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The *Primum Mobile* in the Thomistic Aristotelianism of Charles De Koninck:
On Natural Philosophy as Architectonic

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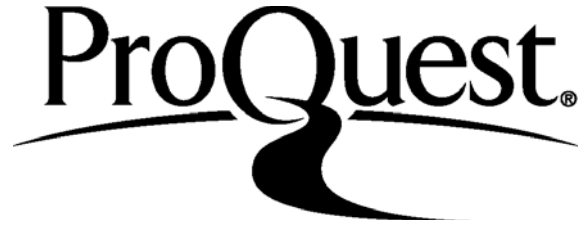
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The *Primum Mobile* in the Thomistic Aristotelianism of Charles De Koninck:
On Natural Philosophy as Architectonic

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This dissertation argues that natural philosophy is a qualified form of wisdom. It thereby provides an avenue towards the reintegration of the scientific specialties into a sapiential view of the cosmic whole. I draw inspiration from Charles De Koninck, who writes in a principled fashion on this theme. The dissertation's main contention is that there are perennial conclusions warranted by Aristotelian physics, and these ground the discipline's claim to being a type of wisdom. One such conclusion is the existence and general nature of the first mobile or fundamental cosmic body, which Aristotle mistakenly identified with the outermost celestial sphere. The current, yet tentative, replacement is "physical space," dialectically studied by modern cosmology via the fundamental spacetime conditions for local motion and the "expansion" of space.

Therefore, two contributions are made by this dissertation. First, it defends the sapiential or "architectonic" role of natural philosophy. The centerpiece for this case is the disentanglement of those features of the ancient theory about the first mobile now surpassed by modern science from those features that necessarily obtain in general natural philosophy. This opens a theoretical space for cooperative work by modern science to discover the specific nature of this fundamental body. Second, by following such a course, the dissertation provides a much-needed exegesis of De Koninck's interpretation of Aristotelian natural philosophy.

The dissertation is divided into two parts. The first part (Chapters 1–5) argues for the existence and nature of the first mobile. Chapters 1–4 in particular defend the traditional natural philosophical proofs for the first mobile’s existence and nature. In a dialectical fashion, Chapter 5 argues that “physical space” is this fundamental cosmic body, drawing extensively from progress in modern cosmology. Based upon these investigations, the dissertation’s second part details the method of general physics and defends its role as directive over the particular domains of modern science. Specifically, Chapter 6 defends the method of natural philosophy as proportionate to the nature of the human mind. Chapter 7 explains the sapiential role of general philosophical physics vis-à-vis modern science, bringing the investigation to completion.

This dissertation by John G. Brungardt fulfills the dissertation requirement for the doctoral degree in Philosophy approved by Richard F. Hasing, Ph.D., as Director, and by Jean De Groot, Ph.D. and Kevin White, Ph.D. as Readers.

Richard F. Hasing, Ph.D., Director

Jean De Groot, Ph.D., Reader

Kevin White, Ph.D., Reader

For my godfather

“La Sabiduría es más ágil que cualquier movimiento;
a causa de su pureza, lo atraviesa y penetra todo.”

– SAB. 7, 24

For the waking there is one cosmos [κόσμον], and it is common; but when men sleep, each one turns aside into a private [cosmos]. We should not act and speak like those asleep. Therefore, we ought to follow what is common. Although reason is common to all, the many live as if having a private wisdom.

HERACLITUS, DK 89, 73, 2

The superior science is more of the nature of wisdom than the ancillary; for the wise man must not be ordered but must order, and he must not obey another, but the less wise must obey him.

ARISTOTLE
Metaphysics, I. 2

Because the aforementioned artisans, considering the ends of certain particular things, do not attain to the end of the whole universe, they are called wise with respect to this or that thing, according to which sense it is said that *as a wise architect I laid a foundation* (I. Cor. III). The name of “wise man” simply speaking is reserved to him alone whose consideration dwells upon the end of the universe.

ST. THOMAS AQUINAS
Summa contra Gentiles, I. 1

I suppose that ideally the physicist should be allowed to elucidate his own universe up to a point, and then hand it over to the philosopher to ascertain its exact status in relation to a wider outlook. But in practice we have not sufficient confidence in one another, and we both make raids over the border to suggest all sorts of ways in which the other fellow may be deceiving himself and us.

SIR ARTHUR S. EDDINGTON
“Physics and Philosophy”

[A] proliferation of scientific beliefs has seriously obstructed our collective vision, . . . it has in fact estranged us from an immemorial wisdom that has nurtured mankind—or at least its more enlightened members—throughout the ages It is our earnest hope that in setting forth considerations befitting this task we may help, in some small measure, to promote a genuine understanding of that *philosophia perennis* which is not just a formal philosophical system, but truly a timeless wisdom and a perennial love.

