds, while (ii) reflects the *'externis*' is Descartes's Latin. Finally, (iii) specifies that what is at stake is an occasional cause for the alteration of the motion of the relevant body. The law itself says that, if nothing satisfies (i), (ii), and (iii), then

[73] Halfway, because the first law does not specify that simple motion is rectilinear and thus leaves open the possibility that curved motion is simple. Descartes rules out this possibility in his second law.
[74] I deal with this issue at length in the next chapter.

the motion of the body is unchanged. The consequent reflects the contention that God regulates his conduct by willing the law; more abstractly, the law amounts to a divine volition of the form *if P, then I will do Q*. As, indeed, will all the others.

One immediate problem with this proposal is that the laws cannot correspond to *distinct* volitions. Here it will be helpful to return briefly to an earlier argument. Helpfully if ultimately unpersuasively, Schmaltz (2008a, 116) argues that occasionalism is untenable as an interpretation of Descartes because of "the implication in Descartes that the various forces… can change through time… [while] nothing in God can be subject to change." Again, this is an inference to the falsity of occasionalism from the variability of physical forces: If physical forces are divine volitions, then God must, *per impossibile*, change over time. To avoid this trap, as previously noted, the occasionalist must say that God eternally wills a complex volition whose conjuncts are temporally indexed. In the present context, the upshot is that the occasionalist proposal must be that some of these conjuncts amount to God willing himself to abide by the laws.

This, however, is still indefensible. The problem is that the added conjuncts are otiose, and so the proposal still sins against divine simplicity. God wills his creative volition *in toto* and eternally, such that second-order conjuncts cannot play any explanatory or regulatory role. Of course, God still wills the particular states of affairs. However, if the efficacy of the laws just is the efficacy these individual conjuncts in God's volition, the distinction between primary and secondary causation collapses. Both would, after all, be shorthand for the very same thing.

What the occasionalist needs is some way of understanding the laws in terms of divine agency without invoking otiose volitional conjuncts or collapsing the distinction between primary and secondary causation. To my knowledge, the only scholar who squarely confronts

this challenge is Walter Ott (2022, 30), who proposes understanding the causality of the laws in terms of a determinate-determinable relationship:

> A scarlet object doesn't have two properties, scarlet and color. Scarlet is simply the determinate way that object has of being colored. Volitions sometimes admit of a parallel structure. Suppose—to keep the parallel with Descartes's account—my nature is such that I will to do the dishes tonight. I might also will to do them according to a particular method… But it's not as if I have thereby sprouted a new, distinct volition… it is the particular form in which my will is made specific and hence efficacious. In the same way, the laws of nature are determinates of God's determinable creative volition: they make precise the form his creative volition is to take. They are not distinct volitions that compete with his general creative volition for the title of 'efficient cause.'

So, "God's determinable creative volition" is associated with primary causality. This volition is rendered "specific and hence efficacious" by the laws, which are determinates of God's primary causality. So, Ott (2022, 30) reasons, the "volition to re-create the world at a given moment is made precise and determinate in the volition to follow the laws." And so, Ott contends, the occasionalist can make sense of the causality of the laws via divine agency without thereby collapsing the distinction between primary and secondary causation or invoking otiose conjuncts.

There may be room to quibble here about points of divine psychology, but we are better off confronting an underlying problem. Let us, like Ott, sneak up on our point via an analogy. Suppose I have willed myself to be risible. Further suppose, if you like, that this volition is a determinate of a determinable volition to be a rational animal. I think it is clear that this volition explains neither my risibility nor any case of the giggles I catch. My risibility follows from what I essentially am, and the fact that I, quite superfluously, will to be as I essentially am does not explain why I am that way. Analogously, the quantity of motion is invariant because God is essentially immutable, not because God wills himself to be immutable insofar as creating motion is concerned. Ott's proposal thus errs by locating the explanatory force of nomological explanation in a volition rather than in essential attributes. I mean this both philosophically and exegetically. Philosophically, for the reasons just adduced. Exegetically, because Descartes

himself hammers home the intimate relationship between the divine essence and the laws. Indeed, Descartes stresses almost *ad nauseum* that the laws are true and epistemically accessible to us because they follow from the intellectually perceptible nature of God. This alone, I think, dooms any rendering of nomological explanation in terms of divine activity.

16. Nomological explanation is formal causal explanation

We have reached an impasse: Understanding the laws via efficient causation leads to no good result, regardless of whether one prefers an occasionalist or non-occasionalist interpretation of Descartes. Rather than tying ourselves in further knots, we should instead reorient ourselves by reflecting on the nature of Cartesian nomological explanation. The most familiar Cartesian law is the conservation of motion (henceforth: CM). So, let us start there.

CM's familiarity partly comes from its obvious similarities with the Newtonian conservation of momentum law. There are, however, also important differences. Significantly, Descartes lacks the Newtonian concept of mass, and so his law is understood in terms of size, which for simplicity's sake we can take to correspond to volume.[75] Now, like all conservation laws, CM makes sense only in the context of a closed system. In particular, CM says that the total quantity of motion exemplified within a closed system at one time is equal to the total quantity of motion exemplified within the same system at any other time. Since the system is so much corporeal substance, this can be put in terms of the modes of the system without undue violence to the Cartesian categories. So, CM says that the total quantity of motion exemplified by the system is constant across all its possible modes. Importantly, however, CM cannot predict what specific mode will be exemplified at any given moment. Rather, CM restricts the possible modes of the system to those that exemplify a particular quantity of motion. I will henceforth

[75] For the actual details, see Slowik (2002, 111-117).

understand *all* Cartesian nomological explanation in this way, as restrictions on the possible modes a corporeal system may exemplify.[76] When such explanations determine a precise outcome, I will say that the restriction is to one and only one mode.[77]

Whence come these restrictions? In one obvious sense, they reflect God's creative activity. However, the crucial point is that God acts thus and so by nature. Divine actions are relevant to nomological explanation just in case they are themselves explicable via the divine essence. This is what makes the difference between natural and miraculous events: We understand the former via God's essential properties but must rely upon "our own plain experience or divine revelation" with respect to the latter (*PP* 2.36). Less ecclesiastically, it marks a key difference between Descartes and Leibniz, who argues that reality is as it is owing to God's acting to bring about the best possible world (*Mon*. 53-55). Descartes finds such teleological reasoning intolerable in physics (*PP* 1.28, 3.2; AT 7.55, AT 7.375). He avoids it without giving up talk of divine activity by restricting himself to those activities that conform to *regula sive leges* that can be deduced from intellectually perceptible essential properties. So, Descartes's invocation of divine agency in the context of nomological explanation is really just explanation from essence with an intermediate step.

This point is also readily appreciable from how Descartes articulates and defends the first law. Here, again, is that law: "each thing, insofar as it is simple and undivided, always remains in the same state, as far as it can, and never changes except as a result of external causes" (*PP* 2.37). This is best understood as a rejection of the distinction between natural and violent motions, according to which some changes result from bodies tending towards states with which they are naturally associated (e.g.: Aristotle, *Phys*. 208b9-23, 212b30-35, *DC* 310a30-35;

[76] Notably, Chen and Goldstein (2022) defend a similar proposal in a contemporary context.
[77] Ott (2022, 35) argues that the Cartesian laws only make specific predictions taken jointly. I suspect he is right.

Aquinas, *ST* I q7 a3 co). Descartes thinks that there are no internal principles of change: A moving body continues to move, a resting body continues to rest, etcetera. So, in our idiom, the first law restricts the possible succeeding modes to those which do not involve the state of a body changing without external impetus. Now, why should this be? Descartes refers us to divine immutability: We know from our intellectual grasp of God's essence that he will not cause a body to deviate from its previous state without reason. So, an explanation in terms of the first law is ultimately just an explanation from God's essence.

The view I find in Descartes is thus that nomological explanation is just an especially useful class of explanation from essence, namely those wherein the explananda are regular physical phenomena and the explanans are essential properties, paradigmatically (but perhaps not exclusively, since the material essence may also play some explanatory role) of God. In other words, nomological explanation is formal causal explanation. So, the laws are best understood via formal rather than efficient causality. And so, the laws are best understood as secondary formal causes of motion. The laws are *secondary* causes, because they explain the diversity in the creation of an immutable primary cause, the problem with which Descartes is officially concerned in *PP* 2.36 and which he invokes the primary-secondary cause distinction to solve in 2.37. The laws are *formal* causes, because explanations from the laws are just explanations from essential properties, such as divine immutability. This also means that the dispute between top-down and bottom-up conceptions of the laws is ultimately a red-herring, at least insofar as Descartes is concerned. Descartes does not actually conceive of the nomological explanation in terms of the directional flow of causal activity, but rather in terms of the essential properties that explain why events regularly unfold as they do.

We are also now in a position to answer the question left lingering at the end of the last chapter: Does formal causation play any non-trivial role in the explanation of particular bodily modes? To answer this question, recall that nomological explanations, for Descartes, amount to restrictions on the possible modes that a system may exemplify. Since nomological explanation is formal causal explanation, this means that formal causal explanations restrict the possible modes that a bodily system may exemplify. For example, the conservation of motion law restricts a bodily system to those modes in which motion is conserved, and something similar holds for all the other Cartesian laws. Such explanations are clearly non-trivial: They are the beating heart of Cartesian science. Thus, formal causation clearly plays a non-trivial role in the explanation of particular bodily modes. In fact, metaphysical formal causation is central to philosophical science, as it was for Aristotle and Aquinas (albeit in very different ways).

17. What are the laws?

This account of nomological explanation in hand, let us return to the question of the ontological status of the laws. Given our interpretation, the laws must enjoy an ontological status consistent with formal causality. What, then, are the laws?

There is one relevant proposal on offer, defended by Daniel Flage and Clarence Bonnen (1997; 1999, 70-99). So, let us begin by considering that proposal. For present purposes, we can encapsulate it in two claims:

(i) the laws are the form of the world (1997, 842; 1999, 72)

(ii) the laws are partly constitutive of the essence of the physical universe (1997, 860; 1999, 85, 91)

I think that both these claims are false, springing as they do from an untenable view of the ontological status of the laws. The problem is that both (i) and (ii) require understanding the laws as attributes, but this is just yet another category mistake.

To see this, first note that Cartesian essences are principal attributes (*PP* 1.53). So, the essence of the material universe is the principal attribute of the material universe, and it is well-known that Descartes repeatedly affirms that extension alone is the corporeal essence – not laws grounded in the divine essence. All on its own, this is probably decisive: The idea that Descartes meant the laws to be partly constitutive of the corporeal essence probably strains the text beyond the breaking point. Even if it does not, however, the underlying ontological problem persists. For surely the laws are no more fit to be attributes that partly constitute the essence of a substance than they are fit to literally be efficient causes that push and pull bodies about.

Flage and Bonnen (1999, 88-89) briefly entertain this objection. In response, they insist that the laws are eternal truths and therefore essences. This is puzzling: To be an eternal truth is not necessarily to be an essence. The only evidence offered to the contrary is the following passage from a relatively early (27 May 1630) letter to Mersenne:

> You ask me by what kind of causality God established the eternal truths. I reply: by the same kind of causality as he created all things, that is to say, as their efficient and total cause. For it is certain that he is the author of the essence of created things no less than of their existence; and their essence is nothing other than the eternal truths [*cette essence n'est autre chose que ces veritez eternelles*] (AT 1.151-152)

Now, a single clause in an early letter is of debatable relevance for an interpretation of the mature Cartesianism of the *Meditations* and *Principles*. And, decisively, Descartes's other and later comments regarding the eternal truths militate against taking this clause to reflect a lasting commitment to the thesis that all eternal truths are essences. For example, we have already noted that Descartes distinguishes merely necessary and genuinely essential properties: While it is necessarily true that matter is impenetrable, impenetrability is not even partly constitutive of the

material essence (AT 5.269). The point is even more straightforward with respect to the "paradigms of eternal truths" cited by Flage and Bonnen (1999, 14; *PP* 1.49): "It is impossible for the same thing to be and not to be at the same time; What is done cannot be undone; He who thinks cannot but exist while he thinks". Descartes does not mean these banal conceptual truths to be constitutive of the essence of any substance. Indeed, the contrary supposition would imply that these conceptual truths are only conceptually distinct from a substance, given that substances are merely conceptually distinct from their principal attributes (*PP* 1.62, 2.8-12). So, while I am sympathetic to the overall thrust of their rendering of Cartesian nomological explanation, I think Flage and Bonnen's proposal must be rejected on ontological grounds.

My counterproposal is that the Cartesian laws are nothing more or less than truths suited to play an axiomatic role within Cartesian physics, truths that are true in virtue of certain essential properties, paradigmatically of God. Ontological modesty is a virtue of my proposal, but my main motivation is negative. I simply do not see how else to fit the laws into Cartesian ontology. We have seen the problems associated with causal powers, divine volitions, attributes, and the like. Absent any plausible alternatives, the laws must simply be true propositions, truths, or facts.[78] After all, Descartes is certainly committed to the existence of laws at least in this minimal sense, as truths that we can come to know.

Furthermore, there is no need for Descartes to be committed to the existence of the laws in anything other than this minimal sense. Laws *qua* truths are perfectly capable of fulfilling their explanatory function. Nomological explanation is formal causal explanation because the truthmakers for the relevant propositions are essential properties. So, for instance, a particular

[78] Throughout, I do not intend my talk of propositions to imply any heavy-duty metaphysical claims. The point is just that the laws are true and that further truths regarding particular states of affairs can be derived from them. Again, there is no defensible rendering of Descartes does not commit him to at least that much, however the details are spelled out, and that is the important point.

event is explicable via a law, the truth of which is explicable via divine immutability. And so, that particular is explicable via essential properties by way of nomological explanation. This is not unlike proving a theorem in geometry from the axioms or proving a subordinate law in contemporary physics from fundamental ones: The fact that the theorem appears as the first step in subsequent explanations within the domain does not mean that such explanations are not explanations from the axioms or fundamental laws.[79] Similarly, the fact that Descartes often starts physical explanations with his laws does not mean that such explanations are not explanations from essence, since those laws are derivable from essential properties.

In this way, then, nomological explanation is formal causal explanation from essence. This proposal solves all the philosophical problems with which we have been concerned, and it also neatly fits the text. Therefore, I conclude that it is this conception of nomological explanation and accompanying understanding of the ontological status of the laws that we should attribute to Descartes.

Of course, one might be inclined to instead take the truthmakers of natural laws to be either bodily states or divine actions. These possibilities are worth discussing briefly, as they are flanking attacks on my favored understanding of nomological explanation that are facilitated by my favored ontology. For, if the truthmakers of the laws are divine or corporeal causal activity, then nomological explanation is best understood in terms of efficient causation after all.

So, suppose the truthmaker for the laws is the states of the physical world or some proper subset thereof, such as the exercise of corporeal causal powers. This may be taken in two ways. First, it may be taken in terms of universal quantification. However, this would disastrously

[79] Examples from geometry are as obvious as they are abundant. An example from contemporary science is the Biot-Savart law, which is often appealed to in explanations in magnetostatics. Such appeals do not show the explanatory inadequacy of Maxwell's equations and the Lorentz force law, however, since the Biot-Savart law is derivable from those fundamental physical laws in the relevant circumstances. For such a derivation, see Feynman (2010b, 14-9).

imply that the laws are false. Apart from any concerns regarding finite minds, Descartes is clear that miraculous violations of the laws occur (*PP* 2.36). So, this proposal is a non-starter. Alternatively, perhaps the laws are true due to statistical regularities. This, however, cannot be correct either, as it still implies that the laws might have been – indeed, might actually be – false. But the laws could not be false – they are as necessary as the truths of mathematics (AT 11.47).[80] Jarringly to contemporary eyes, Descartes considers the truth of the laws to be consistent with most, or even all, events being miraculous violations thereof. So, far from being true because of regularities, he thinks that the laws could be true despite them.

The proposal that the truthmakers for the laws are divine actions leads to no better result. We may again invoke either a statistical or universal interpretation, against which we may again wield the objections just adduced. In this case, however, there is a further difficulty. Descartes clearly does not envisage our knowledge of the laws as springing from our knowledge of divine motives; he is quite clear that final causes, of which divine motives are the archetype, are anathema in physics. At least part of the motivation for this proscription is that divine motives are beyond our ken, deliverances of revelation notwithstanding. So, if the truthmakers were divine actions, we would know that the laws were true only *a posteriori*. This, however, is not Descartes's view. He thinks we have intellectual knowledge of some attributes from which we can know the laws. In other words, he thinks we know the laws to be true *a priori* through intellectually perceptible essences. So, the truthmaker for the laws are not divine actions but are instead those intellectually perceptible essences.

[80] This citation of *Le Monde* requires brief comment, as Descartes's views evolved between *Le Monde* and the *Principles*. Still, on the necessity of the laws, there is no reason to suspect that Descartes wavered: their derivation from essence shows the laws to be as necessary as anything can be in Cartesianism. Perhaps significantly, Descartes restates *Le Monde*'s position vis-à-vis the necessity of the laws in the *Discourse on Method* (AT 6.43).

(One final caveat. The laws are necessary truths, and David Lewis (2001, 604) points out that "if P is a necessary proposition, then for any T whatever, T's existence strictly implies P." So, everything would be a trivial truthmaker for the Cartesian laws, insofar as Descartes is correct that they are conceptually necessary truths. And so, some restriction on the basic idea that a truthmaker necessitates the truth of the relevant proposition is needed to flesh out the Cartesian theory of nomological explanation. This, however, is no special problem for our interpretation of Cartesianism; any plausible version of truthmaker theory requires some such restriction. Accordingly, I set the issue aside without further comment.)

18. Function and Cartesian form

The lingering question with which this chapter began was whether Cartesian formal causation had an interesting role to play in Cartesian physics, specifically whether it figured in the explanation of specific bodily modes in non-trivial way. This question has now been decisively answered, since nomological explanations amount to restrictions on the specific modes bodies may possess and are formal causal explanations from essence. Thus, Cartesian physics is permeated by non-trivial formal causal explanations.

So far, so good. However, the prevalence of formal causal explanations within Cartesian physics raises a new problem. I have repeatedly alluded to the banishment from Cartesian physics of final causes, and I have thus far tacitly assumed that there is no tension between the banishment of final causation and the continued importance of formal causation.[81] This, however, is by no means obvious. On the contrary, formal causation is often taken to imply final

[81] That this banishment is total is not obvious, despite Descartes's protestations, as Simmons (2001) has helpfully pointed out. Gaudemarde (2015) has further argued that Descartes smuggles teleological reasoning into his mechanistic mereology via dispositions; but see also the discussion of Brown (2012), who argues that Cartesian functional analysis in biology is non-teleological. In any case, the objection I broach here has teeth.

causation. This implication would obviously be unacceptable for Descartes, and so, in this section, we shall consider whether he can avoid it.

To begin, as ever, with Descartes's historical context, the connection between formal and final causation enjoys a distinguished philosophical pedigree. Importantly, it is central to Aristotelianism. For example, the function argument in Aristotelian ethics turns on exploiting a link between what it is to be a type of thing and what it is to be an excellent example of that type (*EN* 1097b24-1098a19); in other words, the function argument exploits a link between form and function. Elsewhere, Aristotle goes so far as to claim that "what something is [the formal cause] and that for the sake of which [the final cause] are one" (*Phys*. 198a25; see also *Phys*. 199a30-33). To the theistic inheritors of Aristotle, it was thus natural to conclude that since the form of the eye facilitates sight, the eye was made for seeing.[82] Moreover, though the implication of intelligent design is foreign to him, something like this line of thought is at work in Aristotle himself (*Metr*. 390a10-15; see also, *Phys.* 198b-199a8, *EN* 1098a7-8). There is thus pressure from Descartes's predecessors to think formal causation implies final causation.

There is also pressure from his successors. Consider the following from Leibniz:

> By a consideration of efficient causes alone… we cannot give the reason for the laws of motion. For I have found that we have to bring in final causes, and that these laws do not depend upon the principles of necessity… but upon the principles of fitness, that is, upon the choice of wisdom (*PNG* 11).

> Everything in nature can indeed be explained mechanically, but the principles of mechanics [the laws of motion] depend on metaphysical and, in a sense, moral principles, that is, on the contemplation of an efficient and final cause, namely God (*NB* 245)

Both passages find Leibniz arguing for the necessity of final causes in the context of nomological explanation in physics, and the second shows him gliding seamlessly between

[82] The best-known example is probably Aquinas's design argument (*ST* I q2 a3 co). The most influential early modern advocate of such reasoning was William Paley (*NT* 4.1); more directly germane to our topic, the design argument was put to Descartes as an objection to his banishment of final causality from physics (AT 7.309-310; Descartes's reply is at AT 7.374-375). On a contemporary analogue of the design argument, see Manson (2009).

metaphysical and teleological explanation. Both also show Leibniz rejecting thoroughgoing mechanism because it fails to explain why the laws are as they are, and this is a question that Leibniz would no doubt put to Descartes.

Descartes, of course, has an answer here. He would reply that the laws are as they are because they must be, grounded as they are in essential properties. Leibniz's own answer is that one must refer to God as final cause, but he also could and should accept the Cartesian thesis that the laws are partly grounded in essential properties; like the Aristotelians, Leibniz should emphasize that explanations in terms of divine essence and in terms of divine motives are of a piece. Descartes, by contrast, would not accept the Leibnizian thesis that one must invoke God as a final cause in physics. The question is whether he can avoid doing so while invoking formal causal explanations from the essential properties of God.

There is certainly logical space to do so. Spinoza's assault on final causes in the Appendix to Part I of the *Ethics* does not undercut his use of formal causation elsewhere in that text. This is because Spinoza's God is more akin to a primaeval and ultimately foundational natural principle than the familiar Anselmian God. Leibniz sometimes implies that Descartes must also understand God in this way, since the banishment of final causality from physics seems to him to imply that the Cartesian God does not "act in accordance with some end" and "has neither will nor understanding" (*GS* 242). This, however, is Leibniz the polemicist. The Cartesian God can act for some purpose; Descartes's point is just that we cannot know what those purposes are. Still, there is a genuine dispute here.[83] Descartes does want to hold, *contra* Leibniz, that final causation has no place in physics and, *contra* Spinoza, that God is the right

[83] More than one, in fact. In addition to the dispute I highlight, there is the question of the relationship between God and the good, which is actually forefront in Leibniz's mind. On that dispute, see Bennett (2001, 182-185).

sort of entity to act in accordance with ends. Leibniz understandably cannot see how Descartes can maintain both theses at once.

As usual, Leibniz's criticism is cutting. Even if Descartes can avoid the old Aristotelian identification of form and function, it is difficult to see how he can avoid the importance of divine ends in physics. For example, the thesis that God is not deceiving us apparently involves God's purposes, and this thesis surely underlies any empirical aspect of Cartesian science.

Still, Descartes is not without recourse. The Leibnizian focus on divine motives is, as Descartes points out, a fool's errand. The motives of our family and close friends are often mysterious to us; small wonder, then, if the purposes of almighty God elude us. To grasp divine purposes, we require either religious experience (personal or codified in scripture) or a derivation from something more readily graspable. The former option was recognized by Descartes, but he rightly treats it as out of bounds philosophically. The latter class is what he focuses our attention on by highlighting that God's behavior conforms to certain rules – the laws of nature – in virtue of certain intellectually perceptible essential properties. So, we ought to focus our attention on those essential properties and see what we can learn from them, rather than waste time arguing about the hidden motives of God.

Focusing instead, with Leibniz, on divine purposes thus gets things backwards both pragmatically and epistemically. Pragmatically, because we have a reasonable hope at progress only if we focus on that which is graspable by beings like us. Epistemically, because insofar as we have knowledge of God's ends, it is via antecedent knowledge of his nature. Given this, Descartes's banishment of final causation in physics despite his invocation of formal causation is comprehensible. Indeed, he seems to me to get the better of this exchange.

Chapter 4

Impenetrability

Précis

A theme of the previous chapter was the unsuccessful attempt to ground corporeal causal powers in motion, whether via motive force or inertial tendencies. All such proposals were unsuccessful because they ran afoul of Cartesian metaphysics, specifically the identification of material with mathematical objects. This chapter concerns a challenge, pointedly raised in the 17th century by Bernard de Fontenelle, according to which corporeal causal powers are instead grounded in impenetrability. This objection is especially concerning because it waylays the standard occasionalist rebuttal. After all, it is a central tenet of Cartesian metaphysics that impenetrability is a modally necessary property of matter, and so the occasionalist can hardly object that impenetrability is inconsistent with Cartesian corporeal metaphysics. In addition, excluding other bodies from a location, which is what impenetrability involves, is a good *prima facie* candidate for causal activity. The challenge raised by Fontenelle is thus to show that impenetrability does not amount to a corporeal causal power.

In response, I undertake a close reading of the exchange between Descartes and Henry More. Therein, Descartes infers from our inability to conceive of regions of extension as both colocated and distinct that such a scenario is conceptually incoherent. Thus, bodies exclude colocation in the same way that triangles exclude four-sidedness: conceptually. Such conceptual restrictions do not involve causal activity, however: Just as a triangle does not *act* to preclude four-sidedness from itself, matter does not act on God or other bodies in precluding colocation. What we have are instead formal causal explanations of the sort characteristic of geometry – an unsurprising result, given the Cartesian identification of corporeal and geometrical objects. And so, *pace* Fontenelle, impenetrability poses no threat to the occasionalist interpretation of Cartesian physics, as impenetrability is best understood via formal rather than efficient causality.

19. Fontenelle's challenge

One feature of the most common anti-occasionalist renderings of Cartesian physics considered above (§13-14) is their emphasis on motion, whether via instantaneous speed, motive force, or inertial tendencies. This is unfortunate, since, as previously argued, this strategy is doomed. A more promising candidate for a corporeal causal power is impenetrability: Cartesian bodies occupy locations to the exclusion of distinct bodies, and this exclusion is a good *prima facie* candidate for causal activity. Furthermore, Descartes is emphatic that impenetrability is a merely modally necessary property of matter. So, unlike strategies predicated on motive force, there is no difficulty in accommodating this purported causal power within Cartesian ontology: Not only is impenetrability not prohibited by Cartesian metaphysics, it is required by it.

The importance of impenetrability in this context is readily appreciable from an exchange between two later Cartesians, Bernard de Fontenelle and Nicholas Malebranche.[84] Malebranche, as we have seen (§13), understands true causation to require a necessary connection between cause and effect, and Fontenelle (OCF 1.533) agrees that there must be *une liaison necessaire* between true causes and their effects. Malebranche subsequently argues that there can be no necessary connections in the corporeal domain, and so there can be no true corporeal causes. Fontenelle disagrees. He argues that impenetrability furnishes such necessary connections:

> And notice that the impenetrability of matter alone renders necessary one of the cases [of the alteration of the movement of bodies] that I propose… Therefore, they change as true causes and not as occasional causes [*Et remarquez que la seule impenetrabilite des corps rend necessaire 1'un des cas que j'ai proposes…. Donc ils le changent comme causes veritables, et non comme causes occasionnelles*] (OCF 1.534-535).

So, some bodily changes are necessitated by impenetrability alone, and bodies thus count as true causes of those changes, even by Malebranche's exacting standards. The changes in question

[84] The following discussion is indebted to those of Downing (2005) and Schmaltz (2008b), to which the interested reader is directed for further details.

concern the redistribution of motion upon contact. This feature of Cartesian physics is familiar. Above (§15), we noted that the first law of nature depends upon impenetrability vis-à-vis the specification of external causes of motion. Previously, we understood this requirement in terms of external *occasional* causes. Fontenelle, in effect, argues that we were wrong to do so, owing to the genuine causal contribution of bodies themselves via impenetrability.