WOLFGANG SMITH
Cosmos and Transcendence

From the fact that the experimental sciences go farther in the direction of concretion one cannot conclude that they can be substituted for the philosophy of nature of the ancients. To identify the philosophy of nature with the experimental sciences which are only its dialectical extension is to destroy it in its root, to deny the most certain part of our knowledge of nature, as well as its most noble natural subject. For that reason, the identification of the two misses in the most complete manner the point of the ancients and of wisdom.

CHARLES DE KONINCK
“Are the Experimental Sciences Distinct from the
Philosophy of Nature?”

Nearly everyone holds that whatever interest the *Physics* may now possess can be no more than historical. This we interpret as a challenge, not so much to the particular doctrines it contains but, what is far more important, to the meaning and validity of the kind of questions its author assumes the human mind should be facing.

CHARLES DE KONINCK
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Abbreviations for Frequently Cited Works

The works of Aristotle, using the traditional English or Latin titles, are cited from *The Complete Works of Aristotle: The Revised Oxford Translation*, ed. Jonathan Barnes (Princeton, NJ: Princeton University Press, 1984). The main exception is the *Physics*, where I use *Physics, or Natural Hearing*, trans. Glen Coughlin (South Bend, IN: St. Augustine's Press, 2004). Plato is cited from *Plato: Complete Works*, ed. John M. Cooper and D. S. Hutchinson (Indianapolis: Hackett Publishing Co., May 1997), unless otherwise noted. For the texts of St. Thomas Aquinas used, please see the bibliography. The Leonine is cited when St. Thomas' text is quoted, in the following format: (Leon. *volume.page–page:line–line*), as applicable. For references without quotes, the editorial divisions are cited. The electronically curated texts of Enrique Alarcón (corpusthomisticum.org) and Joseph Kenny, O.P., (dhspritory.org/thomas) were also used. Responsibility for all translations of St. Thomas is my own, although some English translations were consulted for comparison; these are cited in the bibliography.

<i>De Ente</i>	<i>De ente et essentia</i>
<i>De Pot.</i>	<i>Quaestiones disputatae de potentia</i>
<i>De Sensu</i>	<i>Sentencia libri De sensu et sensato</i>
<i>De Veritate</i>	<i>Quaestiones disputatae de veritate</i>
<i>Exp. Per.</i>	<i>Expositio libri Peryermeneias</i>
<i>Exp. Po. An.</i>	<i>Expositio libri Posteriorum Analyticorum</i>
<i>In De Caelo</i>	<i>In libros Aristotelis De caelo et mundo expositio</i>
<i>In Meta.</i>	<i>In duodecim libros Metaphysicorum Aristotelis expositio</i>
<i>In Phys.</i>	<i>Commentaria in octo libros Physicorum Aristotelis</i>
<i>In Sent.</i>	<i>Scriptum super libros Sententiarum magistri Petri Lombardi</i>
<i>Q. De Anima</i>	<i>Quaestiones disputatae de anima</i>
<i>SBdT</i>	<i>Super Boetium de Trinitate</i>
<i>ScG</i>	<i>Summa contra Gentiles</i>
<i>Sent. De Anima</i>	<i>Sentencia libri De anima</i>
<i>Sent. Ethic.</i>	<i>Sentencia libri Ethicorum</i>
<i>Sent. Polit.</i>	<i>Sentencia libri Politicorum</i>
<i>ST</i>	<i>Summa Theologiae</i>

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Introduction

As a rule one discovers that once the ontological muddle underlying contemporary scientific thought has been exposed and eliminated, the way is clear to an integration of actual scientific findings into orders of knowledge pertaining to what has sometimes been termed the perennial wisdom of mankind.

WOLFGANG SMITH
The Quantum Enigma

The goal of this dissertation is to demonstrate the existence and character of the sapiential or architectonic office of natural philosophy. Natural philosophy is a qualified type of wisdom. It is not wisdom *simpliciter* like first philosophy but instead governs as wisdom within the lower sub-domains of natural science (e.g., cosmology or biology). Natural philosophy is a theoretic architect with a determinable and proper level of responsibility over a hierarchy of theoretical knowledge.¹ The method employed is an inquiry into an object shared by both general natural philosophy and a particular science. Specifically, I will investigate the existence and nature of the *primum mobile* or first moved mover. In this fashion, the relationship between natural philosophy and the empirical, mathematical sciences can be more precisely determined. Finally, this dissertation hopes to expose the significant contributions made to

1. The word “architectonic” is not meant in a Kantian sense; see Chapter 7. See Immanuel Kant, *Critique of Pure Reason*, trans. Paul Guyer and Allen W. Wood (Cambridge: Cambridge University Press, 1999), 691 (A832/B860), “The Architectonic of Pure Reason.” The presence of “architectonic” roles in Aristotle’s division of the sciences is well known; see Monte Ransome Johnson, “Aristotle’s Architectonic Sciences,” in *Theory and Practice in Aristotle’s Natural Science*, ed. David Ebrey (Cambridge/New York: Cambridge University Press, 2015), 163–186, for a recent exposition.

the philosophy of nature and science by Charles De Koninck by drawing on his works in these areas.

§I THERE IS A NATURAL PATH THAT CHARACTERIZES HUMAN KNOWLEDGE AND IN PARTICULAR THE STUDY OF NATURAL PHILOSOPHY; DOES THIS PATH MAKE POSSIBLE A TYPE OF WISDOM ABOUT THE NATURAL ORDER?

The truths of perennial philosophy are perennial “not merely because [they are] old, but because rooted as they are in common conceptions they are timeless.”² Perennial natural philosophy is the philosophy about natural things done in a timeless way.

In the first chapter of his *Physics*, Aristotle articulates the method that is foundational to the subject matter of this dissertation. While the method characterizes human thinking in general, it applies to natural philosophy most of all.³ Aristotle calls this way the “natural path.” Since the word “method” is taken from roots meaning “over a road,”⁴ we can say that Aristotle is proposing the natural method for human thinking.

“Natural path” (Coughlin) or “natural road” (Sachs)⁵ renders “πέφυκε . . . ἡ ὁδός,”⁶ where the root verb “φύω” has the senses of something naturally begotten, or what grows, engenders, or brings something forth from itself. The noun “nature,” “φύσις,” comes from this verb. Since nature is an internal principle (*Physics* II.1), the natural path, as a principle or cause of an investigation, arises from within the subject inquiring. The path in human thinking is the course of what grows or is engendered in the human mind according to a natural process. Since it is natural, it belongs to the human mind as such and is therefore a path common

2. Charles De Koninck, “Three Sources of Philosophy,” *Proceedings of the American Catholic Philosophical Association* 38 (1964): 19.

3. Consider St. Thomas, *SBdT*, q. 6, a. 1. I discuss this in §22.

4. See Aristotle, *Physics*, in Coughlin’s “Appendix 1: Method in Aristotelian and Modern Natural Philosophy,” 206: “‘Method’ is derived from the Greek ‘μέθοδος,’ which itself comes from two words, ‘μετά,’ and ‘ὁδός,’ ‘over’ and ‘road.’ To use a method is to be on the way to something, whether a practical result, as when we use the methods of the carpenter to build a desk, or a speculative result, as when we use the ‘experimental method’ to look into the secrets of the natural world.”

5. See Aristotle, *Aristotle’s Physics: A Guided Study*, trans. Joe Sachs, Masterworks of Discovery (New Brunswick, N.J: Rutgers University Press, 1995), 33.

6. Aristotle, *Aristotelis Physica*, ed. W. D. Ross (Oxford: Clarendon Press, 1950), 184a16.

to all men. Furthermore, the path approaches something common, for it is a road towards things which are commonly available to all from resources commonly present in all.⁷

That human knowledge takes root in something common and follows a natural path are ideas with a pedigree preceding Aristotle. Heraclitus tells us that “For the waking there is one cosmos [κόσμον], and it is common; but when men sleep, each one turns aside into a private [cosmos].” (DK 89) He also warns us that “We should not act and speak like those asleep.” (DK 73) His conclusion then follows: “Therefore, we ought to follow what is common. Although reason is common to all, the many live as if having a private wisdom.” (DK 2)⁸ This fundamental attitude of human reason towards the common world requires that wisdom be measured by nature, as Heraclitus notes in another fragment: “Wisdom is to speak the truth, and to act, according to nature, giving ear thereto.” (DK 112)

Plato also speaks of a natural path in our knowledge. When introducing the cave in *The Republic*, Book VII, Socrates aims to “make an image of our nature in its education and want of education.”⁹ In some contrast, no doubt, to the violent, non-natural image he presents of the prisoners being dragged out of the cave, he asks Glaucon to consider “what their release and healing from bonds and folly would be like if something of this sort were *by nature* to happen to them.”¹⁰ Embedded in the analogy of the cave is a natural path that leads the mind from what is better known to us at first towards what is better known by nature.¹¹

7. As Philoponus points out, even Aristotle’s beginning sentence in the *Physics* makes this assumption about what must be common to author and reader. See Philoponus, *On Aristotle’s Physics 1.1-3*, trans. Catherine Osborne, Ancient Commentators on Aristotle (Ithaca, NY: Cornell University Press, 2006), 25. This means that Aristotle’s very discussion of the natural path meets its own self-referential requirement.