Downing (2005, 220-225 and *passim*) helpfully links this dispute between Fontenelle and Malebranche to mechanism, understood not simply as the thesis that all physical events are explicable via matter and motion, but as also requiring that bodily interaction – however understood – occurs only upon contact. Though I have not previously stressed the point, this is an entirely apt description of early modern mechanism in general and of Cartesian mechanism in particular. It is therefore significant that Fontenelle's conception of impenetrability grounds the contact criterion, since interactions arising from impenetrability obviously cannot occur except upon contact. The underlying thought, then, is that the contact criterion is a straightforward consequence of the causal contribution of bodies being exhausted by (or, perhaps, merely parasitic upon) their exclusion of one another from occupied locations. This is an auspicious result. For the occasionalist like Malebranche, by contrast, the contact criterion is troublesome, since there are no immediate grounds for ruling out occasional action at a distance. Why, after all, could not God, in his infinite power, impose regularities upon distant bodies? Thus, it seems that Malebranche has no immediate grounds for thinking mechanism is true. Of course, how problematic this concern ultimately is for Malebranche is less important, for our purposes, than the underlying thrust of Fontenelle's strategy.[85] Let us, therefore, press forward by emphasizing two of its most salient features.

[85] This is not to imply that Malebranche lacks any recourse; see Schmaltz (2008b) for a rescue attempt. Given our Cartesian focus, however, further exploring Malebranche's prospects for success would be cluttersome.

First, the proposal concerns efficient causation. Fontenelle is offering an alternative to occasionalism: The aforecited passage is from his *Doutes sur le systeme physique des causes occasionelles*, the title of which announces this opposition. Now, occasionalism is a thesis about which entities are causally active. So, Fontenelle's thesis that bodies are *causes veritables* is the thesis that bodies are true *efficient* causes. And so, Fontenelle takes the necessary connection at stake to obtain in virtue of bodies excluding one another from occupied locations by *acting*, presumably on one another. On his view, then, the reason that a falling stone does not simply fall through the Earth is that the planet and stone act upon one another.[86]

Second, Fontenelle offers not merely an alternative to occasionalism, but a self-consciously Cartesian alternative. As he stresses, it is characteristic of Cartesian metaphysics that impenetrability belongs to matter essentially: "*les corps sont tels de leur nature*" (OCF 1.534). This is propitious, since it immunizes his proposal against the standard objections to anti-occasionalist accounts of Cartesianism. As we have seen (§13-14), these objections proceed by showing such corporeal powers to be inconsistent with the purely geometrical nature of bodies. In this respect, Fontenelle aims at a striking reversal: Malebranche argues that Cartesian metaphysics renders the supposition of corporeal causality incoherent, but Fontenelle purports to show that the Cartesian conception of matter as extension implies that bodies are causally active.

In short, then, Fontenelle argues that impenetrability is both consistent with Cartesian metaphysics and yields necessary efficient causal connections between bodies and subsequent

[86] It has been suggested to me that such formulations have the ring of the mental. It is therefore worth stressing that the sense of 'action' and related locutions here and *passim* is the one at issue, for example, in discussions of action at a distance in physics. Another excellent example of the usage I intend is the description of the basic project of physics in terms of "the *action* of a relatively small number of elemental things and forces *acting* in an infinite variety of combinations" given by Feynman (2010a, 2-1; emphasis mine). Clearly, such discussions are not meant to connotate the mental. Of course, Malebranche and his ilk would argue that any corporeal causal activity illicitly makes "a human being out of your armchair" (*D* 7; 110-111) by smuggling mentality into the corporeal domain, but casting efficient causation in terms of activity should not be taken to establish or even to suggest this.

distributions of motion. And so, Cartesian physics is not an occasionalist physics. On the contrary, occasionalism is outright inconsistent with Cartesian corporeal metaphysics. Call this *Fontenelle's challenge*.

Before proceeding, we should note and set aside a natural but doomed objection to this anti-occasionalist attack. The objection is that, while impenetrability does require some diversification of motion, it is silent regarding what specific form that diversification must take. As a stand-alone objection, this is unworkable. Consider, analogously, the casual influence of gravitational force in simple cases of projectile motion in classical mechanics. Clearly, the gravitational force is a partial cause of the resultant trajectory, but just as obviously relevant are the initial velocity and angle of projection. The trouble with the present objection is that it assumes every efficient cause determines a specific outcome. This requirement, however, is apt (if at all) only with respect to total efficient causes and thus provides no reason to think impenetrability is not a partial efficient cause. So, while Fontenelle holds that there is a necessary connection between impenetrability and the resultant diversification of motion, this need not imply that impenetrability is the total efficient cause of the specific distribution of motion that results. Indeed, it cannot be, since the prior directions of the motions at issue are also obviously relevant. So, Fontenelle's challenge is best understood as purporting to show that impenetrability renders bodies partial efficient causes, and this thesis is certainly sufficient to establish his anti-occasionalist thesis.

Our question, then, is whether Fontenelle is right that the impenetrability of Cartesian bodies shows that Cartesian physics cannot be occasionalist. To answer this question, it will be useful to turn to Descartes's own writings on impenetrability. Unfortunately, impenetrability is something about which Descartes is often frustratingly cavalier. For example, while the thesis

that matter is impenetrable is required and assumed by the kinematics of the *Principles*, it is never explicitly affirmed within that text.[87] Rather, it is simply presupposed. This is somewhat surprising, since Descartes does argue for other load-bearing metaphysical claims in that text, such as the claim that matter is essentially extension and that the distinction between a substance and its essence is merely conceptual (*PP* 1.62-3; 2.4). Fortunately, he was sufficiently needled by one interlocutor, Henry More, to expand upon his notion of impenetrability and its relationship to materiality *qua* extension. It is therefore to that exchange that we must now turn.

20. The impenetrability argument

In 1649, Henry More wrote a series of letters within which he pressed Descartes regarding the equation of the essence of matter with extension.[88] Anticipating Locke and Euler's later criticisms regarding solidity (*EHU* 2.4; *LE* 1.69, 233-235; 1.70, 236-238), one of More's chief concerns is why impenetrability is not constitutive of the material essence, rather than or in addition to mere extension. Here is Descartes's initial reply:

> Now tangibility or impenetrability in body is like risibility in man, a *proprium quarto modo* [property of the fourth kind] according to the common laws of logic, not a true and essential difference as I contend extension to be. Consequently, just as man is not defined as a risible animal, but as a rational one, so too body is not defined through impenetrability, but through extension. (AT 5.269)

Descartes has in mind the distinction between an essential and a merely modally necessary property. His thought is that just as human beings are necessarily risible without being essentially so, bodies are necessarily impenetrable without being essentially so. Notice, furthermore, that by cashing out impenetrability in this way, Descartes implies that

[87] In addition to the aforementioned role of impenetrability in the first law of motion, the calculation rules for colliding bodies make no sense absent the assumption that matter is impenetrable (*PP* 2.37-52).
[88] Of central import for present purposes are Descartes replies to More in the letters of 5 February (AT 5.267-279) and 15 April 1649 (AT 5.340-348). I take Descartes to present a unified position within these letters, and so I will henceforth move freely between them.

impenetrability is consequent upon extension. So, Descartes affirms not only that extension is explanatorily basic, but also that impenetrability is not.

Let us pause here to precisify this point. What is at stake between Descartes and More is the relationship between two familiar metaphysics. The first says that one body cannot be at the same place at the same time as another. Call this, the *impenetrability thesis*. The second says simply that matter is spatially extended. Call this, the *extension thesis*. Now, some who maintain both theses nevertheless think them independent from one another: on such a view, extension does not entail the impossibility of colocation, nor vice-versa. This is the basic position of, for example, Suárez and Locke (*DM* 40.2.21; *EHU* 2.8.11-12). It is also the position gestured at by More; roughly put, the thought is that matter is essentially extended and essentially impenetrable, but that neither fact is derivable from the other. A contrary position holds that the extension thesis entails the impenetrability thesis, such that any extended thing is *ipso facto* impenetrable. This more idiosyncratic position is Descartes's. Its chief benefits are parsimony and the reduction of impenetrability to the explicitly mathematical, the latter of which coheres so thoroughly with the Cartesian program in physics that it practically encapsulates it. The chief difficulty Descartes faces is establishing that the extension thesis entails the impenetrability thesis in a way that is both principled and plausible. More, in effect, challenges Descartes to provide such a derivation of impenetrability from extension.

As we have seen, Descartes begins by insisting on the distinction between essential and merely modally necessary properties. This distinction, while useful in terms of framing the dispute, is not really to the point: More admits that there is such a distinction, he just questions whether impenetrability belongs in the latter category. One way of putting his concern is that, absent either an admission that impenetrability belongs to the essence of matter or an explicit

derivation of impenetrability from extension, Descartes has no right to assert that matter is impenetrable. After some further prodding, Descartes offers the following, fuller argument in favor of understanding impenetrability as consequent upon extension:

> It is not possible to understand one part of an extended thing to penetrate another equal part without thereby understanding half of this extension to be removed or annihilated. However, what is annihilated does not penetrate another thing; and so, in my judgement, it is demonstrated that impenetrability pertains to the essence of extension but not to any other things.
>
> [*Non potest etiam intelligi unam partem rei extensae aliam sibi aequalem penetrare, quin hoc ipso intelligatur mediam partem cius extensionis tolli vel annihilari: quod autem annihilatur, aliud non penetrat; sicque, meo iudicio, demonstratur impenetrabilitatem ad essentiam extensionis non autem ullius alterius rei, pertinere.*] (AT 5.342)

Call this the *impenetrability argument*. Before proceeding, it should be noted that the conclusion Descartes draws here is twofold: In addition to concluding that it is impossible for distinct bodies to interpenetrate, he further concludes that impenetrability does not belong to the essence of anything other than matter. This further claim is motivated by his eagerness to dodge a stock objection against the derivation of impenetrability from extension. That objection, an illustrative discussion of which can be consulted in Suárez (*DM* 40.2.17), trades on the advocate of the derivability of impenetrability nevertheless being inescapably committed to the colocation of distinct extended things. For the Aristotelian like Suárez, the problematic entities are substances, forms, and prime matter; for the Cartesian, the problematic entities are matter, minds, and God. To take the most obvious Cartesian case, the substantial union between the mind and body seemingly convicts Descartes of the colocation of really distinct substances. More, in fact, also presses this very worry against Descartes, who responds by qualifying the sense in which God and minds are extended (AT 5.269-270; 5.342). In the quoted passage, the cash-value of the claim that impenetrability belongs to the essence of matter alone is therefore that impenetrability strictly so called does *not* belong to the essence of God or mind.

For present purposes, however, we can safely set this issue aside. Let us, therefore, proceed by taking the conclusion of the impenetrability argument to be merely that two distinct bodies cannot be colocated. In other words, let us take the conclusion of the impenetrability argument to be the impenetrability thesis.

Roughly, then, the argument goes like this. We begin by trying to conceive of two bodies interpenetrating. We then see, somehow, that the only way we can conceive this is by conceiving half of the overlapping extension being annihilated. This, in turn, somehow implies that nothing is interpenetrating after all. The argument thus has two substantive steps. First, Descartes requires that the supposition of interpenetration entails that a quantity of volume equal to half the volume of the purportedly overlapping extension be annihilated (or, equivalently, a quantity equal to the volume of the location of the purported overlap). Second, he must show that this falsifies the initial supposition of interpenetration. This second step amounts to establishing why the annihilation must occur such that no two distinct bodies are colocated. So, the impenetrability argument goes like this:

P1) The supposition of interpenetration entails that a quantity of volume equal to that of the region of purported overlap has been annihilated.

P2) If so, then the initial supposition of interpenetration has been falsified.

C) So, the initial supposition of interpenetration has been falsified.

Neither step is straightforward. With respect to the first, the proponent of colocation wants to say that two bodies share a location, and if this is meant to be incoherent, Descartes surely owes us an explanation of why. Further, suppose we grant Descartes (P1) and agree that interpenetration requires the requisite annihilation. Still, it is not established that no overlap occurs. Could not God annihilate, say, all the extension on the right side of the overlap region, leaving both a

region of overlap on the left and a "gap" on the right that is filled by matter from outside the initial system? Even if this is not the most natural suggestion, it is not obviously incoherent.

It is also not plausible that these premises are established merely by a clear and distinct perception of extension. Impenetrability is not an obvious consequence once one understands what it is to be extended in Descartes's sense. For a perception, even if clear and distinct, need not be adequate. In a different context, Descartes makes exactly this point: One can "clearly and distinctly understand that a triangle in a semi-circle is right-angled without being aware that the square on the hypotenuse is equal to the squares on the other two sides" (AT 7.225). So, one can fail to know some conceptual fact about triangles without thereby failing to have a clear and distinct perception of triangularity. The case of impenetrability and extension is analogous. One can have a clear and distinct perception of extension without perceiving that extension entails impenetrability, even if Descartes is right that it does.

Finally, we should note one further difficulty with (P1) that trades on the identification of material and geometrical objects. Amos Funkenstein (1986, 74) puts the objection well:

> Descartes's famous rules of motion seem to assume the impenetrability of colliding bodies. Now, motion of bodies in Euclidian geometry… always assumes that bodies pass through each other (lines, areas) or coincide with each other. Impenetrability can certainly not be derived from the geometrical characteristics of bodies as extended things, even if we understand it in the… sense that one body cannot occupy the same place simultaneously and totally with another.

This objection carries both philosophical and exegetical weight. Philosophical, because it strikes against the inconceivability of colocated extended things: Descartes wishes to subsume physics to geometry, but the positing of colocated objects is evidently unproblematic within geometry. Euclid had no issue speaking of circles inscribed in triangles, for example (*Elem.* 4), and neither, for that matter, did Descartes (AT 7.225, quoted above). It is difficult to see how this does not amount to conceiving of part of a circle being co-located with a triangle, where both are

considered distinct extended things. But, if so, why should we have trouble conceiving of corporeal objects interpenetrating, at least insofar as we agree with Descartes that corporeal objects just are geometrical objects? The exegetical problem is that it is implausible that Descartes, the foremost geometer of his day, just overlooked this problem.

One suggestion, made by Stephen Gaukroger (1995, 367), is that the impossibility of colocation is precisely what Descartes thinks distinguishes corporeal extension from geometric extension. This would refute Funkenstein's objection, but unfortunately it is also unworkable. Exegetically, Descartes persistently identifies geometric and material objects and stresses to More that impenetrability is a conceptual consequence of extension (i.e., without restriction to the corporeal). Philosophically, matters are even more dire. Why should More grant to Descartes some aggrandized notion of corporeal extension that builds impenetrability into the notion in such an obviously *ad hoc* manner? He should not, nor should anyone else.

To this point, Fontenelle's challenge seems insurmountable. Not only does the reply to More offer no obvious solution to Fontenelle's objection, it does not seem to even answer More's concerns. Despite this, I shall argue that Descartes has principled reasons for holding that impenetrability follows conceptually from extension and that these reasons are plausible by his lights. My thesis is thus a conservative one, as scholars have almost uniformly attributed to Descartes the view that impenetrability follows from extension as a conceptual truth.[89] Scholars have also often asserted this reading as if it were obvious.[90] The trouble is that even if Descartes's basic position is obvious, the details are not. We have already noted that Suárez and Locke, writing before and after Descartes respectively, deny that impenetrability followed from

[89] Some examples: Des Chene (1996, 377-382), Gabbey (1980, 234), Garber (1992, 144-148), Gaukroger (1995, 367), Massin (2008, 29), Schmaltz (2008a, 171), Williams (1978, 229), Wilson (1978, 87).
[90] Laudable exceptions include Garber (1992), Bennett (2001), Pasnau (2011), and Downing (2018).

extension; indeed, the topic is a controversial one in the medieval Aristotelianism against which Descartes is consciously reacting.[91] This is reason enough to think the orthodox reading of Descartes in need of further elaboration and defense.

This need has recently become more pressing, as the orthodox reading has come under attack. Drawing on the work of Daniel Garber (1992), Jonathan Bennett (2001, 30-32) has argued that the orthodox interpretation is doomed to attribute to Descartes a viciously circular argument.[92] This threat of circularity has in turn prompted the revisionary reading of Robert Pasnau (2011, 317-322), according to which the impenetrability of matter is for Descartes a matter of natural rather than conceptual necessity, an application of law rather than a conceptual truth about materiality.[93] So, our first challenge is to defend our favored orthodox reading of Descartes's reply to More without falling into Bennett's circle, thus avoiding the necessity of Pasnau-style revisionism. Only once we have done so will we be in a position to evaluate the success of his reply and consider what response, if any, he could give to Fontenelle's challenge, which turns on a particular understanding of impenetrability via efficient causality.

Given the complexity of this material, however, some foreshadowing is in order. Ultimately, I argue that Descartes derives the impenetrability thesis from the extension thesis as a conceptual truth. The trick is turned by showing the impossibility of conceiving of two regions of extension as both entirely overlapping and non-identical, since there is no property by which to distinguish them. This, in turn, grounds the necessary connection identified by Fontenelle between bodies and subsequent distributions of motion, since the conceptual necessity of

[91] While I ultimately disagree with his interpretation of Descartes on this issue, Pasnau's (2011, 300-316) discussion of this controversy is easily the most helpful I have encountered.
[92] See, in addition, Garber (1992, 147) and Downing (2018, 71).
[93] Of course, given that the laws themselves are conceptually necessary for Descartes, the distinction must ultimately be that the necessity of impenetrability follows from God's nature rather than from extension. The distinction is nevertheless important. The revisionist Descartes should, for example, think colocation conceivable and therefore possible in miraculous cases, whereas the orthodox Descartes should not.

impenetrability restricts the possible modes of any corporeal system to those that do not involve overlap. However, *pace* Fontenelle, I further argue that this necessary connection is not well understood in terms of causal activity. Consequent as it is upon the conceptual connection between extension and impenetrability, the necessity in question is itself conceptual. Thus, bodies exclude one another in the same way that triangles exclude four-sidedness. However, such conceptual restrictions clearly do not involve causal activity, and so efficient causation is not afoot. In fact, explanations from impenetrability ground out in the material essence, and so, in Cartesian terms, the explanations are formal rather than efficient causal explanations. This should be unsurprising, at least upon reflection. Cartesian bodies are, after all, geometrical objects, and impenetrability is a conceptual truth about such objects, and so explanations from impenetrability are akin to explanations from other conceptual geometrical truths like, say, the Pythagorean theorem. In both cases, the explanations ground out in conceptual facts derivable from an essential property of extended things (or subset thereof, such as triangles).

All this in mind, let us begin by laying out Bennett's charge of circularity.

21. Bennett's circle

Bennett's charge of circularity arises from a consideration of how Daniel Garber (1992, 147) glosses the impenetrability argument:

> The argument is simple and ingenious. If a body is an extended thing, in the sense in which Descartes understands it, then take away extension and you take away body. But if two bodies could interpenetrate one another, then the total volume, and thus some amount of body itself, would be eliminated… Consider two spheres, A and B, approaching one another and eventually appearing to interpenetrate. If they do interpenetrate, then the total volume of A and B is less than the total volume of the two spheres before interpenetration. And so, Descartes concludes, some amount of bodily substance must be eliminated in the process of this supposed interpenetration. Descartes's claim seems to be that… the area of apparent overlap belongs to one sphere alone… and that a corresponding amount of [the other] has been annihilated.

The inference proceeds, according to Garber, from the amount of volume present over the course of the interaction to the impossibility of interpenetration. Recall that the impenetrability argument has the following two premises in need of motivation:

P1) The supposition of interpenetration entails that a quantity of volume equal to that of the region of purported overlap has been annihilated.

P2) If so, then the initial supposition of interpenetration has been falsified.

Garber interprets Descartes as justifying each premise via lost volume. So, (P1) is meant to be true because the "total volume of A and B is less than the total volume of the two spheres before" the interaction. For simplicity, assume the overlap is total. Then, before the interaction, there are two things occupying two units of non-overlapping volume, whereas after the interaction only one unit of overlapped volume is occupied. This same is true for cases in which the overlap is partial. In those cases, before the overlap, there are two identically sized proper parts occupying two units of volume, whereas afterwards these parts overlap and so occupy a single unit of volume. Thus, in conceiving of interpenetration, we are *ipso facto* conceiving of a state of affairs in which total volume has decreased by precisely the volume of the overlap region. Since lost volume just is lost matter, this shows that an equivalent quantity of matter has been annihilated. Similarly, (P2) is meant to be true because the lost volume is lost in the region of purported overlap, since it is the overlap that is responsible for the reduction.

To be a bit more precise, let V_A be the volume of the first sphere, V_B be the volume of the second sphere, and C be the volume of overlap region, and let V_t and $V_{t'}$ be the total volumes of the system before and after the interaction occurs. Garber implies the following analysis:

$V_t = V_A + V_B$

$V_{t'} = V_A + V_B - C$

If interpenetration occurs, then C is non-zero. Which implies:

$V_t \neq V_{t'}$

$\Delta V = V_t - V_{t'} = C$

Again, volume is just a way of talking about the quantity of matter, and so a quantity of matter, equal to the volume of C, has been annihilated.

Now, according to scholarly orthodoxy, the impenetrability argument amounts to the derivation of a conceptual truth about extension. The question, then, is whether it is conceptually possible to offer different characterizations of the total volume of the system at either *t* or *t'*.

Garber answers negatively on the grounds that the volumes of the locations occupied at *t* and *t'* are clearly given by the above equations. The problem with this is that it assumes that the sum of the volumes of each sphere equals the total volume of the locations occupied by at least one sphere. This, however, is true if and only if (i) the two spheres share no parts in common and (ii) parts of the two spheres cannot simultaneously occupy an identical location. Obviously, (ii) is the problematic element of this biconditional, since the impossibility of distinct bodies simultaneously occupying a location is just the impenetrability thesis – it is what was to be shown. Noticing this, Jonathan Bennett (2001, 31) writes that the impenetrability argument succeeds only on the circular assumption that bodies cannot share any space, by which I understand him to mean (ii).

Absent this circular assumption, the proponent of colocation is free to characterize Garber's two spheres system, for any value of *C*, as follows:

$V_t = V_A + V_B$

$V_{t'} = V_A + V_B$

$V_t = V_{t'}$

$\Delta V = 0$

The reason *C* drops out of the above characterization is because proponents of colocation will not grant at the outset of the argument that it is impossible for two things to simultaneously occupy the *C*-region, since this would be tantamount to granting the conceptual impossibility of interpenetration. So, they need not grant that the size of that region has any bearing on the sum of the volumes of each sphere. In other words, the proponent of colocation ought to hold, *contra* Garber, that the volume of the locations occupied by the spheres can change without altering the sum of volumes of the spheres themselves: That is just what colocation means. Descartes held this to be impossible, of course, but as rendered by Garber the impenetrability argument justifies this position by assuming it. And that, of course, is no justification at all. To return to the dialectic between Descartes and More, this means that More was correct: Descartes is not entitled to assert the impenetrability of matter, for he refuses to admit that matter is essentially impenetrable and has no non-circular argument deriving impenetrability from extension.

At this point, two natural escapes from Bennett's circle bear mentioning. The first is the contention that the region vacated when the spheres overlap gets into the act, perhaps via a conservation of matter law. Riffing on an obscure (to me, at least) comment from Alan Gabbey (1980, fn. 27), Lisa Downing (2018, 69) offers the following possible line:

> Suppose two pieces of extension shift so as to overlap. Then it would seem that a gap has opened up. But the 'gap', of course, is extended, so it is a body, and, supposing the overlap is genuine, you have more body than you used to have, but that violates '*ex nihilo nihil fit*' [from nothing, nothing comes].

The possibility broached here is that the problem with the supposition of overlap is that it requires a miraculous creation of new matter to fill in the resulting gap in the plenum created by a novel overlap region. As Downing notes on different grounds, however, this is a red herring.[94]

[94] The grounds Downing (2018, 69-70) cites are that the constructed inference moves from overlap to the creation of new matter *ex nihilo*, whereas Descartes actually moves from the impossibility of overlap to the necessity of annihilation. This is also decisive.

Granted, Descartes and the proponent of colocation are both presumably committed to a conservation of matter principle, but, like all conservation laws, this one applies only to closed systems. What happens in the now vacated location is, however, obviously outside the system and thus irrelevant.[95] As for what does happen, presumably matter from outside the system occupies the location at *t'* from elsewhere in the indefinitely large plenum, much as water occupies the locations vacated by a submarine as it travels underwater. And, just as the water occupying those vacated locations is obviously irrelevant to the question of whether any submarine-matter has been lost over time, so also the matter filling the locations vacated by the spheres is obviously irrelevant to whether the spheres themselves have lost any volume.

Second, Pasnau (2011, 320) has suggested, in addition to his revisionary understanding of impenetrability in terms of natural necessity, that what is at stake throughout Descartes's discussion of impenetrability is "non-overlapping" quantity rather than volume *simpliciter*. All on its own, this is an interesting tack. So, suppose Descartes appeals to the conservation of non-overlapping volume within closed systems to defend the impenetrability argument. This is to assume that within a system in which no amount of matter is created or destroyed, the sum of the volumes of all the locations occupied by one and only one body is a constant. This does indeed establish that the volume of the overlap region in the two spheres system must be a constant. Crucially, however, that constant need not be zero. The overlap could in fact be total, provided that the overlap remains total throughout the interaction. Thus, the conceptual impossibility of

[95] In other words, the closed system is defined not by location but by constituent bodies, just as an elementary problem in electromagnetism concerns a closed system of point charges rather than the locations occupied by those charges. Of course, closed systems in Cartesian physics require an idealization, since the impossibility of a vacuum and indefinite size of the plenum imply that there are no truly isolated systems: Every Cartesian body is in direct contact with others always and on all sides. Perhaps this idealization is problematic, but even if so, it is hardly a difficulty unique to the case at hand. In fact, the issue of idealized and non-idealized systems in Cartesianism is underexplored; the most helpful discussion of the subject of which I am aware is that of Slowik (2002, 86-90), though even this discussion is concerned with a specific idealization, namely the assumption of poreless bodies.

interpenetration can be established along such lines only by assuming the impossibility of an initial region of overlap. The proponent of overlap will obviously not assume *that*, and Descartes can do so only on pain of circularity. To assume that it was impossible for God to create an initial region of overlap is just to assume that overlap is conceptually incoherent, and that, of course, is just to land back in Bennett's circle.

22. Against revisionism

Let us turn now to the revisionary reading of Robert Pasnau, who contends that the trouble is not just with Garber's specific interpretation of the impenetrability argument, but with the scholarly orthodoxy according to which Descartes holds impenetrability to follow from extension as a conceptual truth.[96] On the contrary, Pasnau (2011, 319) argues that if "Descartes's argument is to have a chance at success, it needs to be construed… so as to follow from facts about bodies as they are in the natural world." In other words, the impenetrability of matter is naturally rather than conceptually necessary: it is a truth about matter as it happens to exist, not a truth about what must be the case for something to be corporeal.

Here is how this revisionist reading goes. First, note that there is a tension in Garber's interpretation of the impenetrability argument. On one hand, Garber (1992, 146) emphasizes that the "notion of impenetrability… is a direct consequence of the very notion" of extension. This is both characteristic of the orthodox reading and exegetically persuasive. On the other hand, Garber sees the violation of a conservation principle, namely the conservation of volume and

[96] Actually, Pasnau (2011, 318) is understandably cagey about his interpretation: "There is no argument in this [enormous] book that I have gone back and forth on so many times." Pasnau attributes this instability to the possibility of construing the argument either in the orthodox or the revisionary way, opting for the latter on the grounds that the former interpretation renders the argument a failure. This is quite sensible, I think. Thus, my terming his reading 'revisionary' should not be taken as a straightforward value judgement. My own eventual interpretation is basically an attempt to rescue scholarly orthodoxy by preserving the philosophical virtues of Pasnau's interpretation without the attendant reconceptualization of the necessity at issue.

therefore matter, as central to the impenetrability argument. Again, the inference proceeds, for Garber, from the total volume occupied by the two spheres to the claim that some sphere-matter has been annihilated. This looks less like the derivation of a conceptual truth and more like an application of natural law. Pasnau (2011, 320), in effect, takes up this suggestion, arguing that the impenetrability of matter is vouchsafed nomologically via the conservation of non-overlapping quantity: "it is logically possible for bodies to overlap… the fact that they do not is a result of the laws of nature rather than any conceptual point about extension." So, the impenetrability of matter is a top-down imposition of God, rather than a bottom-up fact about what is conceptually required of a material thing: Impenetrability is a fact about God's creative activity rather than a conceptual truth about matter.

On its face, this is difficult to swallow as an interpretation of Descartes: There are, after all, good reasons why taking impenetrability to be a conceptual consequence of extension has enjoyed the status of scholarly orthodoxy. Before rehearsing these good reasons, however, we should note the significant philosophical virtues of Pasnau's proposal.

Chief among these virtues is that the revisionist Descartes can escape from Bennett's circle. Recall that the circular assumption, in Bennett's original presentation, is that it is conceptually impossible for two distinct bodies to share any space. If the impenetrability argument amounts to an application of natural law, however, no such assumption is required. The revisionist Descartes is free to consider interpenetration a conceptual possibility, since nothing about extension itself rules out colocation. Granting this conceptual possibility has the additional benefit of making sense of why geometrical objects are freely considered, by Descartes and everyone else, to be colocated in geometry. Again, there is nothing incoherent about such suppositions, it is just that, as a matter of fact, God did not create a universe in which

such things happen in non-miraculous cases. In short, the conservation of non-overlapping quantity is simply a fact about God's creation and re-creation of the universe.[97] Similarly, it simply happens that, as a matter of fact, God did not create any initial regions of overlap.

The philosophical virtues of the revisionist reading are therefore considerable. Unfortunately, the same cannot be said from an exegetical point of view. First, note that what is doing all the explanatory work on the revisionary reading is a conservation law that does not ultimately rest on the nature of matter, but on the nature of God. Again, Cartesian conservation laws are true and epistemically accessible because the divine essence is such that God creates the same amount of stuff in the same orderly way, miracles notwithstanding. The problem is that Descartes consistently refers More to extension in explaining impenetrability, while he does not refer to God's nature at all, except by way of arguing that God's presence in the world does not amount to his being extended in the strict sense (AT 5.269-270; 5.341-343). One wonders, if the divine rather than the corporeal nature is ultimately doing all the explanatory work, why Descartes did not refer More to the divine nature instead.

Furthermore, Pasnau is compelled to read Descartes's insistence that it is impossible to conceive of interpenetration in an unnatural way, according to which what is being claimed is that it is impossible to conceive such a state of affairs obtaining non-miraculously. That does not seem to be Descartes's intent. He appears to want to claim that impenetrability comes for free with extension, that no extended thing could ever be colocated with a distinct extended thing. If the impossibility of interpenetration is just one of the rules God follows in creating the universe,

[97] There is another philosophical problem here, albeit one not unique to the matter at hand. Why, one wonders, did God decide to conserve one quantity rather than another? Descartes thinks the laws of nature follow from the divine attributes, but it is unclear how these attributes could establish that, say, motion rather than speed is conserved. This is a deep problem for Descartes, but for that very reason it is not a very deep problem for Pasnau. One intriguing suggestion that might alleviate this problem, at least with respect to motion, is that the relevant conservation law reflects the formative influence of hydrostatics within Descartes's thought; see Gaukroger (2002, 115). Even if workable, however, this specific solution leaves the general problem unsolved.

then Descartes's repeated insistence on the inconceivability of interpenetration and on extension rather than on the divine nature is obscurantist.

The revisionist reading is thus worth avoiding on exegetical grounds. Still, such worries are not necessarily decisive so long as the revisionist reading alone enjoys its philosophical advantages. What is wanted is therefore a way of defending the orthodoxy that enjoys these same advantages without the attendant exegetical disadvantages.

23. Inconceivability and impenetrability

Let us begin by considering some key text from Descartes's letters to More in which he argues for the impenetrability of matter:

> If we examine what this extended being which I described is, we will find that it is clearly the same as the space which the vulgar suppose sometimes to be full and suppose sometimes to be empty… For in a space… we all easily imagine various parts of determinate size and shape, and one part can be transferred in imagination to the location of others, but in no way can two parts be conceived [*concipere*] as simultaneously penetrating one another in one and the same place, since this involves a contradiction (AT 5.271)

> It is not possible to understand one part of an extended thing to penetrate another equal part without thereby understanding half of this extension to be removed or annihilated (AT 5.372)

The similarity between the two letters on this subject is striking, and reinforces the orthodox position that Descartes conceives of impenetrability as a conceptual consequence of extension. Furthermore, and *pace* Garber, Descartes does not seem in either case to be inferring the impenetrability of matter from the volume of occupied locations. Nor, *pace* Pasnau, does he seem to be inferring the impenetrability of matter from facts about God's creative activity. Instead, he seems to be doing exactly what scholarly orthodoxy has always taken him to be doing, namely inferring the impossibility of interpenetration from the essence of matter. He is inferring the impenetrability thesis from the extension thesis as a conceptual truth.

A promising way to understand this inference is to exploit the connection Descartes stresses to More between divisibility and extension:

> [T]angibility and impenetrability have a relation to parts and presuppose the concept of division or limitation, whereas we can conceive a continuous body of indeterminate size, or an indefinite body in which there is nothing to consider except extension… One can distinguish by the imagination various parts of determinate size and shape, each non-identical with the others. Some of these parts can be imagined as transferred to the place of others, but no two can be imagined simultaneously in one and the same place. (AT 5.269-270)

Several features of this passage require comment. First, the immediate context once again shows that Descartes is making more than one point: He is attempting to establish both that extension is basic to materiality and also that the sense in which God (as well as angels and finite minds) is extended must be distinguished from extension properly so-called.[98] This latter aim cannot be totally ignored in the present context, as it at least partly accounts for why Descartes emphasizes divisibility and parthood, as these clearly cannot pertain to Descartes's simple God. Still, it cannot be doubted that Descartes is thinking that there is some conceptual connection between parts and impenetrability, for he a little later insists this same reasoning would apply to empty space if, *per impossible*, such a thing existed (AT 5.271).

Descartes also suggests in the above passage that we can conceive of a material object of indeterminate size that is devoid of parts. If impenetrability were meant to follow from the having of parts, this would be a troublesome object. Descartes did not believe that two (or three, or four...) indefinitely large, partless material objects could interpenetrate; such would be tantamount to admitting that there could be an indefinite number of overlapping material universes. This unacceptable consequence is avoided by considering the role subsequently played by the imagination in the text. Descartes is thinking that we can conceive of an

[98] What sense that is has itself been a matter of dispute in recent years. See Slowik (2019).

indefinitely large material object that, as a matter of fact, happens not have any parts. But it is nevertheless the sort of thing that *could* have parts. It is not divided, but it could be; God could cause it to have as many parts as suited him at any moment. This motivates the contrast with God, since God could not cause himself to have parts. It also shows extension to be prior to divisibility, since we can conceive of an extended thing that happens not to have any parts, but we cannot imagine anything with parts that is not extended, for, as Descartes elaborates, "Nothing of this kind can be said about God or about our mind" (AT 5.270). Finally, it allows Descartes to maintain that the impenetrability thesis holds with respect to all and only extended objects, since what is important is not that an object has parts, but that be the sort of thing that could have parts. And this is true, he thinks, of all and only extended things.

So far, so good. But if the "reference to parts" is not the possession of parts, what is it? A strategy for how to proceed here can be gleaned from the work of Dennis Des Chene (1996, 381), one that hangs on (i) finite bodies being really distinct and (ii) having "that mode of existence which entails that one body is really distinct from another only if their locations are disjoint."[99] The idea would be that bodies cannot both be really distinct and share a part, since part sharing implies that the locations of the bodies are not disjoint. I do not find this proposal attractive, however. First, (i) is a controversial claim among Cartesian scholars.[100] Even setting this concern aside, however, the solution remains unsatisfying: Des Chene (1996, 381) admits that he is "not sure" that his response "does not again beg the question" at issue. Neither am I. The problem is that one needs to spell out why extended things have "that mode of existence"

[99] For another interesting attempt, see the discussions of Anfray (2014), (2020).
[100] For the view that Descartes does not endorse (i), see Secada (2000a, 208-210) and Sowell (2004). The chief difficulty with an interpretation like that of Secada and Sowell is how to make sense of passages like *PP* 1.60. The chief difficulty with an interpretation like that of Des Chene is that it is difficult to see how finite bodies count as substances according to the existential independence criterion on substantiality noted above (§10). I discuss this issue below (§33).

whereby they are distinct things only if they are not colocated. Absent further justification, the proponent of colocation will rightly complain that this is just Bennett's circle in different clothing. To assert (ii) is to assert the impossibility of colocated, non-identical corporeal things, which is, of course, just to assert the impenetrability thesis.

There is, however, a non-circular way forward. Here is the basic idea. First, the impenetrability argument hangs on our inability to conceive of interpenetrating regions as distinct from one another. This much seems clear from the text itself: Descartes consistently maintains that genuine colocation is quite literally inconceivable. The question, then, is what goes wrong when we try and conceive of such a state of affairs.

Now, I take it as given that if two bodies are distinct, there must, at minimum, be some principle of individuation such that they are countable.[101] Since, *ex hypothesi*, location cannot serve as the principle of individuation for colocated regions of extension, the principle of individuation must be some property of the overlapping bodies themselves. Here we come to the heart of the matter: Interpenetrating regions of extension share all such properties, and so it is impossible to provide a property by which to individuate them. To say that two bodies are colocated is just to say that they have the same location, dimensions, and so on, but, if bodies are purely geometrical objects, then their properties are exhausted by location, dimensions, and the like. Thus, it is inconceivable that two colocated bodies could be non-identical, because there is no divergent property by which to individuate them. So, the impenetrability argument asserts that if interpenetration is possible, then we ought to be able to conceive of two regions (read: possible

[101] One could put this point in terms of the identity of indiscernibles, and such an attribution would not be a particularly radical position. Flage and Bonnen (1999, 225), for instance, suggest that Descartes relies on that principle in establishing the uniqueness of infinite substance in the *Meditations*. Secada (2000a, 212) goes further, arguing that Descartes is in fact committed to something *stronger* than the identity of indiscernibles in the case of numerically distinct substances. I steer clear of the principle mainly to steer clear of related disputes about how the principle should be understood.

parts) of extension as both non-identical and colocated. As I read him, Descartes thinks we cannot do this, and so he concludes that interpenetration is inconceivable, incoherent, and conceptually impossible, such that impenetrability is a conceptual truth about extended substance. And, of course, this inference does not run afoul of Bennett's circle. For the argument turns not assuming that bodies cannot share space, but on the perfectly reasonable requirement that the proponent of colocation provide a principle of individuation for colocated bodies.

Put another way, trying to conceive of two colocated but distinct Cartesian bodies is like trying to conceive of two colocated but non-identical regions of Euclidean space. Indeed, for Descartes, the two come to the same thing. Now, this recalls Funkenstein's worry regarding the apparent colocation of extended things in geometry itself. My rendering of the impenetrability argument highlights this problem, since on my view the impenetrability argument actually exploits the conceptual incoherence of colocation in geometry rather than simply (and apparently disastrously) implying it. This difficulty, however, is easily overcome.

Above (§21), I argued that Garber could justly equate the sum of the volume of two spheres with the sum of the volume of the locations they occupy if and only if (i) the two spheres share no parts in common and (ii) parts of the two spheres cannot simultaneously occupy an identical location. Previously, our concern was with the circularity, vis-à-vis the impenetrability argument, inherent in condition (ii). Now, I want to call attention to condition (i). The rough idea here is that two entities can share a region of extension as a common part, much as the territorial extent of the European Union and of NATO both include Germany without implying that two non-identical regions of land overlap in-between the Oder and the Rhine. Rather, the EU and NATO both include an identical part, the territory of Germany. Similarly, Descartes can maintain that two geometrical objects overlap by sharing a part without contravening the impenetrability

argument, since the sharing of a part is not colocation in the relevant sense. So, once again, there is no difference between material and geometrical objects: Colocation is conceivable, in both geometry and physics, only if it is understood as the sharing of an identical part.

With all this in mind, let us walk through the impenetrability argument in detail. Consider two bodies, P and Q. Suppose that P interpenetrates Q. If so, then there is some location, call it S, that is shared by parts of P and Q. The question is whether we can distinguish a part of Q that occupies S from a part of P that also occupies S. For convenience, call these parts, Q_S and P_S, respectively. Is there some principle of individuation that serves to distinguish Q_S from P_S?

There is not. If there were, it would have to be either an intrinsic or an extrinsic property. But not intrinsic, for colocated regions of extension, as purely geometrical objects, have identical intrinsic properties. They are not colored or endowed with substantial forms, motive force, or anything like that, owing to the parsimonious mathematical character of Cartesian matter. In the present context, this means that the intrinsic properties of Q_S and P_S at a time are exhausted by their geometrical properties—that is, by shape and size. And, of course, the shape and size of colocated regions of extension are identical. So, there is no way to individuate Q_S and P_S via their intrinsic properties. But their extrinsic properties will not do either. Again, Q_S and P_S are merely geometrical objects that are in exactly the same place at exactly the same time, so there is no way to individuate them in terms of spatiotemporal location or any other extrinsic property proper to a geometrical thing. In short, Q_S and P_S are two names for the same thing. P and Q are not interpenetrating each other in any relevant sense; rather, they simply share an identical part.

Why, then, does Descartes speak of annihilation in the correspondence with More? After all, the sharing of a part in geometry obviously does not generally require annihilation. I think he speaks of annihilation because he is imagining a case in which bodies were initially separated,

came together, and now overlap. If my reconstruction of the impenetrability argument is correct, then Descartes is thinking that the only way we can clearly and distinctly conceive of two bodies, such as P and Q, overlapping is by sharing a part. Now, once the overlap has occurred, we still have P and Q, which other than moving around remain otherwise unchanged. This means the volume of P before and after the interaction remains the same, and so also for Q. But this means that the sum of the volumes of P and Q must have decreased by precisely the volume of the now shared part and that the lost volume has to be accounted for, via annihilation (how else?), in the now overlapping region. Which is exactly what Descartes insists must have happened.

In short, our rendering of the impenetrability argument as an inference from the conceptual impossibility of colocated and non-identical regions of extension preserves the scholarly orthodoxy that Descartes infers the impenetrability thesis from the extension thesis as a conceptual truth. Furthermore, it does this without falling into Bennett's circle or impinging upon colocation in geometry. In other words, our rendering shares the philosophical benefits of the revisionist reading without the attendant exegetical drawbacks. Indeed, our rendering underscores how the impenetrability of matter follows from some of the deepest commitments within Cartesian metaphysics, especially the identification of geometrical and material objects. For all these reasons, I think it is this inference that we should attribute to Descartes.

This is not, of course, to say that the impenetrability argument, so interpreted, is immune from further criticism. Indeed, two criticisms are immediately pressing. The first is that one could appeal to motion; the second is that one could appeal to the past states of bodies. The basic idea, in both cases, is to provide a plausible candidate for a principle of individuation in cases of colocation. Let us, therefore, lay these objections out and attempt to turn them aside.

24. Motion and Lockean properties

The most immediate difficulty lurking, directly suggested by the above talk of P and Q coming together, is that colocated regions of extension can be individuated via motion. One, after all, might be at rest and the other traveling at great speed. Is such a difference enough to block the impenetrability argument?

I do not think so. The crux of the issue is how to understand Descartes's references to motion as a mode of the moved (*PP* 2.25, 27, 36). While it is perhaps natural to read this as motion being an instantaneous property of the moved, this is misleading. Officially, Descartes understands modes as follows: "By *mode*… we understand exactly the same as what is elsewhere meant by an *attribute* or *quality*. But we employ the term *mode* [in particular] when we are thinking of a substance as being affected or modified" (*PP* 1.56). So, in calling motion a mode of the moved, Descartes might mean that motion is an instantaneous property of bodies, or he might mean that motion consists in matter being "affected or modified" in some way. The discussion of the laws of motion suggests that we take it in the latter sense:

> We must be careful to note what it is that constitutes the power [*vis*] of any given body to act on… another body. This power consists simply in the fact that everything tends, so far as it can, to persist in the same state, as posited in our first law… what is at rest has some power of remaining at rest and consequently of resisting anything that may alter that state of rest; and what is in motion has some power of persisting in its motion, i.e. of continuing to move with the same speed and in the same direction (*PP* 2.43).

The reference to the first law points to the following, and already familiar, passage:

> From God's immutability we can also know certain rules or laws of motion, which are the secondary and particular causes of the various motions we see in particular bodies. The first of these laws is that each thing, insofar as it is simple and undivided, always remains in the same state, as far as it can, and never changes except as a result of external causes… If it is at rest, we hold that it will never begin to move unless it is pushed into motion by some cause. And if it moves, there is equally no reason for thinking it will ever lose this motion of its own accord (*PP* 2.37).

The upshots of this in the present context are the following. First, note again that Descartes ultimately grounds a body's "power" to remain in a given state of motion or rest in a law of

nature. Second, this law of nature is itself grounded in the divine nature, not in any facts about matter. That is, God's immutability grounds the law via the constancy of his act of creation and conservation in non-miraculous cases: Again, Cartesian conservation laws amount to affirmations that God always creates the same amount of stuff in the same orderly way. With respect to motion, the picture that emerges is the following. Motion is indeed a mode of the moved, but only in the sense that it is a function of how bodies are "affected or modified" by God over time. There is nothing to motion other than God's creating a body first here and then there. In other words, motion is just a fact about divine creative activity, not a property that bodies themselves possess at any particular time.

The importance of this is obvious. That motion is a mode of the moved does not amount to the claim that matter has a motion property at any given moment. This, in turn, means that motion does not provide a way of distinguishing P_S and Q_S from one another, and this means that, even if P and Q happen to be moving relative to one another, P_S and Q_S remain indiscernible and thus identical at every moment.

There is, however, another passage that bears mentioning, as it might seem to suggest that Descartes is thinking that motion is an instantaneous property of the moved.[102] Here it is:

> For he [God] always preserves the motion in the precise form in which it is occurring at the very moment when he preserves it, without taking any account of the motion which was occurring a little while earlier. It is true that no motion takes place in a single instant of time; but clearly whatever is in motion is determined, at the individual instants which can be specified as long as the motion lasts, to continue moving in a given direction along a straight line (*PP* 2.39).

One might take this talk of the rectilinear determination of motion at an instant as an affirmation that moving bodies have an instantaneous motion property. This, however, is mistaken. Rather,

[102] Slowik (1999, 183) seems to me to take up this suggestion. There is also a parallel passage in *Le Monde* (AT 11.44-45), though in my view this passage is of dubious value with respect to Descartes's mature position.

what is going on is that God, at every moment, is determined to move an object from one location to another, which means he is determined to move it along a straight line from here to there. Indeed, he could not do otherwise; there is no sense in which God could create an object first here and next there without the resulting movement amounting to movement in a straight line. The key to seeing this is that one cannot describe a curve with only two points: Two points always determine a straight line. That, I think, is what Descartes is getting at here.[103] The rectilinear character of instantaneous determinations of motion is to nothing more than God's determination to subsequently create bodies some other place. And, again, this tendency could in no way be read off the material object itself at any point, because it is not a property of that object but of God.

Moreover, and decisively, Descartes officially defines motion in terms of *translatio*, or transfer: "motion… in accordance with the truth of the matter… is the transfer of one piece of matter… from the vicinity of the other bodies… which are regarded as being at rest, to the vicinity of other bodies" (*PP* 2.25). Motion, in the strict sense, thus requires the comparison of two points of time.[104] This, in turn, means that to speak of motion as an instantaneous property is to speak loosely or to talk nonsense. So, motion cannot serve as the principle of individuation between colocated regions of extension at any given time. And so, there is no objection to the impenetrability argument in the offing.

Another natural objection is the, broadly Lockean, thought that things are individuated by their histories. Perhaps, then, P_S and Q_S are individuated by having once had disjoint locations.

[103] I do not mean this argument to hang on temporal atomism, though it is of course consistent with it. The idea is just that the most basic movements are determinations to create a thing first here and then there, which always amounts to movement in a straight line. On Descartes's conception of time, see Secada (1990).

[104] The strict sense of motion is also relational. These complexities are, however, worth avoiding, as they introduce disastrous complications. For example, the strict, relational definition of motion plainly implies that the situations at issue in Descartes's fourth and fifth collision rules concern equivalent situations, yet Descartes treats the two situations as if they are different (*PP* 2.49-50); on this problem and related concerns, see Slowik (2002, 60-62).

After all, they are easily individuated prior to overlapping, and so perhaps can be individuated when overlapping by reference to earlier times. Indeed, knowledge of that fact that the two spheres now overlap is predicated on knowledge of their pre-overlap volumes. Small wonder, then, if my ability to individuate the now overlapping regions also hangs on their previous states.

My reply here is twofold. First, I am not aware of Descartes ever appealing to such a principle of individuation or to such historical properties; I highlight the Lockean character of the proposal precisely to stress its lack of Cartesian pedigree. As such, the proposal is purely speculative even if workable. Second, it is difficult to see how Cartesian ontology could accommodate such Lockean properties, at least if they are understood as corporeal, as they must be to cut ice in the present context. It is difficult to see how a purely geometrical thing could have the relevant property: One could, after all, know everything there is to know about the size and shape of a geometrical object and remain ignorant of its previous locations. Furthermore, we have just seen that motion is best understood in terms of divine creative activity rather than in terms of properties bodies themselves possess at particular times, and so Lockean properties cannot be smuggled into the ontology via motion. This is not necessarily to say that the proposal is without philosophical merit, but it is to say that such a proposal is not a Cartesian proposal. Thus, no objection to our rendering of the impenetrability argument is in the offing.

25. The zeroth law of Cartesian physics

Let us briefly recapitulate the main upshots of the foregoing discussion of impenetrability before returning to Fontenelle's impenetrability-based challenge to Cartesian occasionalism. First, recall that the overarching inference of the impenetrability argument is the following:

P1) The supposition of interpenetration entails that a quantity of volume equal to that of the region of purported overlap has been annihilated.

P2) If so, then the initial supposition of interpenetration has been falsified.

C) So, the initial supposition of interpenetration has been falsified.

According to our reading, (P1) rests on the impossibility of conceiving of two bodies which are both colocated and non-identical. In other words, the only way of conceiving of colocation is to conceive the sharing of a proper part. So, if two formerly non-colocated bodies now overlap, it must be the case that they now share a part. This, in turn, means that some part that existed pre-overlap no longer exists, since where once there were two parts there is now only one. In other words, the supposition of interpenetration entails that a quantity of volume equal to the volume of the now shared part has been lost. So, (P1) is true.

Why, then, is (P2) true? The answer is simple: The overlap region is where a part is now being shared; it is where there is now one thing in place of two. So, whatever volume has been lost has been lost there, and in such a way that no colocation (understood as something other than part sharing) has occurred. And so, (P2) is true.

We also noted an objection that turned on the pervasiveness of colocation in geometry. This objection is easily parried: The colocation of geometrical objects is conceivable because there is nothing inconceivable about geometrical objects sharing proper parts. And so, colocation is conceivable in both geometry and physics only if understood as the sharing of parts.

All this in mind, let us return to Fontenelle's challenge. Fontenelle contends that impenetrability grounds a necessary connection between bodies and subsequent distributions of motion *and* that this necessary connection qualifies bodies as partial efficient causes of those distributions. So, Fontenelle purports to show that impenetrability implies that Cartesian bodies are causally active, such that occasionalist interpretations of Cartesian physics are untenable.

Now, it should be beyond dispute that the necessary connections identified by Fontenelle obtain. This is undeniable because the necessity at issue is grounded in the Cartesian conception

of materiality. Thus, Fontenelle's challenge turns on the dictum, well-put by Aquinas, that "what things do reflects what they are" (*QPD* 3.1).[105] For an Aristotelian like Aquinas, the paradigmatic instances of this fact are to be found in the exercise of creaturely powers – fire heats because fire is essentially hot, for example. Fontenelle attempts a similar move within the Cartesian context – Cartesian bodies exclude one another because they are necessarily impenetrable, and they are impenetrable because they are essentially extended. The great virtue of this strategy is that it insulates Fontenelle purported causal power from charges of metaphysical incoherence; its great defect is that it robs impenetrability of its plausibility as a locus of causal activity.

To grasp what goes wrong with Fontenelle's challenge, it is helpful to consider how Descartes would understand Aquinas's dictum as applied to impenetrability. Of course, there is a sense in which impenetrability reflects what it is to be a body, and so in that sense the dictum is apt. Crucially, however, what is at stake for the Aristotelian is the empirical observation of the exercise of a causal power – observations which, moreover, ultimately play a part in attaining understanding of the relevant essential properties. For Descartes, by contrast, what is at stake is the derivation of a merely modally necessary property from an essence – an essence which has been grasped in a purely intellectual manner. Descartes does not, that is, direct More to conduct an experiment or to undertake systematic observations in order to establish the relationship between impenetrability and materiality. Instead, he provides him with an *a priori* argument that purports to derive impenetrability from extension as a conceptual truth. We thus have yet another

[105] This pleasing if perhaps not quite literal translation is borrowed from McDermott's *Thomas Aquinas: Selected Philosophical Writings*. The actual Latin is *agens agit sibi simile*; more literally, the idea is that a cause causes things similar to itself. For example, that fire causes heat in objects reflects that fire is itself necessarily hot owing to its nature. The analogy to the Cartesian context would then go like this: That bodies exclude one another reflects that matter is itself necessarily impenetrable owing to the corporeal essence. Of course, the Aristotelian principle is not necessarily restricted to the case of essential properties – it is more akin to the more general and more ancient principle that like causes like.

instance of Descartes substituting an intellectual explanation from essence where an Aristotelian would appeal to empirical observation and causal powers. The reason Cartesian matter is impenetrable thus has nothing to do with corporeal or even divine causal activity as such: Bodies are necessarily impenetrable because impenetrability is a conceptual consequence of materiality.

The cogency of Fontenelle's challenge thus turns on whether this sort of conceptually necessary connection is best understood as an efficient cause, and it clearly is not. Granted, putting the point in terms of exclusion is both apt and rings of causal activity. Nevertheless, understanding impenetrability in this way is ultimately bizarre. The exclusion in question is exactly analogous to the way in which triangularity excludes four-sidedness: Just as God cannot create something that is both a triangle and four-sided, God cannot create something that is both material and capable of interpenetration. Obviously, however, this does not mean that triangles or triangularity are literally *acting* on God or anything else. A triangle is not an efficient cause of God's subsequent creative activity; it is just that, in virtue of what it is to be a triangle, God cannot create a triangle with four sides. In exactly the same way, God cannot create something extended and penetrable, but this does not mean that bodies or extension are literally acting as efficient causes that restrict God's creative activity or influence distinct bodies. In fact, the appropriate causal notion in this context is not efficient but formal causation, because the explanations in question are from essential properties and not causal activity. This should be unsurprising, since explanations from the impenetrability of matter are, for Descartes, quite literally explanations from a conceptual truth of geometry.

Here, then, is what Descartes would have said to Fontenelle. Occasionalism is a thesis about causal activity, in particular about whether bodies are endowed with causal powers. The occasionalist is distinguished by claiming that God alone is a genuine efficient cause, while

bodies are relegated to the status of the occasional causes of God's activity. The impenetrability of matter, while grounding certain restrictions on divine activity, does not accomplish this feat by acting on God or other bodies. Rather, the restrictions are conceptual restrictions that follow from the corporeal nature. So, impenetrability is not a causal power, nor does it involve corporeal causal activity of any kind. And so, Fontenelle's challenge to Cartesian occasionalism fails.