8. These translations are by Duane H. Berquist and are quoted from his unpublished papers, where he also helpfully points out the illation between these three fragments. I have made minor modifications, following the Greek text of Hermann Diels and Walther Kranz, eds., *Die Fragmente der Vorsokratiker griechisch und deutsch* (Berlin: Weidmannsche Buchhandlung, 1903).

9. Plato, *The Republic Of Plato*, 2nd ed., trans. Allan Bloom (New York: Basic Books, 1991), 193 (514a).

10. Ibid., 194 (515c), emphasis mine; “by nature” is “φύσει.”

11. To be sure, Plato’s application of this image to the life of Socrates (see 517a) might indicate how this “natural” release from ignorance and a philosophical education differs from Aristotle’s sense of “by nature” and indeed “nature” itself. The “release and healing from bonds and folly” recalls the themes of the *Phaedo* (see 67d and 82d) and a distinctively Socratic conception of the purpose of philosophical inquiry, away from the shadow-world of nature. Aristotle’s natural path differs precisely because Aristotle shows how the cave

This dissertation seeks to discover whether this natural path allows natural philosophy to be a type of wisdom with respect to the specific natural sciences. Such a claim seems implausible. Indeed, the poverty of natural philosophy can already be reckoned from what Aristotle says in *Physics*, I.1: natural philosophy begins with what is most general and most removed from the things that are first and most causal in the natural order. How could possessing such knowledge make one wise? Is not such a limitation of knowledge to the “vague and confused” wholes and their parts the reason why Aristotelian natural philosophy was abandoned long ago?

§II THE PATH IN MODERN SCIENCE IS CHARACTERIZED BY PRIVATE AND ARTIFICIAL ROADS, MITIGATING THE POSSIBILITY OF A WISDOM ABOUT NATURE.

The learned all know that there is nothing in Scholastic Physics which is not doubtful, and they also know that in such matters being doubtful is little better than being false, for a science must be certain and demonstrative.

RENÉ DESCARTES
The Passions of the Soul, Preface

The modern philosophers’ rejection of the Aristotelian method for natural philosophy outlined in *Physics* I.1 is carried out, in their various systems, by adopting artificial roads into the study of nature.¹² Yet they still require an architectonic type of knowledge. To sketch these contrasting approaches, and consequently what is at stake, it will suffice to recall

(nature and the natural world) possesses its own intelligibility.

12. This is not to contradict what is noted by Jacob Klein, *Greek Mathematical Thought and the Origin of Algebra* (Mineola, NY: Dover Publications, 1992), 120: “Whereas the ‘naturalness’ of Greek science is determined precisely by the fact that it arises out of ‘natural’ foundations, so that it is defined at the same time in terms of its distinction from, and its origin in, those foundations, the ‘naturalness’ of modern science is an expression of its polemical attitude toward school science. This special posture of the ‘new’ science fundamentally defines its horizon, delimits its methods, its general structure, and, most important, determines the conceptual character of its concepts.” As an assumed “posture,” it is by definition not a natural foundation. I thank Fr. Edmund Waldstein, in a portion of his dissertation draft on David Foster Wallace, for drawing my attention to this passage.

key points from three modern philosophers: Francis Bacon, René Descartes, and Immanuel Kant.¹³

ii.a Francis Bacon and a new logic

Francis Bacon maintains that there is an intrinsic weakness within human reason which hinders it from properly investigating nature.¹⁴ If the human mind is innately “the source of its own problems,” this provokes a self-referential question—how did Bacon escape the influence of this perspective to a sufficient degree to appreciate the distorted view? If the “native force” of the mind and its Aristotelian dialectical tools are of no use, what source remains to restore “the relation between the mind and nature,” which is surely an absolute relation as well as the very condition for any perspective on the problem at hand?¹⁵ If the natural source of human knowledge is corrupt, then how can a secondary effort by that same mind repair or heal what is primarily defective?

It is not necessary here to explain whether or how Bacon answers such difficulties.¹⁶ It is enough that he raises them and thereby dissuades us of the inherent ability of the human mind to understand nature along a “natural path.” The remedial tool Bacon offers is an improvement of the method by which the mind garners experiences: “We need a thread to guide our steps; and the whole road, right from the first perceptions” in order to access “the more remote and secret places of nature,” and instead of remaining in the familiar confines

13. As noted by Wellmuth, the origin of scientism (and hence the weakening and rejection of Aristotelian natural philosophy) is rooted in various scholastic movements which predate even the Renaissance. See John James Wellmuth, *The Nature and Origins of Scientism*, The Aquinas Lecture 1944 (Milwaukee: Marquette University Press, 1944), 46–48.