Interestingly, however, Fontenelle's challenge does further highlight the importance of the corporeal as well as the divine essence within Cartesian physics, especially in the context of the laws of motion and accompanying collision rules. For the conceptual restrictions on God's creative activity imposed by impenetrability are not unlike the conceptual restrictions imposed by divine simplicity and immutability. Like these divine attributes, impenetrability allows us to know truths about God's creative activity that are grounded in readily graspable essential properties, in this case extension. Indeed, to pick up a thread from Downing's discussion of Fontenelle and Malebranche, the conceptual restrictions associated with impenetrability furnish the Cartesian occasionalist with a mooring for the mechanistic contact criterion. Such conceptual restrictions force a deviation on God's part only in the case of contact. Thus, the instability Downing identifies in Malebranche's position is arguably a consequence of his failure to fully appreciate and adopt Descartes's emphasis on the formal causal explanations from essential properties characteristic of geometry alongside his geometrical ontology.

All this also shows that there is a deep sense in which Pasnau was on the right track in arguing for a connection between nomological explanation and impenetrability. In fact, I have no objection to understanding impenetrability as a natural law within Cartesianism, provided that nomological explanation is understood as formal causal explanation from essential properties. As such, my disagreement with Pasnau is ultimately that I think that the impenetrability law should

be understood as conceptual truth derived from the corporeal essence. Pasnau, by contrast, rescues the impenetrability argument by restricting it to something weaker than a conceptually necessary truth about extension. The authentic Cartesian position, in my judgement, is that essential properties of God and matter impose conceptually necessary and intellectually perceptible restrictions on divine activity, namely the laws of nature.

The impenetrability of matter is undoubtedly among the most important such restrictions. It is therefore surprising that Descartes does not give it further attention. Impenetrability is distinguished from the canonical laws of motion by being derived from the corporeal rather than the divine essence, and perhaps this partly explains why Descartes does not explicitly number it among his laws. Moreover, Descartes certainly cannot be faulted for failing to explicitly discuss every conceptual truth assumed within his physics, especially those which he expected to elicit little, if any, pushback. Still, the laws of motion and accompanying collision rules undeniably rest on the tacit assumption that extension is necessarily impenetrable. Furthermore, this assumption itself expresses a conceptual restriction that is like those embodied within the canonical laws in all important respects. One could, therefore, with some justice and to some advantage, dub impenetrability the zeroth law of Cartesian physics.

Chapter 5

Descartes's Geometrical Occasionalism

Précis

In the last chapter, we defanged the most serious obstacle to the occasionalist interpretation of Descartes: Fontenelle's argument that Cartesian metaphysics implies that impenetrability is a corporeal causal power. This chapter seeks to complete our articulation and defense of Descartes's mathematization of the corporeal and attendant embrace of occasionalism in the corporeal domain. This further work comes in three parts.

I begin by rehearsing some of the standard arguments in favor of the occasionalist interpretation. Next, we will dispense with yet another objection to the occasionalist reading, one that purports to show that Descartes cannot account for the phenomena of condensation and rarefaction without invoking corporeal causal powers or otherwise compromising his geometrical conception of matter. Building on the work undertaken in the last chapter concerning formal causality and impenetrability, I show that this is not so. Finally, we will consider a challenge derived from Berkeley's *Principles of Human Knowledge*. That challenge goes like this: The causal impotence of matter straightforwardly argues for idealism, since the occasionalist has no good explanatory reason to posit material in addition to mental and divine substances. This poses a serious threat to Descartes's geometrical occasionalism, his total equation of material with geometrical objects and his identification of dynamical force with divine efficacy. I argue, however, that Descartes has the resources to rise to the occasion. Berkeley complains that occasionalism robs matter of its explanatory purpose, but this is so only on the assumption that matter's explanatory role must be an efficient causal role. Descartes, as we know, need not admit this. Indeed, we have seen in previous chapters that matter *qua* formal cause figures in his account of impenetrability and thus in nomological explanations. Thus, *pace* Berkeley, the casual impotence of Cartesian bodies does not rob them of explanatory purpose.

26. Against corporeal causal powers

Much ink has been spilled regarding Descartes and occasionalism. Within the vast literature on the subject, a wide range of views have enjoyed support. For example, it has been argued that Descartes holds bodies to possess causal powers,[106] that Descartes wants to hold bodies to have causal powers but that this is inconsistent with his metaphysics,[107] that Cartesians find themselves forced into occasionalism by the problem of mind-body interaction,[108] and that Descartes embraced occasionalism within the corporeal domain.[109] I hold to the latter position.

We have already encountered three negative arguments for the occasionalist interpretation of Cartesian physics. These arguments are as follows. First, Cartesian corporeal ontology apparently furnishes no place for causal powers. Second, corporeal causal powers run afoul of Descartes's rejection of physical forms. Third, corporeal objects are purely geometrical objects and are thus incapable of acting on one another. I call these reasons negative because they constitute not so much an argument for occasionalism as a refutation of its alternatives. To these I will add a fourth, positive reason. This is that occasionalism – supplemented by formal causation – is the theory most germane to the throughgoing mathematization of physics. The main task of the present section is to lay out and defend these four arguments.

First, however, something should be said regarding the relationship between occasionalism and our broader thesis regarding the importance of formal causation. Of course,

[106] By Platt (2011a; 2011b), Schmaltz (2008a), and Hattab (2000; 2007).
[107] By an earlier time-slice of Schmaltz (2003).
[108] By (later Kemp) Smith (1902, 85), Copleston (1958, 176-179) and Radner (1993). Scott (2000) argues that Descartes himself consistently resists such coercion, while Nadler (1994) argues for a somewhat more nuanced reading of Descartes's position. Garber (1993) argues that the mature Descartes is an occasionalist with respect to matter's influence on mind, but not vice-versa, while Ott (2009, 76-78) argues that Descartes is not but probably ought to be an occasionalist with respect to mind's influence on body as well. Fortunately, our focus on the corporeal domain licenses agnosticism on the difficulties associated with minds.
[109] By Garber (1993), Hatfield (1979), and Ott (2009). The earliest advocation in English of which I am aware is Smith (1902).

occasionalism is officially silent regarding non-efficient causation: The occasionalist holds physical objects to lack causal powers, but this is consistent with physical objects serving as non-efficient causes. An occasionalist within the physical domain might still hold God to act towards an end and so speak of final causation, for example. More relevant for our purposes, occasionalists can avail themselves of formal causal explanations from essence.

The issue is, however, complicated by the fact that non-efficient causes are often linked by non-occasionalists to causal powers. An Aristotelian, for example, might explain the motion of a stone towards the center of the earth by invoking the nature and attendant natural motions of the stone, such that the causal powers of the stone are inextricably linked to the essence, or form, of the stone. Nor are such explanations limited to Aristotelianism. An especially clear early modern example is Shepherd, who seeks to overcome inductive skepticism by contending that objects essentially have causal powers characteristic of their kind; she argues, for example, that it is conceptually impossible that fire fail to burn because the power to burn belongs to fire essentially (*ERCE* 52-54).[110] Again, the thought here is that the causal powers of an object are consequent upon the essence of that object. The upshot of these examples is that essences furnish a plausible strategy for the vouchsafing of corporeal causal powers, and that this strategy is alive both in Descartes's predecessors and (at least some of) the moderns writing in his wake.

Perhaps, then, Descartes himself makes use of this strategy of grounding genuine corporeal powers in non-efficient causality? Such interpretations are already familiar to us. We have encountered numerous attempts to ground causal powers in extension and its modes (§13-14, 19).[111] These attempts failed, but the general strategy might still be salvageable. After all,

[110] I have discussed the details of Shepherd's proposal at length elsewhere; see my (2022).
[111] For yet another attempt, see the argument of Manchak (2009) that Cartesian force is a "secondary and tertiary" attribute of extension. The problems with this proposal are the same as with the proposals of Platt, Della Rocca, and Schmaltz, namely inconsistency with conceiving of matter as purely geometrical.

God's omnipotence is grounded in his essence, and one might suspect that corporeal causal powers, if there are any, will likewise be grounded in extension. Indeed, one of the most admirable features of the defense of concurrentism offered by Platt (2011a; 2011b) is that he makes this point fully explicit. So, a defense of the occasionalist interpretation of Cartesian physics should ideally show that such a strategy is unworkable. There are, in my judgement, at least four persuasive arguments for this conclusion.

Our first argument against corporeal causal powers turns on the Cartesian ontological triad of substances, attributes, and modes. Presumably, corporeal causal powers would have to be either substances, attributes, or modes. Obviously, however, causal powers are not substances, since they are neither existentially independent nor ultimate subjects of predication, the two notions of substantiality alive in Descartes (§10). So, corporeal causal powers would have to be understood as either an attribute proper to purely geometrical things or modes thereof. As we have repeatedly noted, these attributes are exhausted by size, shape, and movement (in an attenuated sense). None of these attributes or their modes amount to a causal power. The most promising candidate is motion, but, as argued above (§24), while motion is a mode of the moved it is not a property (still less a power) of the moved. Rather, motion is a mode of the moved in the sense that it is a function of how the moved is modified by God over time. Again, there is nothing to motion other than God's creating a body first here and then there, and so the only causal power afoot is divine. So, motion is not a corporeal causal power. And so, there is no place for corporeal causal powers within the Cartesian ontological categories.

The second argument against corporeal causal powers is that such powers fall prey to Descartes's own arguments against physical forms. I have stated this objection at some length above (§8), and so I will not belabor the point. Suffice it to say that corporeal causal powers

share with physical forms the characteristics on which the Cartesian rejection of physical forms is predicated. Thus, if arguments like the little souls argument succeed at eliminating physical forms, then they also succeed at eliminating corporeal causal powers.

Third, the equation of physical with geometrical objects precludes corporeal causal powers. The inference here is that since geometrical objects lack powers, bodies must as well. No one would claim that a circle in Euclidean geometry possessed motive force or an inertial tendency, yet this is exactly what Cartesian metaphysics forces the advocate of corporeal causal powers to say. The lone candidate that seems to elude this objection is impenetrability, but we have just seen that impenetrability, while undoubtedly central to Cartesian physics and corporeal metaphysics, does not amount to or ground corporeal causal activity (§25). Rather, explanations from impenetrability are formal causal explanations from the corporeal essence.

Fourth and finally, occasionalism harmonizes with some of Descartes's most deep-seated convictions and projects. Reducing the physical to the mathematical was, perhaps, Descartes's signal contribution to the new science, and it was certainly one of his most deeply and consistently held ambitions. A completely mathematical physics, however, has no more room for causal powers than does Euclidean geometry, for the subject matters of the subjects are, on the Cartesian view, identical. As Emily Grosholz (1991, 62) has put it, "nothing more can be said [according to Descartes] about *res extensa* [read: matter] than that it instantiates geometrical forms." The difference between physics and geometry is thus the difference between considering particular geometrical objects and classes thereof – a geometrical demonstration typically proves something of squares in general whereas a physical demonstration proves something of a particular square. Yet, in neither case is there any non-trivial role for efficient causality. What we have in geometrical demonstrations, like those of Euclid or Descartes's own *La Géométrie*, are

conceptual explanations. What we are have are metaphysical formal causal explanations from essence, proceeding downward by genus and species.

Aristotle, as we have seen (§2), put forward an ideal of philosophical science in the *Organon* that similarly traded in metaphysical formal causation. Descartes, as we have discussed at great length, breaks with this particular Aristotelian ideal, even as he preserves a central role for metaphysical formal causation in the guise of nomological explanation (§16-17). For Descartes, the ideal science is mechanics governed by natural law, with the efficient causal interactions characteristic of mechanics conforming to the *regula sive leges* derived from the essential properties of the causal relata: God and matter. There is, however, significant pressure on Descartes to go further than this, to renounce efficient causality *in toto*. For, as we have established above, such a repudiation seems to be required by his geometrical conception of matter, as purely geometrical objects seem unlikely loci for efficient causal activity. That is, if the subject matter of both geometry and physics is *res extensa*, then it is unclear why one but not the other would trade in efficient causal explanation. Unfortunately, however, there is also significant pressure on Descartes to endorse efficient causality. After all, such causal activity is necessary for any plausible physics – some accounting must be made for plainly observed phenomena like motion and its apparent communication via impact. This pressure is made all the more potent by Descartes consistent and enthusiastic embrace of mechanism (§5), the thesis that physical science deals in explanations from matter moving about.

Descartes therefore needs some way to smuggle causal activity into his physics without thereby compromising his geometrical ontology. In other words, he needs to endorse the causal activity required of any plausibly mechanistic physics into the corporeal domain without undercutting its mathematization. He must do this in order to endorse both mechanism and the

complete mathematization of the material without sliding into incoherence. Occasionalism provides him with a path forward, perhaps the only path that salvages both his deep-seated convictions. Mechanism is vouchsafed, because physical explanations are shot through with divine causal activity, activity that deviates only upon contact between bodies without requiring those bodies to actively exclude one another from a location (§23). The mathematization of the material is maintained despite this, since the bodies in question are merely geometrical objects being acted upon by God. Small wonder, then, that occasionalism is the causal theory Descartes reaches for in physics. As far as I can tell, it is the only theory that does not force him to abandon one of his most deeply and consistently held philosophical commitments.

27. Rarefaction: Part I

The above case for our occasionalist understanding of Cartesian corporeal metaphysics is, I think, largely persuasive. Still, some obstacles remain. One such obstacle concerns the apparent inability of Cartesian metaphysics – so understood – to accommodate the plainly observed and much-discussed (in 17th century natural philosophy, anyway) phenomena of condensation and rarefaction. This issue is not as peripheral as it probably appears to contemporary eyes. For example, Xiaona Wang (2018) observes that for many thinkers during the Renaissance, "the phenomena of rarefactions and condensations seemed to suggest, inescapably, that matter must have inbuilt principles of activity." Our interest in such phenomena is motivated along similar lines. Since Descartes holds bodies to be causally impotent extended things, so the complaint goes, he cannot make sense of the phenomena of rarefaction nor the phenomena explained by it. Or, at least, he cannot do so without incorporating corporeal causal powers or otherwise

compromising his purely geometrical ontology. This section and the next aim to articulate this objection to Cartesian occasionalism more fully, then turn it aside.

Descartes's own account of condensation and rarefaction is often mentioned, but often only in passing.[112] When it is mentioned, scholars almost uniformly focus on the mechanistic explanation Descartes provides for condensation and rarefaction rather than on the metaphysical necessity he claims for this explanation in the *Principles of Philosophy* (*PP* 2.7). Significantly, however, it is metaphysical necessity that is at stake, for Descartes's rejection of alternative explanations of condensation and rarefaction is shot through with talk of intelligibility and contradictoriness. In other words, Descartes's official conclusion is that his account of condensation and rarefaction is the only metaphysically respectable account. Let us, therefore, begin by setting forth this Cartesian position in outline. Along the way, some clarifications need to be made and a potential distraction needs to be noted and set aside.

Descartes's canonical treatment of rarefaction consists of three interconnected passages in the *Principles of Philosophy*. Here is the first one:

> But there are still two possible reasons for doubting that the true nature of body consists solely in extension. The first is the widespread belief that many bodies can be rarefied and condensed in such a way that when rarefied they possess more extension than when condensed (*ut rarefacta plus habeant extensionis quam condensata*). Indeed, the subtlety of some people goes so far that they distinguish the substance of a body from its quantity, and even its quantity from its extension. (*PP* 2.5)

So, Descartes considers rarefaction at length because he considers it one of two principal reasons for doubting his metaphysics of the material world. (His second reason for doubt concerns the vacuum and need not detain us.) The looming objection turns on the inability of Cartesianism to accommodate a phenomenon that has been plainly observed in experience, namely that bodies do

[112] For example: Agostini (2017, 882-883), Bennett (2001, 51-52), Des Chene (1996, 351-352), and R.S. Woolhouse (1993, 84-85). A concise and useful overview of the Cartesian account of condensation and rarefaction and its function within Cartesian philosophy is that of Palmerino (2015). Ariew (2011, 157-177) and Wang (2018) help to situate Descartes's account within the context of late scholasticism and renaissance thought, respectively.

sometimes appear to be rarefied.[113] Bodies, so the objection goes, must have the ability – the power? – to become more or less rarefied, but there is no way to make sense of this if bodies are merely geometrical and causally impotent. Thus, rarefaction is inconsistent with occasionalism in the corporeal domain and so also with a purely geometrical conception of materiality. This, in turn, just says that the phenomena of rarefaction falsify Cartesian metaphysics.

Descartes begins his response to this objection by explaining the observed phenomena in terms of microphysical structure:

> But with regard to rarefaction and condensation, anyone who attends to his own thoughts, and is willing to admit only what he clearly perceives, will not suppose that anything happens in these processes beyond a change of shape. Rarefied bodies… are those which have many gaps between their parts - gaps which are occupied by other bodies; and they become denser (*densiora*) simply in virtue of the parts coming together and reducing or completely closing the gaps. In this last eventuality a body becomes so dense that it would be a contradiction to suppose that it could be made any denser… In the same way, when we see a sponge filled with water… we do not suppose that in terms of its own individual parts it has a greater extension than when it is squeezed dry (*PP* 2.6).

In effect, Descartes reduces rarefaction to mere expansion.[114] The rarefied body is spread out only in the sense that some other microphysical bodies have inserted themselves between the parts of the original body. Now, this is not actually rarefaction in the usual sense of the term, according to which one and the same body possesses more or less extension depending on its degree of rarefaction. On the Cartesian view, the original body is still made up of precisely the same amount of extension regardless of how rarefied or condensed it is, because the original body and the original amount of extension are two names for the same thing. So, to suggest that the extension possessed by a body varies is either to speak loosely or to talk nonsense. All that changes when a body becomes rarefied in Descartes's sense is whether some other material

[113] Such cases were the subject of considerable scientific and philosophical interest at the time. A clear and relatively well-known example of this interest is Robert Boyle's *Of a Discovery of the Admirable Rarefaction of Air* (1670).
[114] Admittedly, Descartes does not literally use *dilato* or any other Latin term ordinarily translated as 'to expand' or 'expansion' to describe the process of rarefaction, but his example of the sponge and the talk of gaps between parts growing smaller in the case of condensation makes it clear that expansion is what he has in mind.

things are mixed into the original body. So, Descartes takes rarefaction to be reducible to mere expansion, and his example of a sponge soaked in water is exactly to the point. No one, after all, would argue that the expansion of a sponge in water is caused by the sponge itself now being made of more matter. Rather, the sponge matter has been spread out by the water.

A potential distraction rears its head in the above passage: density. A natural objection to the Cartesian reduction of rarefaction to expansion is that rarefaction concerns density as well as volume.[115] That is to say, rarefaction occurs when the same amount of matter is stretched out to cover a larger volume, as happens when a relatively small quantity of heated gas becomes rarefied and fills a paper lantern. If so, then Descartes's reduction of rarefaction to expansion is unacceptable because it fails to explain why a paper lantern floats, and it fails to explain this because it fails to explain the reduction of density characteristic of rarefaction.

This objection looks serious, but it is in fact a red herring. For one thing, 'amount of matter' for Descartes can only refer to volume; the identification of material and geometrical objects leaves no room for anything like mass. So, Descartes would understand *the same amount of matter is stretched out to cover a larger volume* to be equivalent to *the same amount of volume is stretched out to cover a larger volume*. Without some further elaboration, this just states a contradiction, and Descartes is right to ignore it. Nor is such an appeal to Cartesian metaphysics out of bounds dialectically here. Descartes is fending off an assault on his view, and so he is perfectly within his rights to appeal to his views on the nature of matter in showing that a putative counterexample can be accommodated without inconsistency.

Another way of putting this same basic point is to say that "it is impossible to take even the smallest fraction from the quantity or extension without also removing just as much from the

[115] This criticism is an old one. An early and surprisingly sophisticated example of it can be consulted in the appendix of John Sergeant's *Method to Science* (1696).

substance [and vice-versa]" (*PP* 2.8).[116] Again, the point is just that any theory, such as various accounts of the scholastics, which hangs on distinguishing the quantity of a material substance from the substance itself is incoherent, according to Descartes, because there is "no real difference between quantity and the extended substance" (*PP* 2.8). There is no real difference between material objects and their geometrical qualities. So, again, there is no prospect of a coherent account of rarefaction by distinguishing the quantity of a substance from the substance itself, because the distinction between the two is merely conceptual. This is simply a consequence of the throughgoing mathematization of the physical characteristic of Cartesianism.

Of course, Descartes will still need an account of the phenomena that density is typically employed to explain, such as the fact that water is heavier than air, that a paper lantern floats, and so on. His reduction of rarefaction to expansion will often play a role in such explanations, but Descartes's system requires that he primarily deal with such matters via a consideration of weight. Descartes takes up this subject later in the *Principles*, offering an analysis of weight in terms of microphysical pores which allow the body to be interspersed with the "heavenly" matter central to his vortex-centric cosmology (*PP* 4.20-27).[117] Bodies are more or less heavy depending on the abundance and size of microphysical pores and what those pores contain. Thus, Descartes explains weight in terms of both the rarity of a body – understood as expansion – as well as his elemental theory and cosmology. Fully spelling out the details of this account would

[116] What is here translated as "the quantity or extension" is in Descartes's Latin *quantitate aut extensione*, and this choice of conjunction is somewhat unfortunate. Since quantity and extension are distinct only conceptually, they are really one thing. So, *aut*, which is typically (though not always) used to indicate a distinct second alternative is not as natural as, for example, *sive*. I suspect that Descartes uses *aut* because the stated aim of the article is to point out that there is a distinction between the conjuncts, namely a distinction of reason. In any case, the surrounding context and argumentative structure of the passage make Descartes's point clear enough.

[117] The standard English translation of Descartes's philosophical writings contains only some of these articles and speaks of celestial rather than heavenly matter (CSM 1.268-270); I adopt the latter terminology in order to conform with Valentine and Reese Miller's full English translation of the *Principles*.

take us much too far afield.[118] For our purposes, the point is that while Descartes understands rarefaction to be relevant to the explanation of phenomena like the paper lantern, he does not think rarefaction is sufficient for such an explanation.

To return to his earlier example of the sponge, Descartes would thus say that the sponge soaked in water is both more rarefied and heavier than when it is dry.[119] It is rarified, because its microphysical pores have been enlarged; it is heavier, because of what sort of bodies are filling those pores. So, again, Descartes's account of rarefaction is indeed insufficient to explain phenomena like a paper lantern floating, but this is no objection to his account of rarefaction. Rather, it simply shows that the Cartesian must appeal to more than rarefaction in such explanations. And so, what we have here is not an objection but a distraction.

28. Rarefaction: Part II

Nevertheless, Descartes arguably still finds himself in a disadvantaged position dialectically. He has, it is true, parried the initial thrust against his identification of material and geometrical things, but he can also see a riposte coming. While he has provided an explanation consistent with the observed phenomena, he has done very little to show that it is the best such explanation. Indeed, his explanation appears worryingly *ad hoc*, turning as it does on the invocation of unobserved microphysical structures, namely the heavenly matter interspersed within rarified and less weighty bodies. Descartes could, of course, respond to such concerns by observing that such explanations are natural within the broadly mechanistic paradigm of 17th century science, whose Platonic ideal was the explanation of physical phenomenon in terms of

[118] A concise and useful discussion of how these disparate strands come together in the Cartesian account of weight is that of Gaukroger (2002, 162-166).
[119] This makes the idiosyncratic nature of Descartes's notion of rarefaction vivid. But, of course, the mere idiosyncrasy of a philosophical notion is no argument against the position in which it figures.

matter and motion. He could also have appealed to the overall explanatory power of the physical theories in which his account of rarefaction is lodged. I am not sure how convincing such replies would ultimately be. In any case, Descartes thinks he can do much better:

> [The Cartesian account] is the only intelligible way of explaining rarefaction. I really do not see what has prompted others to say that rarefaction occurs through an increase in quantity, in preference to explaining it by means of the example of the sponge. It is true that when air or water is rarefied, we do not see any pores being made larger, or any new body coming to fill them up. But to invent something unintelligible so as to provide a purely verbal explanation of rarefaction is surely less rational than inferring the existence of pores or gaps which are made larger, and supposing that some new body comes to fill them… it is very easy for us to see how rarefaction can occur in this way, but we cannot see how it could occur in any other way. Finally, it is a complete contradiction to suppose that something should be augmented by a new quantity or new extension without new extended substance… being added to it. (*PP* 2.7)

This is where the rubber really meets the road: Descartes's real strategy is to turn the tables on his opponents. The original objection amounted to arguing that Cartesian metaphysics must be rejected because it fails to properly accommodate an observed physical phenomenon, but Descartes now argues that his detractors understand that very phenomenon in such a way that it turns out to be metaphysically impossible. Only the Cartesian view can accommodate the empirical facts in a metaphysically intelligible way.

In short, then, Descartes is clearly confident that any position that differs from his own in overall form is doomed to unintelligibility, even if the grounds for his confidence are not immediately apparent. To spell out the details thus requires us to go beyond the scanty text while remaining answerable to it. So, let us proceed in that spirit.

I propose to reconstruct the Cartesian argument as an argument from elimination. Consider a sphere with radius *r*. Now, suppose that sometime later this very same sphere has a radius of *2r*. Given the Cartesian identification of geometrical and material objects, this is precisely the sort of phenomenon picked out by rarefaction. My reconstruction of the Cartesian position will turn on ruling out as unintelligible all the competing ways this phenomenon could

be explained. The dialectic is, however, tricky. One issue is that, as I read him, Descartes is once again assuming the core tenets of his own metaphysical system, and this is no longer obviously licit. After all, Descartes is no longer merely parrying an objection: He is arguing for the inconsistency of opposing views. In this respect, I take the argument for the Cartesian account of rarefaction to be parasitic upon the arguments in favor of the geometrical conception of matter: Its persuasiveness is proportional to the persuasiveness of Descartes's mathematization of the physical. This in mind, let us step through the available options in turn.

First, one could attempt to explain condensation and rarefaction in the way that many scholastics did, namely by arguing that the matter of the sphere has been stretched out to cover a larger volume.[120] We have already encountered this response, however, and found it unworkable from the perspective of Cartesian metaphysics (§27). To briefly reiterate, there is no sense in which a given quantity of matter can come to fully occupy a larger region because a quantity of matter is and can only be a quantity of volume. The only way of avoiding this conclusion is to give up on the purely geometrical conception of the physical. As such, Descartes considers such scholastic accounts to be quite literally contradictory, metaphysical impossibilities that are inconsistent with an intellectual grasp of the nature of *res extensa* (and, we might add, with the widely appealing idea that physics should be made ever more mathematical).

Second, one could explain matters as Descartes himself does, by reducing rarefaction to expansion via the insertion of new matter in-between the parts of the sphere. Granting Descartes that his own account is at least intelligible, the task now becomes to articulate and rule out any remaining explanations for rarefaction.

[120] The scholastic discussion is of great philosophical interest, but it also falls outside the scope of the present work. For discussion of the scholastic discussion as it relates to Descartes, see the discussions of Des Chene (1996, 107-109), Pasnau (2011, 301-308), and especially Ariew (2011, 157-177).

This task is made easier by the spartan character of Cartesian material ontology—any such explanation must be given only in terms of the size, shape, and movement of geometrical objects. Moreover, such an explanation cannot, on pain of conceptual incoherence, involve the supposition of truly empty space, since Cartesian metaphysics precludes the possibility of a vacuum (*PP* 2.16-18). Indeed, Cartesian corporeal ontology is so limiting that I can see only one other way of proceeding.

That lone remaining option is to argue that the parts of the sphere may be colocated with one another. The explanation for rarefaction would then be that some of the parts which were previously colocated are not any longer, such that the sphere's parts now occupy a larger region than they did previously. In such a case, the total volume occupied by the sphere would increase without the supposition of empty space. This proposal, however, is also unworkable. For, as we have seen (§23), Descartes takes the impossibility of colocation to follow directly from the fact that material objects are essentially extended. In other words, Descartes thinks that the colocation of distinct regions of extension is metaphysically impossible. He alludes to this in the context of rarefaction when he asserts that "it would be a contradiction to suppose" that a body without any gaps in its internal structure could become any denser (*PP* 2.6); it cannot become any denser because doing so would require colocated material things. As such, the lone remaining path toward a non-Cartesian explanation of rarefaction has been closed, completing Descartes's argument from elimination and establishing the metaphysical necessity of the Cartesian account.