14. See Francis Bacon, *Francis Bacon: The New Organon*, ed. Lisa Jardine, trans. Michael Silverthorne (Cambridge: Cambridge University Press, 2000), 2.

15. Bacon, in his treatment of the four “idols” which beset the mind in its attempt at knowledge, arguably avoids some of the glaring self-referential difficulties that his *ad lectorem* glosses over by making these weaknesses he has in mind more specific. Nonetheless, his rejection of the “natural path” as Aristotle would have set it down is presented just as clearly in those passages on the idols.

16. Bacon, *The New Organon*, 4; in the Epistle Dedicatory to King James, Bacon calls his discovery of the new method a “wonder” and a “fortuitous” event to be imputed to the “goodness of God.” It is unclear whether this suffices to escape the self-referential difficulties.

of “the senses and common notions,” it is “absolutely essential to introduce a better and more perfect use and application of the mind and understanding.”¹⁷ The goal is to produce a natural history which is, in fact, a catalog of nature “vexed” so as to reveal her secrets.¹⁸ If nature loves to hide, then through the “harassment of art” she must be forced to do what she hates: show herself.

Consequently, Bacon proposes an operative or active constitution of the object of knowledge. This is a consequence of recasting the “road” human knowledge takes.¹⁹ The mold is measured by the notion of the close connection of knowledge and power. The measure of truth is no longer the *adaequatio* of thought and thing; instead, the “discovery of products and results is like a warranty or guarantee of the truth of philosophy.”²⁰ The power of knowledge comes from its grasping in one form “the unity of nature in very different materials.”²¹ Form is no longer a co-cause with fitting or proper matter. This power is directed to “the relief of man’s estate,” through inventions of a technological character and this constitutes the “excellence of the Purpose” of human knowledge.²² Here we can see that not only does the primacy of the speculative fall to the practical, but the sapiential character of first philosophy—and, *a fortiori* natural philosophy, should it prove to have one—is also lost.²³

17. Bacon, *The New Organon*, 11.

18. Peter Pesic argues that thinking such vexation involves the “torture” of nature is unfounded; see Peter Pesic, “Wrestling with Proteus: Francis Bacon and the ‘Torture’ of Nature,” *Isis* 90, no. 1 (1999): 81–94. All that my point requires is that this experience be the product of artifice. Roberto Torretti, *The Philosophy of Physics* (Cambridge; New York: Cambridge University Press, 1999), 3, points out that this idea of “torturing” nature draws out the tension inherent in an artificial experience of nature. He refers us to *The Republic*, 531b (Torretti’s footnote misleads one to 537d), where Socrates speaks in a disapproving manner of those who “harass” and “torture” (βασανίζοντας and στρεβλοῦντας) the strings in acoustics, since true insight into the Good, as found in theory about number, is not found in such experiments.

19. See Bacon, *The New Organon*, 103.

20. Ibid., Book I, Aphorism LXXIII, 60.

21. Ibid., Book II, Aphorism III, 103.

22. See *ibid.*, 99. The phrase “the relief of man’s estate” comes from *The Advancement of Learning*. Consider also his *New Atlantis*.

23. De Koninck is keen on this inversion of the primacy of speculative knowledge; see §22.5.

ii.b René Descartes and universal mathematical physics

René Descartes' own refounding of natural philosophy reiterates Bacon's artificiality of method, his recasting of the object of study, and his transmutation of the sapiential office of first philosophy (and hence natural philosophy) into a practical one which is subservient to human desire. In common with Bacon, Descartes redirects the goal of philosophy towards a practical end. He does not require a dedicated work refuting the scholasticized Aristotle point-by-point, as Richard Kennington points out. Bacon's extensive critique can be assumed.²⁴ Descartes also introduces an artificial origin and mode to the experiences out of which the new natural science is made; he exceeds Bacon with the introduction of symbolic conception in a *mathesis universalis* applied to the analysis of nature. These changes condition a change in the character of the architectonic which governs or orders the parts of philosophy: it becomes a mastery of nature.²⁵

The passages in Descartes' writings proclaiming the "mastery of nature" and practical, technological application of knowledge are well known.²⁶ Yet the "Preface" to Descartes' *The Passions of the Soul* also explains this new *telos*.²⁷ The "Preface" consists of an exchange of letters between Descartes and an unknown friend that comment on the vast public benefit and infinity of useful devices which the *Discourse* promises.²⁸ As a consequence of this shift of purpose—from *theoria* to *praxis* and *technê*—the sapiential office of a "highest wisdom" is heavily qualified in Descartes' overall schema of the sciences.²⁹

24. Richard Kennington, *On Modern Origins: Essays in Early Modern Philosophy*, ed. Pamela Kraus and Frank Hunt (Lanham, MD: Lexington Books, 2004), 17–18.