I attribute the above reconstruction to Descartes for two main reasons. First, it fits the (admittedly scanty) text well. Second, it makes good philosophical sense of Descartes's position and is consonant with important themes in Cartesian metaphysics. Most obviously, Descartes's argument succeeds on the assumption of his identification of material with geometrical objects.

Second, the above reconstruction also reveals the deep connections in Descartes between metaphysical and physical explanation, especially how his metaphysics are brought to bear in the explanation of observed physical phenomena: Descartes does and must offer a metaphysical derivation of his account of rarefaction from the corporeal essence. It is precisely this that allows Descartes to accommodate the phenomena of condensation and rarefaction within his system without compromising either the identification of geometrical and material objects or occasionalism within the corporeal domain.

So much for condensation and rarefaction. Let us turn, therefore, to one final objection to our understanding of Cartesian corporeal metaphysics: The allegation that occasionalism within the corporeal domain invites idealism.

29. Berkeley's utility argument

The advent of idealism in the West is usually associated with Berkeley and Kant.[121] A crucial step in the development of idealism was, however, taken by Descartes.[122] That step was the conception of a purely thinking substance. As Descartes stresses in arguing for a real distinction between mind and body, God could create a world populated only by incorporeal minds and their contents (AT 7.78; *PP* 1.60). This is tantamount to admitting the conceptual possibility of idealism. It is therefore incumbent on Descartes to rule out this possibility. This need is especially pressing given that Descartes holds both that idealism is conceptually possible and that material objects are devoid of causal efficacy. The basic challenge is this: If idealism is a coherent alternative and bodies cannot serve as efficient causes, why posit the existence of

[121] Berkeley himself traces idealism to the Greeks, though in this the good bishop was mistaken. On the relationship between idealism and early thinkers, especially Platonists, see the discussion of Burnyeat (1982).
[122] A classic study along these lines is the aforementioned Burnyeat (1982); see also Secada (2000b).

these causally impotent corporeal entities at all? What would be the point? Why not, instead, simply create minds and their contents without matter, a state of affairs that Descartes avers to be both possible and, in principle, indistinguishable (from our perspective, anyway,) from a world with both matter and minds? This, as we shall see directly, is effectively the challenge raised by Berkeley in his *Principles of Human Knowledge.*

Descartes does, of course, attempt to answer this question by ruling out idealism, both in the *Meditations* and in the *Principles*. The argument is essentially the same in both texts: His official objection to the idealist hypothesis is that its actualization would render God a deceiver (AT 7.80; *PP* 2.1). This is weak tea. Descartes has already emphasized that in certain respects the physical world is radically different from the one suggested by sensation, since, for example, sensation trades in secondary qualities (AT 7.74; AT 7.30-32). Indeed, that it is natural to mistakenly suppose secondary qualities to inhere in corporeal objects forms the basis of Descartes's characterization of advocates of such a view – especially Aristotelians – as intellectually infantile (*PP* 1.71-72). Were the supposition not a natural one, children and the childish would not be tempted to make it. It is therefore unclear why whatever sleight of hand saves God from deception in the case of secondary qualities is unworkable with respect to the extra-mental existence of matter. Descartes's line seems to be that one who thinks clearly does not make the mistake of thinking of secondary qualities as existing extra-mentally (AT 7.81-82). Significantly, and I suspect consciously, Berkeley echoes this reasoning when considering the materialist hypothesis in his *Principles* (*PHK* 1.9).

As is well-known, the dispute between Descartes and Berkeley partly turns on whether the materialist hypothesis is incoherent: Berkeley argues that it is, whereas Descartes affirms that it is not. In his so-called master argument, Berkeley attempts to show that matter as conceived by

Descartes and Locke (and, one feels compelled to add, humankind generally) is self-contradictory (*PHK* 1.22-25). The defects of this argument, however, are well-known and decisive, and so Descartes need hardly fret over it.[123]

There is, however, another Berkeleyan argument for idealism. This argument is less ambitious, because it purports to show not that the materialist hypothesis is incoherent but that it is unreasonable. It is also more interesting, because it stands a better chance of hitting some of Berkeley's targets, including Descartes. The argument is that the existence of matter would be otiose and that God would therefore not have wasted effort to create it:

> Yet though we might possibly have all our sensations without them, yet perhaps it may be thought easier to conceive and explain the manner of their production, by supposing external bodies in their likeness rather than otherwise; and so it might be at least probable there are such things as bodies… But neither can this be said; for though we give the materialists their external bodies, they… are never the nearer knowing how our ideas are produced: since they own themselves unable to comprehend in what manner body can act upon spirit, or how it is possible it should imprint any idea in the mind. Hence it is evident the production of ideas or sensations in our minds, can be no reason why we should suppose matter or corporeal substances, since that is acknowledged to remain equally inexplicable with, or without this supposition. If therefore it were possible for bodies to exist without the mind, yet to hold they do so, must needs be a very precarious opinion; since it is to suppose, without any reason at all, that God has created innumerable beings that are entirely useless, and serve no manner of purpose. (*PHK* 1.19)

Call this *the utility argument*. It turns on the supposed uselessness of the materialist hypothesis, from which it concludes the unreasonableness of materialism. Here is one way of cashing it out:

P1) For all explananda, *p*, and for all *q*, if *q* is a material object, then there does not exist a *p* such that *q* explains *p*.

P2) If so, then it is unreasonable to believe in material objects.

C) So, it is unreasonable to believe in material objects.

[123] The classic objections are probably those Moore (1903) and Pitcher (1977, 113). A more recent and, to my eye, clearly successful objection is that of Dicker (2011, 139-146). (Thanks to Nate McKay for directing me to Dicker's discussion of the argument.) For a more sympathetic treatment, see the discussion of Winkler (1989, 187-189). For my part, I do not think there is an interesting argument for idealism in the offing here.

Importantly, the domain of *p* in (P1) is assumed by Berkeley to range over all and only mental states. This assumption – and my reasons for dropping it – require immediate comment.

Doubtless, Berkeley takes the official dialectic within the text to license his assumption that mental entities are the explananda at stake. Consider this earlier passage:

> But though it were possible that solid, figured, moveable substances may exist without the mind, corresponding to the ideas we have of bodies, yet how is it possible for us to know this… It remains therefore that if we have any knowledge at all of external [material] things, it must be by reason, inferring their existence from what is immediately perceived by sense. (*PHK* 1.18)

This simply embodies Berkeley's empiricism, his all-encompassing emphasis on the observable. His basic idea is that only that which is necessary to explain observables ought to be posited, and this because the ultimate explananda are exhausted by observables. It is this that grounds his restriction of the domain of *p* in (P1) to mental states. Obviously, this is an interesting line, but it is also one to which a Cartesian is opposed on the deepest possible grounds. Descartes takes himself to perceive some things via purely intellectual perception, most importantly real definitions (§6), and so he would reject any argument that assumes the ultimate primacy of empirical perception. Thus, Berkeley's formulation of the utility argument in terms of the need to explain "what is perceived by sense" succeeds only if the Cartesian theory of intellectual perception is untenable. But, if that is so, then Cartesianism is already doomed, and the utility argument loses its interest *qua* Cartesianism.

Thus, while Berkeley's assumption that the domain of *p* in (P1) ranges over all and only mental states is understandable given its placement within the *Principles of Human Knowledge*, it is also dubious, at least if the argument is taken as an independent argument aimed at those not antecedently convinced of Berkeley's radical empiricism. After all, advocates of the materialist hypothesis, like Descartes, typically hold that material objects explain each other's behavior, and so they should not grant at the outset of any argument against materialism that matter is

explanatorily useful only if it explains mental phenomena. The utility argument cannot omit this possibility without directly begging the question against the materialist. My rendering of (P1) is meant to account for this without altering Berkeley's overall thrust; it also has the virtue of highlighting that Berkeley needs more than a rehash of Elizabeth of Bohemia's interaction problem to motivate his first premise, at least insofar as the argument is meant to cut ice against non-empiricists, since Berkeley must do more than argue that body cannot causally explain mental phenomena. Whether Berkeley intended the argument in that spirit is unclear. In any event, the underlying challenge Berkeley suggests furnishes an interesting objection to Cartesian physics only when stripped of any presumption of Berkeley's radical empiricism. Hence, I render the argument as I do, without restricting the domain of *p* in (P1) to mental phenomena.

So much for (P1). Thankfully, Berkeley's second premise, (P2), is more straightforward. It simply says that if something is not directly observed and serves no explanatory purpose, then there is no reason to believe in it. Notably, the premise presumes an indirect theory of perception, since Berkeley is assuming that belief in matter cannot be justified by direct observation. In the present context, however, this looks like a safe assumption, since Descartes also defends an indirect perceptual realism. Given the acceptable presumption of indirect realism, then, Berkeley demands that matter play some explanatory role in order to justify positing it as an unobservable entity. Whether or not this principle stands up to withering scrutiny, it seems unlikely that Descartes, at least, would object to it. One of Descartes's official arguments against the existence of physical forms is that, even if they did exist, they would not explain anything (§8). Thus, I will henceforth take (P2) as granted and focus our attention instead on (P1), since it is with respect to that premise that the dispute between Berkeley and Descartes comes to a boil.

The question, then, is whether the Cartesian has principled reasons to reject (P1). Answering that question requires reflecting on the sorts of explanations admitted by the Cartesian, and this, in turn, necessitates clarifying the relationship between causation and explanation. Consider again the occasionalist contention that material objects lack causal powers. This means that bodies can play no role as genuine efficient causes – their non-existent causal activity cannot explain anything. This makes Cartesianism seem particularly susceptible to the utility argument, as the existence of matter does appear unavoidably otiose. Why, on such a view, should God create an entire material universe parallel to the mental when material objects cannot interact with minds? Or, indeed, with one another? Granted, matter serves as the occasion on which God acts, but this apparently does no more than add an unnecessary step to the casual process. Descartes grants that God could create the mental without the material, and if bodies act neither on each other nor on minds, then it is difficult to see why he would not do so.

We have already encountered Descartes's official response that his embrace of the materialist hypothesis rests on the belief that God is no deceiver. We have also already found it lacking, a point which now bears emphasizing. Elsewhere (AT 7.76-80), Descartes acquits God of the charge of deception by arguing that one who thinks in an orderly manner would not think of secondary qualities as inhering in matter. Yet, we have just seen how a Cartesian occasionalist who thinks in an orderly manner arrives at the conclusion that the creation of matter would be a wholly pointless effort unbefitting the deity. In other words, if matter does not act on anything, it seems that the Cartesian ought to think (P1) is true, since the reasoning Descartes uses to acquit God of deception in the case of secondary qualities serves just as well in the case of the existence of matter. One who thinks everything through in an orderly way will see that God could create only mental entities and that bodies, even if they existed, could play no ineliminable explanatory

role. Naturally, then, one who thinks in an orderly manner will realize that God would not waste effort creating superfluous material entities. That is the Berkeleyan utility argument in a nutshell.

The most obvious response is, of course, to simply reject occasionalism in the corporeal domain. After all, what is wreaking havoc is not the existence of matter *per se* but the existence of matter devoid of causal powers. Yet, as previously argued, Descartes is committed to occasionalism, on pain of compromising his purely geometrical conception of matter (§26). So, this way of avoiding idealism is unavailable to him. What, then, is to be done?

30. What Descartes would have said to Berkeley

Descartes's best reply to Berkeley's challenge arises out of his underlying commitments to essentialism, intellectual perception, and formal causal explanation.

The trick is turned by reconsidering the relationship between explanation and causation. Thus far, we have tacitly assumed that if material objects serve an explanatory role, then they serve as efficient causes. From this, we have argued that the Cartesian ought to accept (P1), which augurs idealism. In fact, of course, this assumption is mistaken – it is the all-too-common error of neglecting formal causation. The omission is crucial in the present context, for formal causation furnishes the Cartesian with a principled way to reject (P1) and thus to avoid the slide into idealism.

That rejection goes like this. It is true that Cartesian bodies lack causal powers, but it is incorrect to conclude from this that Cartesian bodies play no role in causal explanation. Absent causal powers, Cartesian bodies obviously cannot serve as efficient causes, but it is equally obvious that is consistent with bodies figuring in non-efficient causal explanations. Now, Cartesian bodies are essentially extended, and, as we have seen (§23), Descartes holds that

impenetrability follows from extension. This means that the material essence, extension, plays an explanatory role in Cartesian physics, because impenetrability figures prominently within Cartesian kinematics. Furthermore, Descartes holds that the distinction between a substance and its essence is merely conceptual – they are two ways of conceiving the same underlying thing (*PP* 1.62). So, matter itself plays an explanatory role in Cartesian physics. And so, (P1) is false.

Of course, Berkeley would still insist that the existence of matter remains otiose. Again, this is partly predicated on his empiricism, since it is unclear what observable Descartes can explain via his embrace of the materialist hypothesis that Berkeley cannot explain idealistically via the invocation of God. It is still true, as Descartes readily admits, that God could bring about an empirically indistinguishable state of affairs if matter did not exist. The underlying point here is that both the Cartesian and Berkeleyan theories are empirically adequate, or, failing that, could be made to be so. A natural application of Ockham's razor would then suggest discriminating between the two theories on the basis of their fundamental ontological commitments, and this is a contest Berkeley looks likely to win. If correct, this would mean that Descartes loses the war against the idealism despite winning the battle over the utility argument.

Actually, however, I do not think this is so. The issue with the Berkeleyan counterattack is that it treats empirical adequacy and ontological simplicity as the only virtues a theory might possess. Here, our earlier discussion (§16) of the distinction between nomological and miraculous explanations can be brought to bear. That bodies do not interpenetrate, for example, is not true by divine fiat according to Descartes: It is true due to what it is to be corporeal. Similar points obtain with respect to all kinematical and dynamical laws, since all such laws rest on the assumption of impenetrability. This is a distinction Berkeley will have supreme difficulty explaining, since his explanatory apparatus is impoverished compared to the Cartesian. For

Berkeley, it is difficult to avoid the conclusion that the laws are simply true by divine fiat, as no other sort of explanation seems to be forthcoming. Thus, the trouble with the Berkeleyan proposal is that it obviates the distinction between nomological and miraculous explanations by giving a narrowly top-down, occasionalist rendering of scientific laws. Nothing buttresses the laws, for Berkeley, beyond the brute fact that God acts in a particular way. Descartes avoids falling into this trap by grounding the laws in the essences of God and matter, especially divine immutability and corporeal impenetrability.

There is another defect that Descartes could point to with the Berkeleyan position. The Berkeleyan appeal to empirical adequacy and simplicity implies that two empirically adequate theories necessarily do equally good explanatory jobs, otherwise Ockham's razor would cut no ice. Stated baldly, however, this thesis should be compelling only to the most radical of empiricists. Descartes does think that the idealist hypothesis is empirically adequate, but this does not mean that he thinks idealism is explanatorily adequate. One way to motivate the distinction between empirical and explanatory adequacy is to again note that Descartes can make sense of a robust distinction between nomological and miraculous explanations in a way that Berkeley cannot. Another way to motivate the distinction is to note that a theory may be empirically adequate but fail spectacularly to account for purely intellectual facts, like those at the heart of the Cartesian program. The uncovering of the intellectual capacity to perceive such facts is, as a clearly bemused Descartes found he had to explicitly explain to Hobbes (AT 7.172), one point of going through the process prescribed in the *Meditations*. Thus, to think idealism attractive is to, like Hobbes, miss the Platonic thrust of Cartesian metaphysics.

So, despite initial appearances, the Cartesian has principled reasons for rejecting the utility argument for idealism as unsound. This is the central upshot of this section.

There are others. First, the surprisingly wide-ranging importance of Descartes's account of impenetrability is again highlighted by its role in the refutation of the idealist premise, (P1). Second, the role of Cartesian formal causation in that refutation further stresses the dangers of the common assumption that the only notion of cause alive in Cartesianism is the efficient causation characteristic of mechanism and volitions. Third, by providing a deeper and more philosophically satisfying response than Descartes's official defense in terms of divine honesty, we have cut closer to the heart of Descartes attitude toward idealism. The refutation of the utility argument we have reconstructed on Descartes's behalf rests on the explanatory power of the intellectually perceptible material essence. If one intellectually perceives some essential properties and can derive and explain other properties from them, belief in those essential properties is well-established – the logical possibility of idealism as an empirically adequate alternative is irrelevant. Given that Descartes affirms this antecedent, his somewhat flippant treatment of idealism is understandable. Given some of the central tenets of Cartesianism, the idealist hypothesis is almost (if not quite) unthinkable.

31. Descartes's geometrical occasionalism – A sketch

We have now reached the point where it will be worthwhile to summarize the major upshots of our interpretation of Cartesian corporeal metaphysics. We have seen its major contours, how it relates to the Aristotelianism it supplanted, and how it can successfully respond to various prominent objections. Before turning to objections that cannot be so easily parried, therefore, let us sketch the Cartesian position and its more laudable features.

First, we have consistently taken Descartes at his word by understanding material and geometrical objects to be two names for the same set of things. Taken as a rejection of

Aristotelianism, the Cartesian thesis is that materiality is equated with geometry rather than with potentiality. In a more positive sense, the Cartesian position takes the ideal of the mathematization of the physical to its logical extreme by simply equating the subject matters of physics and geometry. This mathematical purity gives Cartesianism much of its enduring philosophical interest. Despite the falsity of its particular deliverances regarding, say, motion, there is much to be learned from Cartesianism as a test case – What are the upshots of taking the mathematization of the physical to its logical extreme? What difficulties arise? Can these difficulties be overcome? If so, how? If not, why not?

Descartes, as we have seen, personally confronts numerous difficulties that arise from his mathematization of the physical. One such challenge is the need to move from kinematics to dynamics, a move that is problematized by the implication that physical objects – like the geometrical objects with which Descartes equates them – are causally impotent. If bodies are simply Euclidean, then how is one to explain motion or motive force, concepts which any minimally plausible physics must incorporate? Euclidean shapes, after all, are not possessed of motive force. Descartes's answer comes in two parts. First, he accounts for motive force without compromising his geometrical ontology by embracing occasionalism within the corporeal domain. *Vis*, motive force, can only refer to acts of the divine will, which are, given the divine nature, orderly and predictable. In this way, Descartes bridges the gap between kinematics and dynamics by introducing efficient causality without introducing corporeal causal powers that would be inconsistent with his purely mathematical corporeal ontology. Granted theism, this means that Cartesian dynamics is roughly as plausible metaphysically as Cartesian kinematics.

The question of whether Descartes can give a convincing account of the metaphysics of kinematics – of motion – is thus of central importance. It is also the topic of the subsequent, final

chapter of this work. As we shall see, it is a question that Descartes cannot satisfactorily answer. While it is a scholarly truism that the Cartesian account of motion is muddled, I shall argue that Descartes *cannot* satisfactorily answer this question without outright abandoning his mathematization of the material world, on pain of Eleaticism – the impossibility of diachronic change and of synchronic division within the corporeal domain.

Ontologically, then, Cartesianism is characterized by the complete mathematization of the material world and the equation of force with divine efficacy. This ontology itself raises at least as many problems as it solves, some of which we have dealt with at length. It is remarkable how many of these problems Descartes is able to solve. For example, the derivation of impenetrability from extension succeeds, granted the cogency of certain core Cartesian metaphysical theses. This short-circuits the common complaint, commonly associated with Locke, that Descartes simply ignored the importance of solidity to corporeal metaphysics. On the contrary, Descartes grounds the impenetrability of matter in what it is to be a material thing rather than simply asserting that impenetrability is essential to matter. This is no mean accomplishment: It means that Descartes can account for the mechanistic contact criterion in a purely mathematical way, bringing into surprising harmony two ideals – mechanism and mathematization – so prized by early modern scientists. In this chapter, we have also seen how Descartes can account for phenomena characteristic of early modern scientific inquiry that would seem to defy his ontology, such as rarefaction. In sum, then, Cartesianism demonstrates how surprisingly wide a range of physical phenomena admit of a purely mathematical explanation.

In terms of explanatory apparatus, Cartesianism is characterized by efficient causation and nomological explanation. As far as efficient causation is concerned, what is at issue are the divine acts relevant to dynamics and the continued existence of matter. This, as we have noted

above (§26), is the means by which Descartes moves from kinematics to dynamics without compromising the mathematization of the material. Nomological explanation, by contrast, is trickier to nail down, but we have seen (§16) that Descartes is best read as endorsing a theory according to which nomological explanation is formal causal explanation. God's efficient causal activity is orderly because it flows from his essence, and true descriptions of this orderly creative activity can be deduced from God's intellectually perceptible essence (and matter's as well, in the case of impenetrability). These truths are the *regula sive leges naturae* that are the secondary and particular causes of motion at the heart of Cartesian science: Cartesian nomological explanations are metaphysical formal causal explanations. In this way, then, the most strikingly "modern" aspect of Cartesian science – its emphasis on quantitative scientific laws – rests on an avowedly Aristotelian explanatory mode.

In short, then, the achievements of the Cartesian system are not to be underestimated. What Descartes offers is a thoroughly developed metaphysics and explanatory apparatus according to which the material *just is* mathematical, and it is to his credit that this system is as successful as it is. Still, it is not totally successful, and we must now turn, finally, to a consideration of its insuperable defects: motion and the individuation of corporeal things.

Chapter 6

The Road to Elea

Précis

Cartesian physics and corporeal metaphysics are a sustained attempt at upholding some widely held ideals. One of these is the refutation of the "spooky" and "occult" theories of scholasticism. Another is mechanism, understood as the thesis that physical explanation trades in microphysical bodies in motion. To this potent brew, Descartes adds one final ingredient: the reduction of the physical to the mathematical. Our interpretation has been guided, throughout, by the idea that Descartes seriously meant what he said clearly and repeatedly throughout his mature writings, namely that his system erases the distinction between the corporeal and the mathematical. Physical objects, for Descartes, just are mathematical objects. Most of us share this final Cartesian ideal, of course, or something quite like it. We tend to take it for granted that physical science should be quantitative and trade in mathematical laws, and this is one sense in which we continue to labor in Descartes's wake. Yet, in this chapter, we will see that taking this very ideal to its logical extreme leads Descartes himself into disaster.

Before we can chart this disastrous course, however, we need to confront two related issues. The first concerns the actual explanatory role of physical form, while the second concerns how many corporeal substances Descartes purports to recognize. These issues dealt with, we will proceed by showing that, despite evidently thinking of his science in terms of real corpuscularian structures that change over time, Descartes cannot make any metaphysical sense of such structures or such changes. On the contrary, his corporeal metaphysics preclude them by precluding the possibility that there is any entity to exhibit various structures at particular times. Quite the opposite, in fact: Cartesian corporeal metaphysics implies that there is from all eternity only endless and uniform Euclidean space that is incapable of the changes required by his physics. Hence, Descartes finds himself, however unwillingly, on the road to Elea.

32. The explanatory role of physical form

Some 170 pages ago, we began our foray into the history of formal causation with the articulation of a tension, or ambiguity, in the Aristotelian notion. Ultimately, we saw that this tension was a function of the distinction between metaphysical and physical forms, and that Descartes cleanly eliminates it by discarding physical forms on various philosophical grounds. The rejection of physical forms is therefore indicative of Descartes's rejection of hylomorphism, but it also paves the way for his positive program. For a start, the rejection of physical forms facilitates the equation of formal causality with explanation from essence, an explanatory mode that is central to Cartesian physics and corporeal metaphysics. Likewise, the rejection of physical forms eases the reconceptualization of materiality in terms of geometry rather than in terms of potency brought into actuality. The rejection of physical forms is thus an undeniably fruitful metaphysic for Descartes in a wide variety of contexts.

A less happy consequence of the rejection of physical forms is the need to offer alternative explanations in all the contexts in which the Aristotelian appeals to such entities. There is a sense in which our discussion of Descartes has focused on precisely this issue, even if we have not always framed it as such. Descartes's geometrical occasionalism, to cite the most significant case, is a sustained attempt to explain physical phenomena without resorting to physical forms or otherwise compromising the mathematization of the physical. Descartes replaces the complex Aristotelian nexus of physical form, matter *qua* potency, and corporeal causal activity with his own nexus of physical law (grounded in metaphysical form), matter *qua* geometry, and divine causal activity. Again, one way to understand these aspects of the Cartesian project is as an attempt to do the explanatory work associated with physical forms without invoking any such entities, and attestations of this fact are widespread. Specific examples that we

have encountered include rarefaction, impenetrability, motive force, and the reconciliation of divine immutability with the protean nature of creation. In such contexts, Descartes's geometrical occasionalism – his alternative to hylomorphism – is at least a qualified success. Even given its well-known problems regarding points of detail, Descartes undeniably has a compelling natural philosophical *weltanschauung*, one that incorporates Platonic intellectualism, a mathematical conception of the material, and a powerful explanatory apparatus centered on natural laws and divine causal activity. Thus far, our task has been to catalog the impressive successes Descartes achieves with these relatively meagre explanatory and ontological resources.

While impressive, these successes do not show that Descartes has fully paid off the explanatory debt he incurred by rejecting physical forms. To do that, he must provide an explanation for the full range of phenomena Aristotelians explained via physical formal causation. To see whether Descartes accomplishes this task requires us to reflect once more on physical formal causation in Aristotelianism. Let us, therefore, proceed by taking up this task, beginning with the characterization Descartes himself gives.

Descartes's verdict regarding physical formal causation is instructive, not so much for what it reveals about the authentic Aristotelian position as for what it reveals about Descartes's own reductive attitude. The most illuminating passage on this score is from a letter to Regius:

> The second demonstration is drawn from the use of substantial forms; for they were introduced by philosophers for no other reason [*causam*] than to be able to give [*reddi*] an account of the proper actions of natural things, of which these forms are the principles and roots… But plainly it is not possible to give an account of natural actions through those substantial forms… (AT 3.506)

Descartes goes on to give versions of the arguments against physical forms from obscurity and explanatory impotence, discussed above (§8). What is important at this juncture, however, is not Descartes's arguments against physical forms but rather his depiction of their purpose. Most significantly, Descartes equates the purpose of physical formal causation with accounting for the

proper actions – natural motions, causal powers, etcetera – of bodies. This is reminiscent of the scholastic trend, alluded to above (§2, fn. 17; §4), of understanding the physical form as almost an internal efficient cause. It is thus undeniable that Descartes has hit upon a crucial function of physical forms, perhaps even the dominant one in the later scholastic thought against which he is most directly reacting, such as Suárez's *Disputationes*. And, as we have just rehearsed, that reaction is ultimately constituted by geometrical occasionalism, which offers an alternative means of performing this explanatory work via natural laws and divine causality.

All this is encouraging, so far as it goes. But it raises a question: Is Descartes correct to take accounting for the natural actions of things to be exhaustive of Aristotelian physical formal causality? Unfortunately for Descartes, the answer to this question must surely be negative. Consider, to use a frequently discussed case, the role played by physical form in hylomorphic explanations involving human beings. Naturally, the physical form that is the human soul does account for the "natural actions" of the human being: Socrates can reason, for example, in virtue of his rational soul. Yet, just as obviously, such functions do not exhaust the explanatory role of the soul. Arguably, the paramount explanatory function of the human soul within hylomorphic metaphysics is explaining the unity of the human being as a discrete individual, as a substance rather than a mere aggregate. And this point holds generally: Physical form is what explains the distinction between genuine metaphysical unities and mere aggregates.

Aquinas, for one, makes the importance of this explanatory function of physical form perfectly plain: "the body of a human being, or that of another animal, is a certain natural whole [*quoddam totum naturale*]… not merely an aggregate or composition, as happens in the case of a house [*ut accidit in domo*] and other things of this sort" (*QDA* 10 co; see also *QDA* 10 ad16). The point here is that human beings and other lifeforms are unified individuals due to the

composition of the requisite substantial form with matter – it is in virtue of this that Socrates, a human substance, exists, rather than a mere aggregation of matter that resembles him. More broadly, substantial forms play a crucial role in explaining the unity of the fundamental individuals of Aristotelian science and metaphysics. Physical form explains why there is a genuine metaphysical individual rather than a mere aggregate, a bonafide thing rather than a mere heap. One of the core explanatory roles of the physical form, then, is providing an account of metaphysical unity, especially substantial unity.