25. See *ibid.*, for Kennington's essays "Descartes's *Discourse on Method*" and "Descartes and the Mastery of Nature."

26. The central text is, of course, from Part VI of the *Discourse on Method*, see René Descartes, *The Philosophical Writings of Descartes: Volume 1*, trans. John Cottingham, Robert Stoothoff, and Dugald Murdoch (Cambridge: Cambridge University Press, 1985), 142–43.

27. René Descartes, *The Passions of the Soul: An English Translation of Les Passions De L'Ame*, trans. Stephen Voss (Indianapolis: Hackett Publishing Co., 1990), 5–8.

28. As translator Stephen Voss notes, "The friend has been variously identified as Clerselier . . . and Descartes himself In any case, Descartes endorsed the preface's publication . . . , and it therefore must be counted a genuine part of his treatise." See *ibid.*, 6, 7.

29. The Frenchman famously says that one need consider metaphysical subjects only once in one's life and

Descartes adds a mathematical and artificial mode of experience. This artificial mode of experience is detailed in the passages of the *Discourse* and *Passions* describing the extensive program of experiments that is required to supplement the weak state of human knowledge with regard to natural phenomena.³⁰ The opening of the *Optics* also displays a penchant for recasting the phenomena of nature into reductive or redescriptive models. This is evident in Descartes' use of a stick to model both the path and mode of transmission of light.³¹ This method is also heavily reliant on the use of symbols.³²

Finally, and most pertinent to the consideration of Aristotle's "natural path," Descartes proposes that we begin inquiry with ideas which are clear and distinct to us.³³ De Koninck opposes this inversion of the Aristotelian method. Beginning with the (purportedly) "clear and distinct" conceptions is "a universe conceived to the measure of man,"³⁴ because what is taken to be closer to us replaces what is better known in reality. This inversion is possible due to the mathematical method adopted, since mathematics abstracts from the good and, consequently, from the obscurity of matter.³⁵

that only for the sake of continuing on to other subjects—the other branches and fruits in Descartes' famous "tree of philosophy." See *Principles of Philosophy*, Descartes, *Philosophical Writings of Descartes*, 186–88, (AT 8:14–17) and Descartes's 28 June 1643 letter to Princess Elizabeth (AT 3:695, 4–15). The fact that metaphysics is merely for the sake of the surety it provides to the basic concepts of the other disciplines points to its servile rather than its contemplative, sapiential character. The sciences are no longer speculative, and therefore no longer theocentric—no longer hierarchically arranged so as to lead the mind "up" towards the consideration of objects higher than itself. The sciences become anthropocentric, for the sake of human purposes and technological aims. The roots of the tree of philosophy, metaphysics, are hidden from view once the tree begins to grow. The most conspicuous parts are the tree's fruits, whose consumption erase the memory of metaphysics from the mind of man.

30. See *ibid.*, 143–44, AT 6:63–65 and also *ibid.*, *Principles of Philosophy*, 188 (AT 8:17); finally, Descartes, *Passions of the Soul*, 12–15, AT 11:318–22.

31. See Descartes, *Philosophical Writings of Descartes*, 153–54, AT 6:82–86.

32. I return to this topic in Chapter 6, §25.

33. See the famous statement in the *Discourse*, Part II, Descartes, *Philosophical Writings of Descartes*, 120 and compare this to Rules 3 in *Rules for the Direction of the Mind*, *ibid.*, 13–15, and well as *Principles of Philosophy*, I:45, *ibid.*, 207–208.

34. Charles De Koninck, "Introduction a l'étude de l'âme," *Laval théologique et philosophique* 3, no. 1 (1947): 20. All translations of this article are by David Quackenbush, with minor modifications.

35. That is, since mathematics abstracts from sensible matter, it must also abstract from the good insofar as matter is the root cause of all potentiality to form and, consequently, in conjunction with form, is the cause of any natural order to the good; see St. Thomas, *ST*, Ia, q. 5, a. 3, ad 4: "Mathematica non subsistunt separata secundum esse, quia si subsisterent, esset in eis bonum, scilicet ipsum esse ipsorum. Sunt autem mathematica

ii.c Immanuel Kant and a new metaphysical order

The clearest rejection of the natural path into the knowledge of nature comes from Immanuel Kant. In contrast to the Heraclitean attitude of listening to nature (DK 112), Kant provides a new image for the method followed by modern science.³⁶ Its model is a judge who puts questions to nature in the manner of a witness; we are no longer on nature's leading strings: "This is how natural science was first brought to the secure course of a science after groping about for so many centuries."³⁷ In this fashion, nature no longer holds reason *entirely* as her "pupil" in an *a posteriori* method. Rather, nature is compelled as a witness is—answering only within strictly defined parameters of a well-defined procedure. Reason can only "put into nature" what reason has proposed in its scientific questions: nature either confirms or denies the soundness of reason's proposal.³⁸

Kant also envisions an architectonic of pure reason that serves as the foundation for any real knowledge of nature. The examples of Galileo, Torricelli, and Stahl serve to illustrate the new mode of "natural science only insofar as it is grounded on empirical principles."³⁹ Kant's critical project elevates this primitive *a priori* character of a hypothetical-

separata secundum rationem tantum, prout abstrahuntur a motu et a materia, *et sic abstrahuntur a ratione finis*, qui habet rationem moventis. Non est autem inconueniens quod in aliquo ente secundum rationem non sit bonum vel ratio boni, cum ratio entis sit prior quam ratio boni, sicut supra dictum est." (Leon.4.59) My emphases. See also *SBdT*, q. 5, a. 4, ad 7; *De Veritate*, q. 21, a. 2, ad 4; and *In Meta.*, lib. III, lect. 4, nn. 375 and 385, on Aristotle's *Metaphysics*, III.2, 996a21–40.

36. Kant, *Critique of Pure Reason*, 108 (B xii).

37. *Ibid.*, 109 (B xiii).

38. In a word: nature is reduced to a binary response of yes or no, answering our requirements for certitude with strict proportionality to our touchstone of certitude, the principle of contradiction. (Andrew Romiti pointed out this "binary" character. Hence, modern science's form of knowledge is uniquely "digital," says Richard F. Hassing, "History of Physics and the Thought of Jacob Klein," *The New Yearbook for Phenomenology and Phenomenological Philosophy* 11 (2012): 240, fn. 59.) Kant's insight is echoed by Sir Arthur S. Eddington, *Space, Time And Gravitation: An Outline Of The General Relativity Theory* (Cambridge: Cambridge University Press, 1921), 200-201: "We have found that where science has progressed the farthest, the mind has but regained from nature that which the mind has put into nature. We have found a strange footprint on the shores of the unknown. We have devised profound theories, one after another, to account for its origins. At last, we have succeeded in reconstructing the creature that made the footprint. And Lo! It is our own."

39. Kant, *Critique of Pure Reason*, 108 (B xii–xiii).

experimental method into an all-encompassing vision of the fundamentally rational, pure, and *a priori* origin of the conditions for the cognition of nature as a law-governed system of appearances. In short, the Kantian categories provide the grounds for transcendental laws of nature.⁴⁰ This is how Kant's transcendental metaphysics is "architectonic." The "natural road" of Aristotle is a dead-end road since it can never reach the necessity of an *a priori* synthetic judgment.⁴¹

This *a priori* character inaugurates a new type of ruling mind. This mind can rule over the empirical investigation of nature, Kant reasons on an Anaxagorean theme, because it is "separated and wholly unmixed."⁴² Without the principles it provides, natural science would be without the true character of a Kantian science.⁴³ The use of the metaphysics of nature is found in the direction it provides to natural philosophy.⁴⁴ This need for fundamental background claims in the study of nature shares a similarity with what I hope to establish but has crucial differences.

Summary

The "modern turn" in philosophy, exemplified in our sample exposition of Bacon, Descartes, and Kant, provides four fundamental points of contrast with Aristotle's "natural path" and

40. Kant, *Critique of Pure Reason*, 263–64, (B 163–65) and 320–21, (A216/B263–A218/B265). Ernst Cassirer, *Substance And Function & Einstein's Theory Of Relativity* (Chicago: The Open Court Publishing Company, 1923), 394, notes that: "[Kant] himself believed that he possessed in these deductions a philosophical grounding of the presuppositions of the science of Newton; today we recognize to an increasing extent that what he so regarded was in fact nothing but a philosophical circumlocution for precisely these presuppositions."

41. Kant explains the new character of this architectonic in several places, the most notable of which are the "Preface" to the *Metaphysical Foundations of Natural Science* and "The Architectonic of Pure Reason," the third chapter of the second division of the *Critique of Pure Reason* (the "Transcendental Doctrine of Method").

42. See Immanuel Kant, *Metaphysical Foundations of Natural Science*, trans. Michael Friedman (Cambridge: Cambridge University Press, 2004), 5, where Kant is arguing that natural science requires a pure "part" in order to be apodictic, i.e., a true science.

43. Ibid., 3. Indeed, Kant claims in both the *Critique of Pure Reason* and *The Metaphysical Foundations of Natural Science* that "natural philosophers" (ibid., 8) and "mathematicians" (A847/B875) have unconsciously used metaphysical principles, or tried to and failed, burdening the investigation of nature with false doctrines.

44. See ibid., 8–9; see also Kant, *Critique of Pure Reason*, 699 (A847/B875).

overall vision of natural philosophy.