Thankfully, the precise details of this hylomorphic explanation of unity need not detain us.[124] What is important for our purposes is that, as Dominik Perler (2020, 144) has recently put it, "From an Aristotelian point of view… the substantial form is the principle of unity and therefore indispensable" metaphysically. Now, the substantial form is just a particular sort of physical form – a particularly important sort, for the reasons just adduced. In abandoning physical formal causation, then, Descartes incurs a greater debt than the need to account for the "natural actions" of bodies, whatever his protestations to the contrary. Even granting that Descartes's geometrical occasionalism explains the behavior of bodies in a mathematically rigorous and predictively powerful way, that theory presupposes rather than provides an account of the unity of the bodies whose behavior is so-explained. Perler (2020, 144) actually comes close to stating this problem, observing that "As long as advocates of the 'new physics' do not make clear what accounts for the unity of a material thing, their program is doomed to failure. It cannot explain why there are many distinct things in the world, rather than a giant heap of corpuscles." In fact, however, the problem is even worse than that: Perler is far too generous in his assumption that the unity of the corpuscles themselves is unproblematic. The hylomorphist

[124] Notably, this is an issue on which Aquinas and his followers tended to disagree with thinkers like Ockham and Suárez; see Perler (2020) for a recent discussion of this dispute and further details.

has no reason to concede even this much unless some account of the unity of corpuscles is forthcoming from their "scientific" interlocutors.

The cash-value of all this is that Descartes needs an account of the unity of material bodies, especially of the fundamental bodies of his physics. If he cannot provide one, then his physics rests on little more than an unmotivated and probably dubious assumption that the ontological status of material objects is unproblematic. Moreover, he will have failed in his ambition to provide an alternative to Aristotelian hylomorphism that is of equal explanatory power, since he will leave something unexplained, namely the unity of bodies, which the Aristotelian explained via physical forms. Indeed, Descartes's repeated insistence that physical forms are explanatorily impotent is seriously imperiled if the hylomorphist can explain something through them that Descartes himself must leave utterly inexplicable.

The overarching thesis of this chapter is that this problem is ultimately insuperable: Cartesianism furnishes no way of performing the necessary explanatory work. Descartes simply has no plausible account of the unity of corpuscles, still less of the bodies composed of them in turn. As we have seen, the explanatory resources of the Cartesian system are (i) formal causal explanation from a metaphysical form, especially nomological explanation and (ii) efficient causal explanation from divine causal activity. Ultimately, the problem is that all purported solutions, which must necessarily be couched in these terms, require some *thing* to exhibit geometrical structures at particular times. Yet, this is precisely the problem. The plenum *just is* the metaphysical form of extension; it *just is* Euclidean space; it *just is* geometrical structure. There is no *thing*, no *stuff*, to exhibit particular geometrical structures at particular times and in particular locations: There is just endless, undifferentiated, immutable Euclidean space. Thus, we

will finally conclude that, like the Aristotelianism it supplanted, the Cartesian research program is untenable in virtue of its underlying ontology.

All this, however, puts the cart before the horse. Our first task is clarifying the problem itself. It will be useful to begin by distinguishing it from a closely related and more frequently discussed problem: *the problem of corporeal substantiality*. This problem concerns what counts as a corporeal substance by Descartes's lights and has begat an acrimonious cottage industry within Cartesian studies. At the risk of digression, I enter into this well-worn dispute in the next section. Afterwards, we will be free to engage fully with the more dire problem of how to account for the unity of purely geometrical and causally impotent bodies with only formal and occasional causation at our disposal.

33. The problem of corporeal substantiality

One of the more vexed disputes in Cartesian studies concerns corporeal substantiality. In brief, the problem goes like this. On the one hand, the *Principles of Philosophy* is littered with talk of finite bodies as substances. So, in what is arguably the definitive statement of Cartesian physics, it seems there are many corporeal substances. On the other hand, the standards for substantiality within the *Meditations* seem to preclude the possibility that finite bodies could count as substances. On the contrary, it seems that the plenum alone qualifies. So, in what is arguably the definitive statement of Cartesian metaphysics, it seems that there is only one corporeal substance, the plenum. The problem of corporeal substantiality is reconciling the seemingly contradictory positions implied by Cartesian metaphysics and Cartesian physics. Furthermore, it might be thought that a satisfactory solution to this problem would, *ipso facto*, provide the necessary unities fundamental to Cartesian physics: The fundamental bodies in

Cartesian physics just are the fundamental corporeal substances. Ultimately, I do not think that this is so – but that conclusion needs arguing. Hence, I offer this discussion of the substantiality problem as a necessary prelude to our discussion of the physical individuation problem proper.

Let us begin with the *Principles*. Perhaps the most evocative passage is the following, taken from Descartes's articulation of the real distinction that obtains between substances:

> For example, even though we may not yet know for certain that any extended or corporeal substance exists in reality, the mere fact that we have an idea of such a substance enables us to be certain that it is capable of existing. And we can also be certain that, if it exists, each and every part of it, as delimited by us in our thought, is really distinct from the other parts of the same substance. (*PP* 1.60)

Obviously, the key point here is that a real distinction is said to obtain between each part of corporeal substance, suggesting that there exists an indefinitely large plenum of extension, each part of which is a substance. Interpreted straightforwardly, the picture that emerges is quite radical, an ancestor of what Daniel Korman (2020; 2015, 13-19) has termed "plenitudinous forms of permissivism" in contemporary object metaphysics. Descartes seems to be saying that each and every part of the plenum is a substance, citing no restriction on such parts save that they can be delimited in thought. Arguably, this is not really a restriction at all, requiring only that the purported parts not be literally inconceivable. It permits substances to have discontiguous parts, for example, or to bear no resemblance to the entities encountered in ordinary experience or quantified over within scientific theories. Stressing the analog with contemporary metaphysics, we might say that Descartes apparently thinks that the composition of corporeal substance is unrestricted: For any part of the plenum, there is a substance that is constituted by that part. Such an interpretation enjoys both textual support and some significant philosophical advantages. Small wonder, then, that it has also enjoyed significant scholarly support.[125]

[125] For example: Garber (1992, 175), Stuart (1999), Reid (2014), Rozemond (2011), and Schmaltz (2020). Schmaltz (2020, 144-145) traces this reading back to the first edition of Bayle's *Dictionnaire historique et critique* (1697).

On the other hand, Descartes might instead be taken to defend a more restricted view according to which finite corporeal substances are those parts of the plenum that hang together over time.[126] Thomas Lennon (2007, 30), for one, asserts that "we know that for Descartes motion is the individuator of material bodies" and links this assertion to the question of how many corporeal substances Descartes recognized. The rudiments of this view are based upon the link Descartes draws between motion and corporeal parts:

> All the properties which we clearly perceive in it [i.e., matter] are reducible to its divisibility and consequent mobility in respect of its parts, and its resulting capacity to be affect in all the ways which we perceive as being derivable from the movement of the parts. If the division into parts occurs simply in our thought, there is no resulting change; any variation in matter or diversity in its many forms depends upon motion. (*PP* 2.23)

One surface reading of this passage is that mere division in our thought – which is probably equivalent to the delimitation of 1.60 – cannot track real distinctions because it does not track real change. Rather, change is the result of the movement of parts of the plenum, out of which arise all the microphysical explanations characteristic of Cartesian science.

Perhaps, then, finite corporeal substances are just those bits of matter that move together, such that the only genuine entities are those capable of grounding genuine change. That is, perhaps corporeal substances are just those entities in virtue of whose behavior all the changes characteristic of Cartesian science – discussed more fully below in reply to Lennon (§34) – obtain. The major virtue of this interpretation, if tenable, is the collapse of the individuation problem into the more well-studied problem of corporeal substantiality, since the corpuscles would simply be the ontologically fundamental class of corporeal substance. More broadly, this

[126] This is not necessarily the only restriction that might be tried. Brown and Normore (2019, 58, 63) have recently argued that Descartes holds that everything that "has a true and immutable nature is a genuine thing" or *unam per se*, with automata serving as a paradigm. At least insofar as the problem of corporeal substantiality is concerned, I do not see that this proposal has sufficient benefits to offset the additional difficulties it engenders. As a response to the individuation problem raised by Leibniz, Brown and Normore (2019, 52, fn. 35) relies on the supposition that Cartesian matter does, in fact, possess an intrinsic *conatus* – a possibility that we have already considered and found inconsistent with the mathematization of the physical that is the hallmark of Cartesian corporeal metaphysics.

reading promises to harmonize the categories of Cartesian metaphysics and physics: The bodies fundamental to physics *just are* the fundamental substances of corporeal metaphysics.

It is therefore somewhat regrettable that this proposal is beset by numerous and insurmountable difficulties. For a start, the proposal just strains the text. While Descartes does claim that the division into parts in thought does not track with the changes we observe in the world, this is simply the boring and obvious claim that we are able to mentally divvy up the plenum in ways other than by what parts move together. It is not the more interesting and controversial claim that the only partitioning of the plenum that tracks really distinct corporeal substances is division into parts that move cohesively. To see this, note that the text of 2.23, the crux of the motion-based proposal, is consistent with the permissivist reading of Descartes, since the parts which move together are readily comprehensible as a special subset of all corporeal substances, namely the set that is useful in the context of Cartesian physics.

To expand upon this point somewhat, let us recall again that Descartes's physics is exhausted by kinematics and dynamics. Now, the fundamental ontological units of kinematics are obviously the entities which move cohesively, to which dynamics adds force (which is, for Descartes, divine causal activity). Descartes's emphasis, both in 2.23 and in the definition of body in 2.25 (to which we will turn directly), is thus perfectly natural: They are definitions appropriate to the scientific context within which he is working at that point in the text. This motivation, moreover, in no way intersects with the criteria Descartes gives for substantiality in either the *Principles* or the *Meditations*. Descartes is not explicitly talking in 2.23 or 2.25 about corporeal substance *simpliciter*; he is talking about the bodies that play a fundamental role in his physics. There is no need, therefore, to see Descartes as here delimiting a metaphysically robust

category of corporeal substance at all, rather than, for instance, simply flagging and defining the subset of that category which is of special scientific interest.

Now, Descartes does go on to say that "by 'one body' or 'one piece of matter' I mean whatever is transferred at a given time" (*PP* 2.25). Again, however, this is plausibly taken as cashing out how a term will be used in the scientific context: Descartes's avowed motive here is clarifying what these terms mean in his strict definition of motion, but such a clarification is of no straightforward metaphysical consequence. The category of body within physics, that is, need not be entirely coextensional with the category of corporeal substance.[127] As before, it is perfectly possible to read Descartes as claiming that the category of body quantified over in his physics is a proper subset of the totality of corporeal substance, which might include the plenum and all its proper parts. So, again, bodies are just the corporeal substances that are currently behaving in a way that makes them scientifically interesting, and so there is no persuasive textual evidence for the claim that corporeal substances are just the bits of extension that travel together.

These challenges are, I think, probably decisive on their own. Yet there is another, even worse problem for motion-based proposals, namely their patent inconsistency with the standards of substantiality Descartes sets forth in the *Meditations*. Let us, therefore, turn to that text.

In §7, we saw that the *Meditations* contains two criteria for substantiality. The first is existential independence – a substance depends on nothing, save God, to exist (AT 7.226); the

[127] This contrast only loosely tracks the contrast between physical and metaphysical parts in Schmaltz (2020, 154). Adopting that terminology, my proposal is that the metaphysical parts of the plenum are substances whereas physical parts – bodies – are the scientifically interesting subset thereof. Schmaltz, however, does not understand physical parts to be substances. His concern is that such parts are defined by motion and can therefore be destroyed, but I suspect that any disagreement here between myself and Schmaltz is largely terminological. I take talk of bodies as substances to reflect that there is a substance associated with every physical body: If some extension is currently moving together, then there is a part of extension – a corporeal substance – that is currently moving together such that it currently counts as a body. So, while I agree that "Descartes simply cannot accord such objects [i.e. the category of body] ultimate metaphysical reality" (Schmaltz 2020, 180), I still suspect that we can make sense of why Descartes speaks of bodies – of physical parts and ordinary material objects – as substantial.

second is that a substance is that in which properties inhere but which does not itself inhere in anything else (AT 7.161). The troublesome criterion for the advocate of motion-based accounts is existential independence. Here are two illustrative passages wherein Descartes states this criterion, from the *Objections and Replies* and the *Meditations* proper, respectively:

> The answer is that the notion of a *substance* is just this – that it can exist by itself, that is without the aid of any other substance. (AT 7.226)

> First, we need to know that absolutely all substances, or things which must be created by God in order to exist, are by their nature incorruptible and cannot ever cease to exist unless they are reduced to nothingness by God's denying his concurrence to them. Secondly, we need to recognize that body, taken in the general sense, is a substance, sot that it too never perishes… whereas a human body loses its identity merely as a result of a change in the shape of some of its part. And it follows from this that… the body can very easily perish. (AT 7.14)

The problem with the motion-based account of corporeal substantiality is that bodies that move together can be easily destroyed without the need to resort to anything so dramatic as divine annihilation, and this implies, as Descartes makes quite clear in the above passages, that such bodies are not substances. To destroy a corpuscle, for example, God could, to be sure, annihilate it, but he could also divide the corpuscle in half and move the resulting fragments in opposite directions. This would certainly destroy the corpuscle, the body "that is transferred at a given time" (*PP* 2.25), since the extension is no longer moving together as a unit. According to the motion-based theory of corporeal substantiality, this alone suffices for the destruction of the corporeal substance. Yet, by existential independence, the destruction of a substance should require far more: It should require outright annihilation by divine fiat. This, again, suggests that Descartes's definition of 'body' in 2.25 cannot be an account of corporeal substantiality.

Notably, this difficulty, while decisively refuting motion-based accounts, should be of no concern to advocates of the permissivist reading. This is because the permissivist holds to two theses: (i) all parts of the plenum compose a substance and (ii) the category of 'body' defined in

Principles 2.25 is simply the subset of the broader category of corporeal substance that is of scientific interest. Now, by (ii), the permissivist should be unperturbed by the fact that God can divide a corpuscle and move its parts in opposite directions, thereby destroying a body without resorting to annihilation. On their view, it is simply no longer the case that the substance composed of the resulting fragments is a member of the subset of corporeal substances that are interesting from the perspective of doing kinematics and dynamics. The composition still picks out a corporeal substance, but it no longer picks out a body in the technical sense important for Cartesian physics and defined in 2.25.

The pressing question for the permissivist is therefore whether (i) is consistent with existential independence, and it certainly is. The permissivist claims that all conceivable parts of the plenum constitute a corporeal substance, and existential independence says that all corporeal substances can only cease to exist via divine annihilation. The intractable problem for motion-based accounts is, as we have just seen, their implication that substances can be destroyed by purely mechanical means. The permissivist theory, by contrast, does not share this implication. God can move the parts of any corporeal substance around in any arbitrary manner without thereby destroying the substance, because the resultant distribution of extension will remain a conceivable part of the plenum and thus, by (i), a corporeal substance. On the contrary, the only way to eliminate a corporeal substance is for God to outright annihilate it or one of its proper parts.[128] Again, the crucial point is that bodies moving cohesively are just a proper subset of corporeal substances. This is a definite advantage of the permissivist interpretation over its motion-based competitors, and so I think it clearly preferable to them.

[128] It is a good question how big a part must be annihilated to destroy the whole. Still, this is no special problem for the permissivist reading, since any rendering must account for the venerable paradoxes of composition and identity.

Admittedly, the permissivist interpretation also has other, perhaps more surprising, implications. For example, it immediately implies that there are an indefinitely large number of corporeal substances, since the plenum is both indefinitely large (*PP* 1.26, 2.21) and clearly partitionable in an indefinite number of ways. This consequence should not actually be all that surprising, however, as Descartes draws it elsewhere on different grounds (*PP* 2.34). More jarring is the implication that there are an indefinite number of substances partially located at any given region, since that region is a proper part of an indefinite number of substances. Still, this is colocation in the metaphysically respectable sense of sharing an identical part, rather than in the prohibited sense of interpenetration, and so no genuine conflict with Cartesian corporeal metaphysics results. Thus, the permissivist reading offers a promising way of reconciling the claim that Descartes thought of finite bodies as substances, as clearly attested in the *Principles*, with his official criteria on substantiality in both that text and the *Meditations*.

Of course, there is third option. One could, after all, simply deny that Descartes actually thought of finite bodies as substances, despite the surface reading of the *Principles*.[129] One way to motivate such a reading is to lean into the aforecited passage from the *Synopsis* of the *Meditations*, wherein Descartes speaks of body in general as a substance. One natural way of taking this is as a reference to the plenum, in which case the claim is that the plenum is itself a corporeal substance. From there, it is a short step to claiming that the plenum alone is a corporeal substance, since the plenum is immune to destruction by the mechanical dissolution of its parts, whereas particular bodies are not. On such a reading, Descartes is a monist about corporeal substance: There is only one corporeal substance, the plenum, with particular bodies reduced to the ontological status of modes. The main issue with this interpretation is, of course, making

[129] See, for example, Gueroult (1953), Sowall (2004), Secada (2006, 206-210), and Lennon (1994), (2007).

sense of Descartes's persistent references to particular bodies as substances in the *Principles* and, indeed, elsewhere throughout the corpus.[130] As a rule, the approach will be a deflationary one according to which Descartes is either not concerned with such metaphysical niceties or deliberately speaking with the vulgar by obscuring his actual metaphysical views for reasons of rhetorical expediency.

Whether the permissivist or the monist reading is the most persuasive is a question that I do not intend to resolve here, although my sympathies are probably apparent. What is important, for present purposes, is that neither reading provides a solution to the problem of physical individuation. On the monist reading, for example, one needs an account of why it is that corpuscles exhibit the peculiar unity required to serve their explanatory function as the foundational entities of Cartesian science, and simply pointing out that they are not genuine corporeal substances does not solve this problem. Nor, for that matter, does pointing out that corpuscles are modes of the one corporeal substance, since presumably every describable region is a material mode, but every describable region is obviously not a corpuscle. Similarly, the permissivist interpretation rests upon distinguishing between the question of the unity of the fundamental entities of physics from the question of their substantiality, and so it too does not constitute a resolution of the individuation problem. If anything, it makes the problem worse by suggesting that the category of 'body' that Descartes defines in the *Principles* is not a metaphysically robust category at all, but is rather a pragmatically useful one. Yet, even if so,

[130] In fairness, even opponents of the monist interpretation sometimes find themselves compelled to resort to some such reading away. Schmaltz (2020, 146) and Stuart (1999, 100), for example, both find themselves forced to take Descartes to either be flirting with error or "speaking lightly" when calling ordinary material objects substances. I think it an advantage of the permissivist reading I sketch above that sense can be made of such usage without resorting to anything quite so deflationary.

this does not absolve Descartes of the need to account for the unity of the fundamental entities of his physics in a metaphysically robust way, for all the reasons cited above (§32).

In short, then, accounts of corporeal substance in Descartes are solving a different, if superficially similar, problem from the one with which we are concerned. The distinction between these problems is well put by Garber (1992, 176):

> Material substances, should they exist, are *not* the same as individual bodies… being a substance (if individual bodies are indeed substances) doesn't differentiate actual bodies from bodies that are only individuals in thought. And, Descartes is clear, it is only *actual* bodies that are relevant to physics.

The problem with which we are concerned is not the problem of corporeal substantiality. It is, to borrow a formulation from Katherine Brading and Dana Jalobeanu (2002, 3), the problem of "how to generate the bodies that are to be the subject-matter of the new physics." This question is not resolved by either of the defensible answers to the problem of corporeal substantiality, and so we must look elsewhere for possible answers.

34. Is Cartesian physics intentionally illusory?

The problem of generating the bodies of Cartesian physics is really two problems. One problem is synchronic: How are the fundamental bodies individuated at a particular time? Another problem is diachronic: How do these fundamental bodies account for the changes characteristic of Cartesian science? It will be convenient to treat this second problem first.

We should begin by establishing that Descartes himself clearly envisages the physical realm as mutable, such that Cartesian science is in fact characterized by change. This point is not entirely obvious, despite the abundance of textual evidence in its favor. In fact, the point has been valiantly contested by Thomas Lennon (2007, 38), who has argued at length that Descartes thinks there "is only one real [corporeal] thing, *res extensa*, and it never changes." I say that the

defense is valiant both because of the subtly of the arguments Lennon adduces and also in recognition of the manifest difficulty of maintaining such a thesis in light of the preponderance of passages in which Descartes seems to openly deny it.

The problematic passages for Lennon's interpretation are indeed legion.[131] Consider, for example, the fate of Cartesian cosmology. To Lennon (2007, 31), the "celebrated theory of vortices" must ultimately amount to little more than hot air, a mere appearance *as if* there were vortices. After all, it is a consequence of his reading that the overall state of the plenum does not change over time, yet the existence of actual swirling cosmic vortices would surely yield different states of the plenum at different times. Indeed, Descartes is entirely consistent in characterizing the corporeal domain as mutable, rich with microphysical and macroscopic entities that change over time and differ from one another. The apparent existence of the vacuum is explained away by invoking a change in the kind of matter filling the vessel (*PP* 2.17-18), rarefaction by the substitution of one kind of matter for another within a porous body (*PP* 2.6-7), refraction by light particles traveling through diverse media (AT 6.97-105), and the orbits of the heavenly spheres by swirling vortices of heavenly matter different from the sort ordinarily encountered terrestrially (e.g., *PP* 3.30). Descartes plainly thought of the physical realm as characterized by changes of this kind. The only contrary position available is that Cartesian physics is quite literally illusory.

Embracing this consequence, Lennon (1988, 53; 1994, 13; 2007, 30) tends to characterize change in Cartesian science as "phenomenal" or "ideal" rather than real. We have already noted the enormous textual difficulties with this proposal, since it means that, among other things, the vast bulk of the *Principles of Philosophy* is devoted to the description of a complex illusion that

[131] For another argument against Lennon's interpretation, see Thomas (2015) and the reply offered by Lennon (2015).

is given to us, I suppose, by God. But set this sort of worry aside momentarily. The idea that Cartesian science describes merely apparent phenomena naturally raises the question of what entity has the relevant appearances. Given the fact that a great many of these phenomena are unobserved by human beings, the only likely candidate is God. But this is the view of Berkeley, not of Descartes. The problem is especially acute with respect to the uncountably many microphysical bodies that are the bedrock of Cartesian physics, none of which are directly observable by beings like us. In fact, Descartes proclaims that one persistent source of confusion amongst atomists – ancient and modern – is that they think "there are no bodies which are not perceivable by sense" despite there being "no solid reason" for such a belief (AT 5.271). The unmistakable implication here is that Descartes thinks that there are a great many bodies that are unperceived by human beings, and that changes in these imperceptibly small bodies account for some of the macroscopic changes that we can detect. The upshot is this: If Lennon (2007, 34) is right that all corporeal "change is solely in our conception of things," then the referent of 'our' cannot be human beings. It must be God himself. This view is so foreign to Descartes that it is difficult to even state it without lapsing into Berkeleyan paraphrase, since what is being claimed is that microphysical "reality" is just the way things seem to God, a seeming which is reflected in the way that macroscopic things – which are also merely phenomenal – seem to us. Again, I cannot believe that this is actually Descartes's view: He thinks that there is genuine corporeal change. He thinks that the states of the physical universe are distinguishable from one another in various ways and that these differences play an important explanatory role in his science.

At the risk of belaboring the point, another disastrous implication of denying genuine corporeal change in Descartes relates to the union between body and soul. While this is a subject that is notoriously tricky to pin down, Descartes is quite clear on this much at least: There is

some correlation between the states of my mind and the states of my body. As he writes to Princess Elisabeth of Bohemia, "as regards the soul and the body together, we have only the notion of their union, on which depends our notion of the soul's power [*force*] to move the body" (AT 3.665). Whatever the best rendering of the position Descartes presents here is, it is clear that he thinks the states of the soul are at least correlated with bodily states. But notice how Lennon (2007, 33) must read this passage: He has to say that Descartes's point is that the soul's states are correlated with a "change… in our conception of things." In other words, he must take Descartes to be claiming merely that some mental states (volitions) are correlated with other mental states (conceptions). Yet this is clearly not what Descartes wants Elisabeth to think. He is not trying to convince her that her volitions are correlated with her manner of conceiving – that, in fact, would be much easier to accomplish. No, he is trying, however ineffectually, to nudge her into seeing some obscure relationship between mental states and the different states of the body to which it is united. Apart from the obvious philosophical difficulties that this exchange engenders for the illusory reading, that Descartes has so much trouble explaining himself – even to so capable an interlocutor as Elisabeth – is itself good evidence that he is hunting bigger game than the banality that sometimes volitions are correlated with conceptions.

What, then, is the appeal of the illusory reading? Why does Lennon interpret Descartes as he does, despite being besieged by such clear and abundant textual difficulties? I suspect the reason is that Lennon sees that any other option faces philosophical difficulties that are equally dire. The impetus behind interpreting Descartes as consciously denying the possibility of bodily change is that Cartesian corporeal metaphysics precludes any such change. Faced with the choice between an interpretation that is unworkable philosophically and one that makes Cartesian physics intentionally illusory, one could argue that the latter alternative is the lesser of two evils.

For my part, though, I think this is an excess of interpretative charity. I propose to instead take Descartes at his word, such that he thinks corporeal changes are commonplace, and see whether the metaphysical difficulties this saddles him with are insurmountable.

35. Leibniz's objection – Part I

We know that Cartesian physics is exhausted by kinematics and dynamics. This means that all corporeal changes are changes with respect to motion. Or, as Descartes himself puts it, "all the variety in matter, all the diversity of its forms, depends upon motion" (*PP* 2.23). So, our question is whether the motion of bodies is sufficient to ground the genuine corporeal changes characteristic of Cartesian science. Or, to reframe the question, we need to determine whether the transposition of regions of equally-sized geometrical extension yields genuinely different states of affairs, since this is what motion must amount to given Cartesian metaphysics.

Unfortunately for Descartes, such transpositions are insufficient to ground the genuine changes required by and frequently figuring in his scientific theories. To see why, consider the following argument from Leibniz:

> [Suppose that] motion is just the successive existence of the moving thing into diverse locations… however, motive force [*vis*] is not excluded. For not only does a body in its present motion occupy a location commensurate with itself, but it also has a conatus or exertion for changing place… Otherwise… it would also follow, finally, that nothing would change in bodies, and that all things always behave in the same way. For if no portion of matter whatever differs from another equal and congruent portion… and, further, if one momentary state did not differ from another except by the transposition of equal, congruent, and in all things consistent portions of matter, then it is manifest that, on account of the perpetual substitution of indistinguishables, it is impossible to distinguish different momentary states in the corporeal world. (*NI* 13)

Call this *the immutability argument*. Its conclusion is the impossibility of genuine change in the corporeal realm, and its major premise is that the "substitution of indistinguishables" does not amount to genuine corporeal change. The idea, then, is that the transposition of regions of

extension that, necessarily, are "equal, congruent, and in all things consistent [*æqualium et congruarum et per omnia convenientium*]" is no change at all, certainly not the sort of change required to make sense of the deliverances of Cartesian science enumerated above (§34).

As Leibniz presents it, the immutability argument has three steps. The first is the straightforward one of pointing out that genuine change requires that initial and some subsequent state of a system differ in some way from one another. In the present context, this means that the physical universe changes only if it exhibits first one state and then another distinct state. This step should be uncontroversial, as it simply amounts to clearly stating an uncontentious definition of change. The second step is specifying what is required for two states of the physical universe to differ. Here, Leibniz appeals to the *identity of indiscernibles*, which he takes to state there cannot be two non-identical entities that share all their intrinsic properties.[132] To put the principle in his own words: "To suppose two things indiscernible is to suppose the same thing under two names" (*TC* IV:6). So, the second step of the argument, for Leibniz, is specifying that one state of the physical universe differs from another only if those states differ with respect to some intrinsic property – a premise which Leibniz thinks is established by his strong version of the identity of indiscernibles, according to which things that do not so differ are *ipso facto* identical. This is the heart of the problem as Leibniz understands it, since, as he remarks to Samuel Clarke in an only slightly different context, "two states indiscernible from each other are the same state" (*TC* IV:13).[133] The third step is the claim that no such difference can obtain in virtue of the transposition of indistinguishable regions of geometrical extension.

[132] This "strong" version of the principle is not to be confused with the weaker – and arguably analytic – truth often referred to as Leibniz's law, according to which two things differ only if they differ with respect to some property. The key point for our purposes is that Leibniz wants to say something much stronger, such that two distinct things cannot differ only with respect to relational or other extrinsic properties.

[133] The official target here is Newtonian absolute space, but note that Leibniz, in the same letter, likens Newtonian absolute space to the "Cartesian supposition of a material extended unlimited world" (*TC* IV:11).

The appeal to the strong version of the identity of indiscernibles throws the Cartesian a lifeline: Unlike Leibniz, there does not seem to be any reason for a Cartesian to dismiss out of hand the possibility that things might differ in number alone. So, absent an argument that they must be committed to Leibniz's strong version of the identity of indiscernibles, the Cartesian would seem to be free to deny the second step in the immutability argument by insisting that the relevant bits of extension are discernible via their *extrinsic* properties, e.g., their locations.

This lifeline is, however, easily severed. Leibniz does not, in fact, need to appeal to anything so strong as the thesis that things are distinct only if they differ with respect to some intrinsic property. All that he needs to show is that the Cartesian is unambiguously committed to the states of the physical universe differing with respect to such properties over time. We have already seen ample evidence that this is so in reply to Lennon's interpretation of Cartesian corporeal metaphysics. Again, it is supremely difficult to understand how swirling cosmic vortices or the kinematics of countless microphysical bodies could be rendered consistent with the thesis that the states of the physical universe do not differ with respect to intrinsic properties over time, and so the Cartesian is committed to such differences.

We also mentioned, in this connection, the interaction of the mind and the body, a point which now bears stressing. Consider the following passage:

> A sword strikes our body and cuts it; but the ensuing pain is completely different from the local motion of the sword or of the body that is cut – as different as color or sound or smell or taste. We clearly see, then, that the sensation of pain is excited in us merely by the local motion of some parts of our body in contact with another; so we may conclude that the nature of our mind is such that it can be subject to all other sensations merely as a result of other local motions (*PP* 4.197).

While the details of this account of perception might be obscure, its overall thrust is readily apparent: Genuine corporeal changes are correlated with (and, indeed, play an important role in

the explanation of) genuine mental changes, such as perceptions. This same theme is stressed throughout the corpus. To cite but one further case, consider the following from the *Optics*:

> You will no longer find this strange, however, if you recall the nature that I ascribed to light, when I said it is nothing but a certain movement or an action received in a very subtle matter which fills the pores of other bodies. And you should consider too that, just as a ball loses more of its motion in striking a soft body than a hard one and rolls less easily on a carpet than on a completely bare table, so the action of this subtle matter can be impeded much more by the parts of the air (which, being as it were soft and badly joined, do not offer it much resistance) than by those of water, which offer it more resistance; and still more by those of water than by those of glass or crystal (AT 6.103).

Again, while the details here are perhaps unclear, it is perfectly transparent that Descartes is thinking that the states of the physical universe have different intrinsic properties that change over time: I can see no way of cashing out all this talk of local motion, subtle matter, softness, and resistance that does not commit Descartes to at least that much. His point is clearly that there are differences in the intrinsic properties of matter and that such differences are part of the common currency of the scientific explanatory apparatus. To say otherwise is to, with Lennon, read Cartesian science as nothing more than the description of a complicated illusion.

36. The immutability argument

This point made, let us explicitly formulate the immutability argument. The fulcrum of the immutability argument is the claim that Cartesian metaphysics implies that each state of the physical universe can differ only via "the transposition of equal, congruent, and in all things consistent portions" of extension. The problem that is being highlighted here is that substituting indistinguishable parts does not yield the distinct physical states that, as we have just established, are part and parcel of Cartesian science. This in mind, here is a reconstruction of the argument:

P1) All corporeal changes in Cartesian science must amount to the transposition of indistinguishable regions of extension that do not differ with respect to any of their intrinsic properties.

P2) If so, then the changes characteristic of Cartesian science are impossible.

P3) So, the changes characteristic of Cartesian science are impossible.

Again, this reconstruction differs from Leibniz's original version in that it does not invoke his version of the identity of indiscernibles. Rather, it rests on the more modest claim – embodied in (P2) – that the changes characteristic of Cartesian science require that the physical universe differs with respect to some intrinsic properties over time. Put another way, (P2) rests on the claim, established above in refuting the illusory interpretation of Cartesian physics, that the states of the physical universe are distinguishable from one another in various ways and that these differences play an important explanatory role in his science. The argument as a whole purports to show, disastrously, that such changes are precluded by Cartesian corporeal metaphysics.

The core question, then, concerns the justification of (P1). As we know, Cartesian corporeal metaphysics collapses the distinction between material and geometrical objects, while Cartesian physical science is mechanistic in the sense that kinematics and dynamics are the foundational sciences. Accordingly, all corporeal changes must be reducible to the transposition of regions of geometrical extension. This is the first part of the premise, and it can be avoided only by the abandonment of one of Descartes's core commitments: It is an implication of the conjunction of his mechanism and his mathematization of the material, and so it can be denied only by denying one of those (to Descartes) sacrosanct theses. Thus, the only question – with respect to (P1) – is whether transpositions of regions of extension really is the transposition of indistinguishables that do not differ with respect to any intrinsic property.

That this question must be answered in the affirmative can be established by leaning into the mathematization of the physical that is, as we know, a Cartesian calling card. So, consider Euclidean space, of the kind at issue in Euclidean geometry and the Cartesian conception of matter. Suppose, for the sake of argument, that God creates this space at time t and then, at t_1,

rotates the vast majority of it by 90 degrees about a stationary circular region. This amounts to moving every region of extension into a new location, save the region serving as the axis of the rotation, and so it should amount to a dramatic change in the physical universe – among the most dramatic that could be imagined if Descartes is right that the universe just is so much Euclidean space. Yet, catastrophically, even so drastic an apparent change does not yield any genuine alteration: The space at t_1 remains indistinguishable from the space at *t*. After all, *ex hypothesi*, the only thing that has supposedly taken place is the transposition of indistinguishable bits of space, but such a transposition, even one as widespread as the one at issue, provides no way to distinguish the two states of affairs. There just is no way to gin up genuine change by swapping around bits of geometrical extension that are, by their very nature, impossible to distinguish from one another. There is literally no difference to be detected between the two overall states of affairs: Even God could not tell the difference, because there just is no difference. At both *t* and t_1 there is only an indefinitely large region of uniform Euclidean space.

An analogy may be helpful in grasping this admittedly abstract point. So, consider a painting, such as Malevich's *Red Square*, that consists entirely of a single color uniformly distributed within a symmetrical region. Suppose I told you that I had swapped the paint from the top half of the region with the paint from the bottom half and claimed, thereby, to have altered the image. Clearly, I am fibbing. The image after the transposition of exactly congruent regions of exactly the same color is indistinguishable from the image before the transposition, and so I have not actually altered the resultant image in any way. There is no way to detect any difference between the image before and after the supposed alteration, because there just is not a difference to be detected. Similarly, the state of the physical universe after the transposition of exactly congruent regions of indistinguishable Euclidean space is exactly identical to the state of the

physical universe before the transposition occurred. Again, the point is that no genuine change has taken place, since there is no way to distinguish the states of affairs before and after the supposed alteration. The picture is the same; the two states are not actually different.

Of course, we should be careful not to push this useful parallel with altering artwork too far. One crucial disanalogy between the painting case and the transposition of Euclidean space is that the former is at least conceivable as a genuine case of change, even if that change is not to be found in the image depicted. The reason for this is that there is some entity, the paint, that is located first here and next there upon the canvas. A crucial point is that there is some constant against which this genuine change can be understood, in this case the canvas on which the paint is spread. More generally, the presence of these two features – an entity that changes and one that persists throughout the change – seems to be required of any plausible analysis of change.[134] The reason that the Cartesian transposition of indiscernible regions of extension is in even more dire straits is that it is unclear what these two entities could possibly be. Geometrical extension, as Descartes readily affirms, is a metaphysical form – an unchanging attribute – that is only conceptually distinct from material substance itself. Yet, in order to accommodate genuine change, there must be some further entity that exhibits various geometrical structures over time, and there simply is no such entity on the Cartesian view. The only corporeal entity is extension; the physical universe is another name for – another way of conceiving of – the metaphysical form of extension. Yet, if all that exists is endless and uniform extension, then how can the Cartesian make sense of one entity changing with respect to another? To return to the artwork analogy, it is as though one claims that the image depicted on a fresh canvas has been altered despite there being no paint on it at any point in time.

[134] Aristotle's hylomorphic analysis is illustrative: All change is analyzed in terms of persisting matter that either gains or loses some form (*Phys.* 200b32-201a5; quoted above in §2).

Even so, it is tempting to think that this challenge, at least, can be met. After all, change could perhaps be understood by reference to distinct parts of this one entity. Tellingly, this is the very strategy that Descartes adopts in defining motion as the transference of one bit of extension from "the vicinity of other bodies… to the vicinity of [another set of] different bodies" (*PP* 2.25). Unfortunately for Descartes, there is no way to tell that one part of the plenum has been held at rest, such that the changes within the rest of the plenum could be understood with respect to it. At both t and t_1, for example, there just is no way to tell which parts are in motion and which are at rest; at both times there is just endless, uniform extension. It thus follows that our initial supposition – according to which God could create and then rotate Euclidean space by 90 degrees – was itself incoherent. That supposition relied upon fixing an axis of rotation, such that the rotation could be understood with respect to it, yet such a state of affairs is indistinguishable from one in which the supposedly fixed extension was transposed with some other extension – or even annihilated outright and replaced with a novel region.

All this makes vivid that the argument for immutability in fact intersects with the argument that there is no way to individuate bodies in the requisite way. Let us, therefore, finally turn our attention to the individuation problem proper.

37. Leibniz's objection – Part II

As we have seen, Leibniz is anxious to show that it is necessary to posit some corporeal conatus or *vis* in order to account for genuine corporeal change. The need to accommodate the requisite changes in the physical universe is, however, only part of the reason Leibniz cites in *De Ipsa Natura* for the necessity of his favored metaphysic of *vis*. More central, perhaps, is that he

considers some such emendation of Descartes's purely geometrical corporeal metaphysics to be required for the individuation of the fundamental bodies of Cartesian kinematics:

> [Suppose that] motion is just the successive existence of the moving thing into diverse locations… however, motive force [*vis*] is not excluded. For not only does a body in its present motion occupy a location commensurate with itself, but it also has a conatus or exertion for changing place… Otherwise, at the present moment (and furthermore at any moment at all) body A, which is moving away from a resting body B, would not differ from it… [and this] would entail that there is no plain criterion for distinguishing bodies, since in a plenum it is not possible to distinguish uniform masses except with respect to motion (*NI* 13).

Call this, *the individuation problem*. To reiterate, the cash-value here for Leibniz is the necessity of positing some corporeal conatus or *vis* in order to individuate bodies. Now, we can easily imagine what Descartes would say in response. He would protest that the *vis* of bodies – the force characteristic of dynamics – is well-accounted for within his system via divine causal activity. This position is deeply embedded in Cartesian corporeal metaphysics and is attractive to Descartes on a number of grounds, not the least of which is that it allows him to hold onto the thoroughgoing mathematization of the physical without implausibly restricting physics to mere kinematics. So, the first question that we should ask ourselves is whether an occasionalist theory of *vis* solves the individuation problem.

Leibniz, of course, is well aware of the likelihood of receiving such a reply from a Cartesian, and he even alludes to the possibility, albeit briefly (*NI* 14). Clearly, he does not take it to cut any ice. What, then, does he think is so obviously unworkable about this occasionalist response? Why does understanding the *vis* of bodies via divine causal activity, as in Descartes's geometric occasionalism, not provide a "plain criterion for distinguishing bodies" in the same way that the *vis* characteristic of Leibnizian metaphysics does?

Part of the answer here is surely that Leibniz just thinks that occasionalism is a non-starter on other grounds. For example, he goes on to argue (*NI* 15) that occasionalism implies –

horror of horrors – Spinozism. Whether such an implication obtains and how worrying such an implication would actually be is, to say the least, unclear. What is clear is that Leibniz has other reasons to deny that equating *vis* with divine efficacy can solve the individuation problem – reasons that are more immediately incisive. As we have seen (§26), perhaps the most attractive feature of occasionalism for Descartes is that it makes possible the transition from kinematics to dynamics without polluting his purely mathematical corporeal ontology with corporeal causal powers. Descartes thus finds occasionalism attractive precisely because it accounts for *vis* without requiring it to be understood in terms of corporeal properties, but this is also precisely why Leibniz thinks that occasionalism cannot account for any metaphysical distinction between bodies. Again (§24), the problem is that, for the Cartesian, any distinction grounded in *vis* is a distinction grounded in facts about the divine will rather than in facts about bodies themselves, and so distinctions grounded in *vis* do not reflect metaphysical facts about material substance at all, much less about particular bodies. So, the Cartesian appeal to *vis* fails to provide a criterion for distinguishing bodies because, unlike Leibniz, Descartes does not understand this as an appeal to a corporeal property.

To refocus, the core problem that Leibniz raises here is the necessity but apparent impossibility of providing a principle of individuation between bodies that is consistent with Cartesian metaphysics. Another way to approach this problem is to note that, without such a principle, there is simply no fact of the matter about what structure the physical universe exhibits. Now, Descartes wants to say that the physical universe does exhibit a fundamental structure – a corpuscularian one. So, the Leibnizian objection is also well understood in terms of a demand for a principle of individuation for corpuscles, and so the argument that Cartesians can

provide no such principle should proceed by showing that motion and geometrical properties – the only candidates on the Cartesian picture once *vis* is eliminated – cannot play this role.

Before turning to those properties, we should pause briefly to make a terminological point. Previously, we have understood 'bodies' in reference to Descartes's definition at *PP* 2.25. If the demand for a principle of individuation were understood in terms of this definition, then determining Descartes's answer would be relatively trivial: It would be contained in 2.25. But the demand cannot be understood in this way. First, as previously noted (§33), the official aim of 2.25 is to demarcate the class of bodies of interest in a scientific context, and so it is, at best, of debatable metaphysical import. Descartes would, therein, be perfectly within his rights to simply give a functionally useful way of reliably picking out bodies rather than a metaphysically robust principle of individuation for them. Second, and decisively, the conception of body laid out in 2.25 is given in terms of motion, whose own strict definition presupposes the resolution of the problem of individuation, and so cannot itself provide that resolution on pain of vicious circularity – a point we will have cause to linger upon below.

38. The individuation problem

How then, are we to understand the demand for a principle of individuation for bodies, paradigmatically the corpuscles that are the basic building blocks of Cartesian physics? I propose to approach this question via the following thesis: *The corpuscularian structure central to Cartesianism reflects physical reality only if the corpuscles themselves are something more than mere aggregates*. One can mentally divide the plenum into aggregates however one wants, of course, but the corpuscularian structure at stake in scientific explanations had better be cutting physical reality at the joints rather than arbitrarily: It had better be tracking some fact about the

physical universe. The only way for this to happen is if there is some corporeal property shared by corpuscles that is not shared by any non-corpuscle. Otherwise, there would be no fact about the physical universe in virtue of which it exhibits a corpuscularian structure.

Denying this is a non-starter. Such a denial would entail that the corpuscularian structure central to Cartesian science reflects, at most, an arbitrary choice by God to mentally divide the plenum up and give us appearances as if this division were, *per impossibile*, actually instantiated. But that, of course, is just to say that corpuscularian structure does not reflect physical reality: In this scenario, the physical universe does not actually exhibit corpuscularian structure at all, and so Cartesian physics would not be dealing with anything physically real. Rather, Cartesian physics would be the description of a complicated illusion – a reading we have already rejected.

In short, then, what is required to solve the problem of individuation is a property that is shared by all corpuscles but which is not shared by any mere aggregate. What is wanted is a principle of individuation for corpuscles, since it is only with such a principle in hand that Cartesian physics can aspire to describe the way the world actually is.[135]

The search for such a principle should be begun by considering kinetic properties more carefully, since these properties are the most obvious candidates available. Tellingly, Leibniz begins his attack on the Cartesian position by defining motion as "the successive existence of the moving thing into diverse locations" (*NI* 13). This definition echoes Descartes's own, according to which motion is the *translatio* "of one piece of matter… from the vicinity of the other bodies… which are regarded as being at rest, to the vicinity of other bodies" (*PP* 2.25). In both

[135] An undeclared assumption of my framing of the individuation problem is thus that the composition of further objects by corpuscles is of only ancillary concern. I think such composition a largely unimportant question from our perspective, akin to contemporary metaphysical hand-wringing over whether, to borrow the framing of Merricks (2001, 3), "atoms arranged statuewise… compose a statue." However interesting as a metaphysical question, I take it that no particular resolution of this problem will have any great ramifications on contemporary science, and I think something similar holds with respect to whether or not Cartesian corpuscles "really" compose macroscopic objects.

cases, the definition of motion is given in terms of the comparison of the location of a body at distinct times. This makes the problem with any motion-based reply to the individuation problem palpable: Motion is defined via individual bodies, and so it cannot, on pain of circularity, provide a principle of individuation for bodies. In order to understand what motion is, we must know that one and the same body has changed locations, but that, obviously, requires knowing that what is at stake *is one and the same body*. In other words, the Cartesian definition of motion presupposes an answer to the individuation problem, and so it cannot itself provide an answer to that problem. The same will hold for kinetic properties generally, since all such properties will by definition involve motion.

When this result is joined to the aforementioned unworkability of appealing to Cartesian *vis*, the conclusion that follows is that the properties characteristic of kinematics and dynamics are unable to solve the individuation problem, since no such properties can perform the required explanatory work in a non-circular way. No appeal to motion – or to the explanatory apparatus built upon motion, such as the laws of motion and the like – will be of any use here.

If the Cartesian conception of motion and *vis* cannot provide a principle of individuation for bodies, then the lone remaining option is that some purely geometrical property does. So, let us consider whether any such property can perform the requisite explanatory work. The most promising attempt to chart such a course, in my view, is that of Edward Slowik (2001). The basic idea is that what individuates bodies is the surface delimited by its "neighborhood" of bodies. So, for example, the surface of the loaf of bread is delimited by the surrounding air and the surface of the counter on which it sits. As Slowik (2001, 3) explains:

> Thus, an individual 'body' is defined by its containing, or common, surface with its contiguous neighboring bodies; where "by 'surface' we do not understand any part of the surrounding bodies, but only the boundary between the surrounding and surrounded bodies…" Descartes also deems this common surface, 'external place' [citing *PP* 2.15].

The immediate problem, of course, is that this definition appears just as circular as the appeal to motion, since once again we have a straightforward reference to individual bodies in our purported principle of individuation for bodies. What I find laudable in Slowik's approach is that he meets this objection head on with, I think, a surprising degree of success.

The trick is turned by considering what would happen if, *per impossibile*, the surrounding neighborhood of bodies were miraculously annihilated. Here is the closest Descartes comes to giving an official analysis of this sort of case:

> If someone were to inquire as to what would occur if God removed the whole body contained in a vessel and did not allow anything to take the place of the body that had been removed, the answer must be that the sides of the vessel would thus become contiguous to one another. For when there is nothing between two bodies, they must necessarily touch [*PP* 2.18].

This analysis is perplexing for a number of reasons, especially given that Descartes clarifies elsewhere that the described process does not involve movement (AT 2.482, 4.109). Yet, how can this be? After all, the walls of the container are now contiguous with one another whereas the were not previously, and this looks to satisfy the definition of motion in terms of a body transferring from one contiguous neighborhood to another. This suggests that one or more terms in this definition or the analysis of the case must have some (relatively arcane) technical force, or else that Descartes is speaking loosely when he describes the process as static. However this quandary is navigated, though, the main point for our purposes is just that, even in this clearly miraculous case, every individual body still has its surface delimited by neighboring bodies. So, this case does not actually yield any straightforward evidence for how Descartes would think of a case in which *all* neighboring bodies were annihilated – that requires a miracle of an entirely different order of magnitude. So, our question remains: If such a state of affairs miraculously obtained, would the surface of the body still suffice to delimit it?

Slowik argues that it would. Part of his argument turns on a particular (and perhaps somewhat peculiar) analysis of the substance-mode relation, but his main point is less complex and should be less controversial. Here is how Slowik (2001, 10-11) puts this main point:

> [While the] contiguous neighborhood… defines the surface or extent of the contained material part [in all ordinary cases], one cannot conclude from this form of dependency that the plenum part would cease to exist if that neighborhood were removed… Of crucial importance, here, is Descartes's claim [in *PP* 1.60] that if we can distinctly understand "one thing without the other", then they really are distinct, independently existing substances. A part of extended substance can be distinctly separated, or delimited, from other parts in the same manner. Thus, Descartes affirms that each material part can be distinctly understood "without the other" parts, a conclusion which closely matches the 'neighborless' interpretation of individual corporeal substance put forth above.

In effect, Slowik understands the delimitation provided by contiguous bodies to be only pragmatically important: It is how we ordinarily individuate bodies, not a metaphysically necessary condition for bodies to be individuated. What actually individuates bodies is just the surface that is, Descartes tells us, delimitable in thought. Yet, it does not follow from the elimination of the neighborhood that ordinarily provides us a convenient way to individuate bodies by their surfaces that such a neighborhood is required for the body to have the relevant surface. If, to return to our early example, God were to miraculous annihilate all corporeal things save only a loaf of bread, it would not follow that this bread lacked a surface. Indeed, insofar as we can conceive of this case, it seems hard to deny that the loaf would have exactly the same surface as before, given that the surface in question is constituted by some extension that is part of the – *ex hypothesi* unaltered – loaf. And so, Slowik concludes, individuating corporeal substances by their surfaces is not circular after all. It so happens that we ordinarily use bodies to individuate other bodies, but this reflects our customary practice rather than metaphysical fact.

Whether this proposal survives withering philosophical scrutiny is unimportant for present purposes.[136] From the point of view of solving the individuation problem, Slowik's reading is doomed because it is not, ultimately, an attempt to solve that specific problem. What we have is, instead, another attempt at solving the related but distinct problem of corporeal substantiality. Note how Slowik quite consciously slides between talk of the individuation of bodies and talk of corporeal substantiality: It is quite clear that, in his usage, these problems are one and the same. In our usage, however, these problems are not equivalent: What we are after is not an account of what makes something an individual corporeal substance but what makes something, in the terminology of Garber (1992, 176; quoted above in §33) an *actual* body that is relevant to Cartesian science. By making "the delimitation… relative to the conceiving" mind, Slowik (2001, 12) is perfectly upfront that he is not solving the problem of individuating these actual bodies. This is, of course, fair enough. But given that his proposal seems the only likely way of avoiding the circularity inherent in appealing to surfaces as a principle of individuation, it seems that we must conclude that surfaces will not provide us with the individuation principle that we seek, one that can render the corpuscularian structure of Cartesian science a physical reality rather than a merely mental phenomenon. Yet, if not surfaces, then what options are left to us? What further geometrical properties are there to which to appeal?

At this point, the prospects for successfully responding to the individuation problem seem dim indeed. Motion, *vis*, and all other such properties have proven unworkable, and we have just reached an equally dismal result by attempting to use the surfaces of bodies. This means, in practice, that the only remaining options through which the fundamental building blocks of

[136] Slowik (2001, 2) himself evinces some doubts; he avers that even his own preferred interpretation is "not free from inconsistences" regarding important metaphysical issues. Part of his motivation is that any issue involving the Cartesian account of motion is metaphysically muddled by Descartes's own manifest confusion about the subject.

Cartesian physics might be distinguished are size and shape. Neither will do, however. Size and shape clearly furnish no criteria by which to pick out all and only the corpuscles at any particular time. Leibniz, once again, is alive to the issue:

> [And] one will never arrive at any true criterion of distinction for the present. This is because, under the assumption of perfect uniformity in matter itself, one cannot in any way distinguish one place from another, or one bit of matter from another bit of matter in the same place. It is furthermore useless to turn to shape… For in a mass that is perfectly homogeneous, undivided, and full, no shape, that is, no boundary or distinction between its different parts, arises, unless through motion itself. But if motion contains no mark for distinguishing things from one another, then it likewise bestows no mark with respect to shape (*NI* 13).

So, to Leibniz, the problem with using shape or size to individuate bodies is that such properties are themselves parasitic on motion. In order to determine the size and shape of a body, Leibniz thinks, the Cartesian can only appeal to the dimensions of regions of extension that travel together. But since appeals to motion are non-starters for all the reasons we have already discussed, appeals to the dimensions of bodies are likewise non-starters.

I think that this argument succeeds, although I am not sure that Leibniz says enough here to establish that it does. For consider the following imaginary – but perfectly natural – riposte:

> It is true enough that the only way that we humans can determine the dimensions of bodies is by observing how the bodies themselves move over time, but this does not show that the dimensions of bodies are ontologically dependent upon their kinetic properties. Rather, it shows that we are epistemically dependent on the kinetic properties of bodies to determine the dimensions of bodies. But epistemic dependence of this sort is plainly of no ontological import.

For all Leibniz says in *De Ipsa Natura*, this reply might succeed. The idea would be that there is an objective fact about the dimensions of bodies, by which they are individuated, despite the fact that we can only discover these facts *a posteriori* via their motion. God, however, could detect the objective microphysical structure of the plenum simply by noting the dimensions of the corpuscles at a particular time; that is, by noting the genuine instantaneous distinctions between bodies of various dimensions instantiated within the plenum.

I strongly suspect that Leibniz does not bother to refute this possibility only because it is so clearly doomed. Even if God can mentally divide the plenum as he likes, this is neither here nor there, since what is wanted is a way to distinguish corpuscles from mere mental aggregations of that kind. So, the proposal must instead be understood in terms of God detecting some objective fact about the plenum at a particular time, namely the dimensions of actual bodies. This, however, is impossible, and the reasons it is impossible are already familiar to us. In order for there to be an objective fact about the dimensions of actual bodies within the plenum, there must be something that is exhibiting particular dimensions at particular times: There must be some entity exhibiting a particular geometrical structure. The first problem with the supposition is that it is, yet again, circular if taken as a response to the individuation problem, since it presumes rather than supplies an account of individuals constituting the structure of the plenum. That is to say, claiming that something has particular dimensions at *t* is to presume that one has an antecedent grasp of that thing as an individual – but that is the very sort of grasp that we are attempting to attain. Second, and as we have noted *ad nauseum*, the Cartesian universe is just Euclidean space, and so it is by definition undifferentiated and uniform. The Cartesian plenum alone can no more exhibit an objective corpuscularian structure than Euclidean space alone can, and this because the Cartesian plenum just is Euclidean space. For these reasons, the proposal that God detects some objective fact in virtue of which the barren Euclidean space that is the Cartesian plenum exhibits corpuscularian structures is also unworkable.

In short, there is no way out for Descartes. There is no solution to the individuation problem that does not run afoul of one of the core commitments of Cartesianism. What, then, is the source of the trouble? What has gone so disastrously wrong?

Cartesian corporeal metaphysics is, as we know, a sustained attempt to fulfill an appealing and widespread ideal: the mathematization of the physical. But we are now in a position to appreciate that this ideal contains the seeds of its own destruction, at least if carried out to its logical conclusion. Mathematical definitions, as we saw Aquinas point out many pages ago (§3), differ from the definitions in physical science in that the latter class "contains not only the form but also the matter" (*EE* 2.25-26). Stripped of hylomorphic trappings, St. Thomas's point is that mathematical definitions concern abstract structural features rather than particularly existing things. One way to understand the role of mathematical explanations in science is that they deal with structural features in the abstract, and, when these structures are present in physical things, can be profitably applied to concrete cases. Yet, it would be a mistake, as Aquinas observes, to infer from this that mathematical and physical definitions do not differ, since otherwise no sense could be made of the idea that physics deals – as it surely must – with particular concrete things at particular times. Indeed, Descartes himself sometimes draws the contrast between the mathematical and the physical in exactly these terms: "The only difference [between mathematics and physics] is that physics considers its object not just as a true and real entity, but also as something actually and specifically existing." (AT 5.160).[137]

One way to understand the insuperability of the individuation problem is that Descartes is not actually at liberty to draw this contrast between the mathematical and the physical. On the contrary, his corporeal metaphysics preclude any such distinction by precluding the possibility that matter exhibits any non-geometrical properties. But this, in turn, precludes the possibility of the physical universe exhibiting any particular structure at any particular time, since doing so would require some entity other than barren Euclidean extension to exhibit that structure. Thus,

[137] For more on this contrast in Descartes and Aquinas, see Smith (2010b, 131 and *passim*).

the individuation problem can be avoided only by abandoning a core tenet of the Cartesian system. Descartes must either abandon his attempt to reduce the physical to the mathematical or else reduce his physics to the description of a complicated illusion. I cannot imagine Descartes countenancing either horn of this dilemma, but I also see no way for him to avoid it. Again, there is no way out. The only options are either outright surrender (the abandonment of one or more core tenets of the Cartesian program) or abject defeat (clear internal inconsistency on central metaphysical issues and obvious empirical implausibility).

That Cartesianism fails in this way shows, I think, that St. Thomas and Leibniz are just right: One has to understand the physical universe not only in terms of mathematical structures but also in terms of something exhibiting those structures. One way to do this is to, with Aquinas and other Aristotelians, understand bodies in terms of both matter and form, potency and activity. Another way is to, with Leibniz among a great many others, make room in corporeal ontology not only for mathematical structures but also for genuine causal activity, such that bodies are not merely regions of space, but regions of space that are loci for genuine causal efficacy.[138] Doubtless there are many other options, yet Descartes can avail himself of none of them. The Cartesian research program is degenerate – in the sense of Imre Lakatos (1968) – precisely because it attempts to make do with mathematical structure alone. But this entire project is, as the individuation problem and the argument for immutability make vivid, unworkable. It leads Cartesian science to deliver a body of predictions – an immutable universe that never exhibits any particular physically real structure – that would have been as unacceptable to Descartes as they are to contemporary scientists and metaphysicians.

[138] Notably, an extremely common candidate for such activity was impenetrability. We have already seen this strategy in Fontenelle and More, but it is by no means limited to them. Other examples that are prominent in the history and philosophy of science include Locke (*EHU* 2.4.1-6), Leibniz himself elsewhere in the corpus (*TDV* 173; *TDB* 203; *BF* 250), and Euler (*LE* 1.69, 233-235; 1.70, 236-238).

39. The road to Elea

Many of the false predictions implied by Cartesian metaphysics adduced throughout this chapter suggest Eleaticism in the corporeal domain. By way of conclusion, I want to consider the degree to which this charge can be made to stick. Now, Eleaticism is the thesis, associated with the ancient Greek port city of Elea on the Italian peninsula and some of her native philosophers, that change and distinction are metaphysical impossibilities. For our purposes, we will restrict the domain of the thesis to the corporeal realm. Thus restricted, the *Eleatic thesis* is twofold: (i) no genuine change occurs in the physical universe and (ii) there are no genuine – as opposed to merely mental – distinctions between material things. The ancient Eleatics consciously defended this supremely unpalatable thesis, as does at least one contemporary philosopher.[139] Descartes, naturally, does not consciously defend the Eleatic thesis; on the contrary, he invariably presumes its falsity. Nevertheless, I think we must conclude that Descartes is on the road to Elea, whether he wishes to be or not. An attenuated Eleaticism, at the very least, is a consequence of his core philosophical commitments. This can be seen by drawing together some of the disparate strands of argument already discussed in this chapter.

We can, therefore, begin by recapitulating and expanding upon the arguments of the previous two sections. First, here again is our reconstruction of the argument for immutability:

P1) All corporeal changes in Cartesian science must amount to the transposition of indistinguishable regions of extension that do not differ with respect to any of their intrinsic properties.

P2) If so, then the changes characteristic of Cartesian science are impossible.

[139] The ancient thinkers that I have in mind are, of course, Parmenides of Elea, Zeno of Elea, and Melissus of Samos, in whose writings Greek Eleaticism, perhaps, reached full flower. A good introduction to these thinkers and their writings is McKirahan (2010, 145-192, 293-302). The lone contemporary defense of which I am aware is *The Parmenidean Ascent* by Della Rocca (2020). The possibility that Descartes might be committed to Eleaticism was first brought to my attention by the work of Lennon (1994), (2004). My own thinking is thus deeply indebted to his, but there are also important differences. To reiterate, the main disagreement is that I do not think that Descartes thought of his physics as describing an illusion. The contrast with Parmenides is instructive: Consider the attitude of the Parmenidean goddess towards the way of mortals, including Parmenidean cosmology (DK 28B6, 146).

P3) So, the changes characteristic of Cartesian science are impossible.

As we have seen, (P1) is a consequence of the identification of geometrical and physical objects. If the physical universe is entirely constituted by geometrical extension, then the only sort of change that can possibly occur is the transposition of regions of extension that, given the uniformity of geometrical extension, are indistinguishable from one another. From this, it follows that all the genuine physical changes involved in Cartesian science are impossible, since such changes require something more than the mere interchange of indistinguishables. In other words, the Cartesian clearly thinks that the states of the physical universe differ over time, but there is no sense to be made of such differences merely in terms of swapping indistinguishable parts of the plenum from location to location. This is the inference embodied in (P2).

Now, (P3) seemingly amounts to one half of the Eleatic thesis, since it holds that the physical realm is immutable. Indeed, it is striking how similar the argument for immutability is to an argument by one of the ancient Eleatics, Melissus of Samos:

> But it is not possible for it [what-is, what really exists] to be rearranged either, for the arrangement that previously was is not destroyed, and an arrangement that is not does not come to be. But when nothing either comes to be in addition or is destroyed or becomes different, how could there be a rearrangement of things-that-are? (DK 30B7, 294)

Melissus's point, like Leibniz's, is that genuine physical change requires a substantive difference between antecedent and subsequent states of affairs, but that this is an impossibility if there is no property of these states of affairs in virtue of which they differ. Since this seems an unavoidable – perhaps even an analytic – dictum, the only question is how far such reasoning establishes the first conjunct of the Eleatic thesis, (i): no genuine change occurs in the physical universe.

The answer depends on how much is built into 'genuine' change. For Melissus and Leibniz *qua* anti-Cartesian polemicist, unwavering commitments to a particular characterization of what-is and the strong version of the identity of indiscernibles, respectively, establish that any

change must be merely illusory, entirely phenomenal. The Cartesian is thus free to resist full-blown Eleaticism by resisting such commitments. The only way to mount such a resistance, as far as I can see, is insisting on the reality of metaphysically distinct finite corporeal substances (if permissivism is preferred as a solution to the problem of corporeal substantiality) or of corporeal modes that correspond to each proper part of the plenum (if monism is preferred). Any victory that is won along these lines will be pyrrhic, however, for such changes cannot ground the genuine changes required by and assumed within Cartesian science. Put another way, any such changes will not concern *actual* bodies; the physical universe will still not actually exhibit a corpuscularian structure; Cartesian science will still be purely illusory. If this avoids Eleaticism, it does so only by embracing its overall thrust.

So much for the first part of the Eleatic thesis: Descartes must embrace it at least in an attenuated sense that is strong enough to undermine his physical science. It thus only remains to be seen whether Descartes is coerced by his core metaphysical commitments into admitting the second part of the Eleatic thesis as well, namely that there are no principled metaphysical distinctions within in the corporeal domain. The question is this: Must Descartes admit, as Parmenides put it, that there is only a single "what-is" that admits of no distinctions, "whole, unique, steadfast… complete" and indivisible (DK 28B8, 147)?

Matters are more immediately complicated here than in the case of immutability. On the one hand, we have seen that Descartes is unable to solve the individuation problem, and this portends disaster. After all, if there is no way to individuate the microphysical bodies at the very center of Cartesian physics, then it seems likely that he will be unable to account for corporeal distinctions of any sort, and so he must, however reluctantly, embrace the Eleatic thesis *in toto*. On the other hand, we have also alluded to the possibility that Cartesian corporeal metaphysics

might be able to accommodate genuine metaphysical distinctions in the plenum, even if these distinctions do not allow Descartes to speak of actual physical bodies or of his desired corpuscularian structure as physically real. Still, *any* genuine metaphysical distinctions would provide an escape hatch from full-blown Eleaticism. So, is such an escape available?

The answer, I think, depends on whether it is possible for God to mentally partition the plenum. Let me explain. We have seen already Leibniz argue for the conclusion that the individuation problem is insoluble by claiming that the only way for the Cartesian universe to exhibit structure is, *per impossibile*, through kinetic properties. Notably, this argument too has precedent in the writings of Melisuss of Samos, in the somewhat oracular proclamation that "if what-is is divided, it moves" (DK 30B10, 293). The idea here is that some principle of individuation is required for the fundamental units in the analysis of physical structure and that motion alone can provide such a principle. Yet, we have also noted that this requirement is *not* equivalent to demanding a solution to the problem of corporeal substantiality (§33). Again, Garber's point is well-taken: "[individual corporeal] substances, should they exist, are *not* the same as individual bodies." Previously, we have wielded this truism to show that solutions to the problem of corporeal substantiality are not solutions to the individuation problem. Now, we must note that the contrapositive also holds: One cannot infer from Descartes's inability to solve the individuation problem that he is unable to make sense of any sort of genuine metaphysical distinction within the corporeal realm. On the contrary, it is quite possible that Descartes cannot make sense of actual bodies or genuine physical structure but can nevertheless accommodate genuinely real finite corporeal substances or finite corporeal modes. Full-blown Eleaticism, of the sort characterized by the Eleatic thesis, requires showing even this to be impossible.

In short, then, if Descartes can make sense of the existence of either finite corporeal modes or finite corporeal substances, then he can avoid total Eleaticism, since there are some distinctions to be made in the corporeal domain – even if these distinctions do not allow for distinguishable states of affairs or place his physics on solid ontological foundations. We know that such distinctions are meant to track what is delimitable in thought, as discussed by Descartes in *Principles* 1.60 and our own previous treatment of the problem of corporeal substantiality (§33). Previously, we have acted as if this delimitation was unproblematic, perhaps even no restriction at all. This, however, presumes that it is in fact possible to mentally divvy up the plenum in the requisite ways. It is this presumption that now requires our attention.

The problem with the presumption is to be found, as has become an all too familiar refrain, within the strictures imposed by a purely geometrical conception of materiality. A helpful path into this specific manifestation of this problematic metaphysic is provided by Stephen Gaukroger (2002, 103-104), albeit in a slightly different context:

> "To determine… whether a body is moving or not, and at what rate, we need to be able to impose some reference point against which the motion can be judged to have taken place. If space itself has no intrinsic directions, and if the reference point cannot be fixed by a global system of coordinates – Cartesian material extension is of 'indefinite' extent, which means there is no centre, or boundaries that we can use as reference points – then this reference point is going to be conventional and relative."

The cash-value for our purposes is Gaukroger's description of the plenum, which is as apt as it is disastrous. The plenum has no central point; stressing the geometrical analog, there is no origin with which to anchor geometrical axes or coordinate systems. As such, the plenum also lacks inherent directionally. It lacks boundaries, given its infinite extent. There is, it seems, no way to fix even a purely conventional reference point. Given this, could even God successfully refer to a particular region of the plenum? Could even God succeed at dividing up the plenum mentally?

I am, frankly, unsure how to answer such questions. Certainly, the most attractive answer to offer on Descartes's behalf is that God is able to do so, even if we cannot understand how. The way in which God fixes a purely conventional reference point in the uniform and indefinitely large region of extension that he has created would then be, like God's purposes in creation, "hidden in the inscrutable abyss of his wisdom" and power (AT 7.375). This appeal to ignorance is perhaps even explicit in Descartes: He seems to gesture at it in this context in the *Principles of Philosophy* (2.35). Even if this "solution" works, however, the victory is again pyrrhic. The scientific image that results is of the deity making seemingly inexplicable divisions (for who can fathom his purposes?) in the plenum by some mental process that is utterly beyond our ken, then transposing the resultant parts with others from which they are entirely indistinguishable.

How far we have strayed, now, from the official Cartesian project of providing a more scientifically respectable alternative to Aristotelianism! Descartes set out to dispense with Aristotelian physics and corporeal metaphysics in favor of matter, motion, and mathematically precise scientific laws, and he did so in accordance with scientific ideals that many of us still share. Yet, his own enthusiasm for these ideals – especially the mathematization of physics – led him into problems far more dire than those he raised for his Aristotelian opponents. Whatever the defects of the natural philosophy adhered to by Aristotle, Aquinas, and Suárez, they at least can offer a theory according to which the physical universe exhibits physically real structures that vary over time. Descartes cannot boast even that much: Even if he cannot be convicted of full-blown Eleaticism, he escapes on a series of fairly unimportant technicalities. Cartesian corporeal metaphysics implies the Eleatic thesis or something close enough. For all intents and purposes, then, Cartesian physics does no more than describe an illusion, one that no more reflects physical reality than the mere appearances so derided by the Parmenidean goddess.

Postscript

Was Descartes the First Ontic Structural Realist?

40. Taking stock

Our reading of Descartes has been a sustained attempt to take him at his word. We have consistently striven to understand Descartes's repeated protestations that his physics and corporeal metaphysics reduce the physical to the mathematical as an accurate description of his program. The strategy we have seen Descartes adopt in that pursuit is twofold. First, there is the negative project, largely constituted by the rejection of hylomorphism. Second, there is the positive project of articulating and defending what we have called his geometrical occasionalism. It will be prudent, at the end of our inquiry, to rehearse some of our main lines of argument.

Descartes's negative project is best understood as a rejection of the scholasticism which he inherited from thinkers like Aquinas and Suárez. Perhaps the most celebrated feature of this project is his rejection of non-efficient modes of causality in physics. We have seen, however, that this familiar rendering of the "birth of modern philosophy" misses the mark in some crucial respects. Most importantly, casting Descartes as the bane of formal causality neglects the clearly attested fact that he endorses and appeals to an avowedly Aristotelian notion of formal causality, namely explanation from essence. We have also noted how thoroughly this embrace of formal causation coheres with some of the features that are thematic of Cartesianism as a whole, namely essentialism and a basically Platonic theory of how these essences are grasped. Nor, given the degree to which Cartesianism is permeated by explanations from essential properties, is this mistake a peripheral one. On the contrary, it is likely to manifest in a wide variety of contexts.

We have examined some of these manifestations in detail, all of them part and parcel of Descartes's own physical program. Again, Descartes's positive project is to render the physical in purely mathematical terms and is built upon the intellectual perception of the real nature of matter, geometrical extension. In the usual Cartesian idiom, we might say that the project is the

reduction of the physical to the purely geometrical. The explanatory mode suggested by that reduction is that of Euclid and, in some moods at least, of Aristotle: The explanation of particular facts by reference to essential properties or real definitions. This is just the definition of formal causation as Descartes understood it, and so we should expect to find his physics and corporeal metaphysics eminently hospitable to formal causality. And, indeed, this is what we have found, a point which bears stressing again at some length.

Consider, for example, the need for any plausible physics to go beyond mere kinematics. Even the most mechanistically-minded scientist cannot escape the conclusion that physics must provide explanations in terms of motive force in addition to mere motion. Put another way, there must be some mechanism by which to account for the fact that bodies move as they do. The solution hit upon by Descartes is ingenious, in that it realizes the move from kinematics to dynamics without compromising the complete mathematization of the physical. That solution has two steps. First, Descartes equates motive force (*vis, conatus, nisus*) with divine efficacy, such that he avoids the literally absurd claim that purely geometrical objects are causally active. Second, he appeals to the intellectually grasped natures of God and of matter to arrive at certain *regula sive leges naturae* that explain why bodies move in the particular ways that they do. The divine nature gets into the act, since the fact that God is essentially immutable and simple explains the regularity of divine causal activity *qua* motive force. The nature of matter is relevant because it follows from this nature that physical objects are impenetrable, such that the colocation of distinct physical objects is quite literally conceptually incoherent.

The derivation of impenetrability from the corporeal nature of extension is, indeed, one of the shrewdest arguments in Descartes. Impenetrability seems to be both ineliminably essential and qualitative – this is the supposition, at any rate, of many of Descartes's interlocutors and of

many of those writing in his wake. What Descartes is trying to show, then, is that impenetrability can be understood in a purely quantitative way by showing that it is derivable from the quantitative essence of matter, extension. The trick is turned by showing how, by his lights, the supposition that a body is colocated with another distinct body is incoherent, and this because the bodies in question are no more than regions of uniform Euclidean space. To return to our broader theme, note again that all the explanatory bite here is from the essence of matter. The explanatory mode at work is formal rather than efficient causation.

The fact that the laws of motion and the impenetrability of matter are best understood in terms of formal causality again demonstrates the centrality of that explanatory mode to Cartesian physics and corporeal metaphysics and, *ipso facto*, the inadequacy of any interpretation thereof that neglects formal causality. This is even more true given that this importance naturally extends to all the further explanations in which the laws and impenetrability figure.

A clear case of this wider applicability is the Cartesian analysis of condensation and rarefaction, another favorite candidate among early modern thinkers for an irreducibly qualitative feature of matter, which Descartes explains partly by appeal to the impenetrability thesis. An even more interesting case is the light thrown by Descartes's embrace of formal causality onto his manifest hostility to idealism. Indeed, without recourse to formal causality that hostility is somewhat baffling, given the natural pull towards such a metaphysic engendered by robbing bodies of any causal activity. One key contrast with paradigmatic idealists like Berkeley is that Descartes recognizes the role explanation from essence can play in distinguishing natural from miraculous events, a distinction which Berkeley must apparently reduce to mere statistical likelihood or psychological expectancy rather than a robust distinction in kind. For Descartes, by contrast, the robust distinction is well-grounded in facts about the divine and corporeal natures.

Formal causation also furnishes Descartes with a persuasive case against the inevitability of sliding from occasionalism into idealism by showing that bodies are perfectly capable of playing an explanatory role even if devoid of causal powers. Again, impenetrability is a case in point. The explanatory role of impenetrability within Cartesian physics is robust and genuinely appertains to matter even though it does not involve any corporeal causal activity (and so does not sin against the central occasionalist contention that bodies are not causally active).

Given the strictures imposed by his identification of material and mathematical objects, all these successes are striking. Yet, we have also seen how the Cartesian research program, so defined, is ultimately doomed. The problem is that reducing physical to mathematical objects involves understanding physical objects in a purely structural way, as instances of particular geometrical structures. This, however, is just unworkable.

One way to put the problem, borrowed from Aquinas, is that physics must differ from mathematics in dealing with particular entities at particular times rather than with abstract structures alone. Another way to frame the problem, borrowed this time from Leibniz, is that understanding physical objects as merely geometrical renders the supposition that physical systems exhibit particular structures (whether diachronically or synchronically) a metaphysical impossibility. Leibniz's point, as we have seen at length, is that from all time there is only uniform Euclidean space that is necessarily incapable of exhibiting particular mathematical structures at particular times. The broader problem hit upon by both St. Thomas and Leibniz is that it is impossible to produce a tenable account of the physical with mathematical structure alone; there must be, in addition, some *thing* that exhibits structure. Unfortunately, Descartes can only accommodate this insight by abandoning his project outright. Yet, abandon it he must, on pain of outright Eleaticism in the corporeal domain.

41. The new Cartesianism

The central defect in Cartesianism, then, is the attempt to reduce the physical to mathematical structure alone. It is the result of taking a widely held ideal – namely that physics should be mathematical – to its logical extreme by simply equating the physical with the mathematical. Despite its disastrous implications, therefore, the central flaw within Cartesianism is not without temptation for those of us who share this ideal. It is a temptation by which some contemporary metaphysics have been lured, as I think, into the same treacherous waters first explored by Descartes himself. I want to end by gesturing briefly at this contemporary analogue, at the emergence of a neo-Cartesian corporeal metaphysics.

The view which I have in mind is *ontic structural realism*, especially the eliminativist variety endorsed by thinkers like Steven French (2010, 2016, 2019a) and James Ladyman and Don Ross (2007). Here is how Ladyman (2023) characterizes the view:

> A crude statement… is the claim that all we know is the structure of the relations between things and not the things themselves… [and] the claim that there are no "things" and that structure is all there is, and in particular there are no individual things… The relata of a given relation always turn out to be relational structures themselves on further analysis… hence it is relational structure all the way down.

The similarities with Cartesian corporeal metaphysics are as obvious as they are worrying. Thus, there is a deep sense in which (i) Descartes is the predecessor of this view in contemporary analytic metaphysics, perhaps even its first explicit advocate, and so (ii) contemporary advocates of this view are, to that extent, aptly characterized as neo-Cartesian. While Ladyman and Ross (2007, 7) take evident delight in painting their opponents as neo-scholastics, the characterization of their own view as neo-Cartesian is no less apt and no more flattering.

Admittedly, the comparison with Descartes is at least partly laudatory. Like Descartes, contemporary ontic structural realists take the admirable and surely accurate view that metaphysics should be answerable to the deliverances of our best scientific theories. For

Descartes, this meant that any metaphysical theory that is at odds with the ideals of mechanism and mathematization was a non-starter. In the same way, a contemporary metaphysical argument that, for example, rests on the presumption of presentism is necessarily unconvincing, as it simply ignores the overwhelmingly weighty scientific evidence against the possibility of absolute simultaneity. Indeed, it is not merely unconvincing: It is an utter non-starter. Even if Quine (1953, 446) overreached in claiming that "philosophy of science is philosophy enough," therefore, the impulse underlying the overstatement is a good one.

This same good impulse animates the way that Ladyman and Ross (2007, 25) fulminate against what they deem to be a neo-scholastic tendency in contemporary analytic metaphysics that refuses "to take seriously the implications of living in a world that has turned out not to be Newtonian" and instead resorts to reasoning *as if* there were an objective fact about which events are simultaneous with one another, *as if* there existed in nature the unentangled particles and atoms discussed in high school science courses, and so on. But these are toy worlds and should be treated as such. Drawing metaphysical lessons from such toy cases is often deeply misleading and always apt to distort what our best scientific theories actually say about philosophical topics like ontology, temporality, and the like. The contrary position – that we are free to conduct our metaphysical theorizing about the way reality is without concerning ourselves with what science says on the subject – is in fact downright irresponsible. It effectively presumes that we are free to ignore the deliverances of our best scientific theories about the way the world works when it suits us, and this epistemic attitude is relevantly similar to that of the climate change denier, the flat-earther, and the ancient astronaut theorist. That, surely, is an attitude to avoid cultivating!

The operative ideal here – which in my estimation should be entirely uncontroversial – is that our metaphysics should not ignore the relevant deliverances of our best scientific theories.

On the contrary, our metaphysics should be informed by our best scientific theories in cases where those theories are of metaphysical import. Such cases are legion in corporeal metaphysics and the philosophy of science in particular, and Ladyman and Ross (2007, 26) are no doubt correct to call our attention to the fact that much metaphysical theorizing has fallen short of this ideal by neglecting the deeply relational character inherent in contemporary scientific ontology. Indeed, it is not grotesque to characterize ontic structural realism as an attempt to arrive at a metaphysical theory that harmonizes with the deliverances of quantum mechanics and the general theory of relativity. The alternative is, as Ladyman and Ross (2007, 26) put it, to continue to pretend that "it really doesn't matter that classical physics is false… [and so] we might as well do our metaphysical theorizing on the basis of Aristotelian or Cartesian physics." Ironically, Descartes was animated by this same impulse, this same desire for a scientifically respectable and maximally mathematical metaphysics of the material world. Thus far, then, contemporary ontic structural realists are partners in virtue with their Cartesian predecessors.

They are also partners in vice. The problem is that ontic structural realists agree with what we have discovered to be the most disastrous of Cartesian corporeal metaphysics: The identification of corporeality with mathematical structure alone. Of course, the mathematical structures in question are quite different. For Descartes, they are purely geometrical, of the kind encountered in Euclid. For Ladyman and Ross (2007, 159), the relevant structures are largely cribbed from the deliverances of quantum mechanics, general relativity, and other contemporary scientific theories. This difference is substantial, but in the present context it also turns out to be inconsequential. The reason for this is that the greater complexity of the mathematical structures at stake in contemporary ontic structural realisms – such as the four-dimensional manifolds and tensor calculus of general relativity – does not touch upon the problems identified by St. Thomas

and Leibniz. The fact that these mathematical structures are different and far more complex than the structures of Euclidean geometry does not lessen the incoherence of positing a world that exhibits structure despite there being no entity that is so structured.

Ladyman and Ross (2007, 154) anticipate this objection, or something quite like it; here is their response:

> Relations are impossible without relata… This objection has no force against the view propounded… A core aspect of the claim that relations are logically prior to relata is that the relata of a given relation always turn out to be relational structures on further analysis.

One way to put the objection under consideration is in terms of entanglement: If two particles are entangled, well then *there are two particles* and this means there are individual things. Ladyman and Ross respond that the particles themselves will turn out to be relational upon further analysis. Yet this surely will not do, I think. For one thing, it just pushes the objection back a level of analysis. Thus, adopting the solution offered by Ladyman and Ross requires them to embrace what Ross Cameron (2022, 3) has dubbed "*Metaphysical Infinitism*" or the view that there "are some infinitely descending chains of metaphysical determination relations, such that each link on the chain takes you to an element that is more fundamental… and this proceeds *ad infinitum* such that nothing on the chain is absolutely fundamental." All on its own, this is worrying, and those worries are by no means based on a refusal to take the deliverances of contemporary science seriously. They are based on common intuitions and well-known arguments against the possibility of genuinely explanatory infinite regresses.

Even setting such worries aside, however, there is a more familiar problem. This problem is suggested by Bas van Fraasan (2006, 292-3) and Michael Esfeld (2013, 20), respectively:

> [Ontic structural realism] must imply: what has looked like the structure of something with unknown qualitative features is actually all there is to nature. *But with this, the contrast between structure and what is not structure has disappeared.* [Emphasis mine]

> However, even if the commitment is supposed to be one to structures without objects, for the resulting view to be a complete realism, we have to be told how the structures in question are instantiated.

The objections here are familiar. Esfeld is simply making something akin to Leibniz's point regarding individuation when one has substituted structures for objects. Again, the basic problem is how to make sense of there being structure without anything that is structured. Van Frassan's objection is likewise familiar to us because it is just the point St. Thomas makes about the impossibility of erasing the distinction between the physical and the mathematical. What Van Frassan is at pains to point out is that there is no way to make sense of the distinction between what is structured and the structure itself; there is no way to understand the distinction between the mathematical structures exemplified and what exemplifies them. Ladyman (2023), for his part, avers that he and his coauthor bite this bullet: "Ladyman and Ross (2007) argue that no account can be given of what makes the world-structure physical and not mathematical."

I think this a bridge too far. It is to just to join Descartes in making the metaphysically disastrous claim that there is structure but nothing that is structured, to claim that the physical *just is* the mathematical. We have argued at length that this particular metaphysic leads Descartes into insurmountable difficulties relating to the individuation of the fundamental objects of his physics, the reality of corporeal structure, and the possibility of physical systems exhibiting different structures at different times such that the genuine physical changes delivered by his scientific theories are physically real. For my part, I strongly suspect that his contemporary inheritors will meet with no better result. The new Cartesianism seems to me no more defensible than the old, though this is a conclusion that would take another 200 pages to defend adequately. That defense must, therefore, be left to future work.

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