1. The speculative end of natural philosophy is replaced by a practical end.
2. The natural origin of knowledge (the “natural path”) is replaced by an artificial or conventional one.
3. The form of the investigation (in predicable wholes or universal words, from the general but vague and confused to the specific and more distinct) is replaced by a symbolic one, prizing clarity and distinctness.
4. The traditional sapiential character of philosophy is changed into a new character.

To the degree, therefore, that the modern turn in philosophical physics advances along these points of contrast, the “natural path” of Aristotle’s physics and whatever fruits such a method bears for the mind are lost.

§III MAINTAINING A SAPIENTIAL VIEW OF THE STUDY OF THE COSMOS IS THE ROLE OF NATURAL PHILOSOPHY AND MUST BE RECOVERED.

While the modern philosophy of nature has turned away from the beginnings proposed by Aristotle in the opening lines of the *Physics*, its success raises serious doubts whether Aristotle’s alternative is true and (even if true) desirable. Why not simply cede natural philosophy to the scientists and take up Thomistic metaphysics—or is this problematic, as Yves Simon notes, since “the bad thing with Thomistic metaphysics is that it implies the possibility of a philosophy of nature”?⁴⁵ Is there a *via media* between the artificial roads of the modern sciences and scholastic metaphysics?⁴⁶ To the latter two questions, I defend an affirmative answer.

45. Yves R. Simon, *The Great Dialogue of Nature and Space* (Albany, NY: Magi Books, 1970), 17.

46. See James A. Weisheipl, “The Relationship of Medieval Natural Philosophy to Modern Science: The Contribution of Thomas Aquinas to Its Understanding,” *Manuscripta* 20, no. 3 (1976): 193, 196. This essay is republished in James A. Weisheipl, *Nature and Motion in the Middle Ages*, ed. William Carroll, *Studies in Philosophy and the History of Philosophy* v. 11 (Washington, D.C: Catholic University of America Press, 1985), 261–76.

§IV THIS PROJECT WILL EXAMINE THE SAPIENTIAL ROLE OF NATURAL PHILOSOPHY BY CONSIDERING AS ITS TEST-CASE THE EXISTENCE AND NATURE OF THE FIRST MOVED MOVER, FOR THIS BEING (OR BEINGS) STANDS AT THE BORDER BETWEEN GENERAL NATURAL PHILOSOPHY AND COSMOLOGY.

And at any rate, you can imagine, if it seems good to you (since it is held by the greater part of the Doctors) that there is some First Mobile which, rolling about the world with an incomprehensible swiftness, is the origin and the source of the other movements which one encounters.

RENÉ DESCARTES
Le Monde (AT 11:11–12)

Aristotle’s “natural path,” if it is the natural road along which human knowledge is acquired, could hardly be anticipated without being experienced. Its shape could only be acquired afterwards by reflection upon the fact of having traveled along it. Since the modern sciences and their founding philosophies are so far removed from Aristotle’s researches in his *Physics*, it is necessary to propose some subject which could be common to both the Aristotelian and modern scientific approaches to nature in order to examine the relationship (if any) which obtains between them. Reasons for why such a strategy is followed will be given in §V, and reasons why De Koninck is chosen as a central guide in §VI. Since any number of topics taken up by Aristotle could have been selected: e.g., the nature of motion, place, time, or the void, in this section I defend why the *primum mobile* is to be considered.

The inspiration for taking the *primum mobile* as a “test case” is found in De Koninck. He comments as follows on an argument of St. Thomas’ for the active potency of the first mobile heaven:

We know moreover that the celestial body was in its turn moved by a separate substance, by a pure spirit. If we have, centuries since, abandoned the surpassed astronomy implied by this text of St. Thomas, we have wrongly rejected the philosophical idea beneath the argument. If we cannot put our finger on the

intracosmic instrument which serves as the being endowed with the active power necessary to the cosmos, we are no less obliged to affirm its existence.⁴⁷

Now, such an argument, from the side of natural philosophy, is only made at the end of an inquiry such as Aristotle's *Physics*. According to this Aristotelian view, the mind, naturally following the road from what is known at first towards what is first in itself, does not reach a dead-end. Rather, the road forks in two directions: one upwards into "the spiritual universe" not subject to matter and motion, and from which the material "cosmos is . . . essentially suspended,"⁴⁸ the other downwards toward more particular investigations of the cosmos and its parts founded on experiences that are proportionately more specialized or determinate. The natural philosopher by turning "upwards" becomes a metaphysician and by turning "downwards" becomes a cosmologist, a chemist, a biologist, etc.

This is why it is fitting that the *primum mobile* be the test case as opposed to other materially common objects between natural philosophy and the modern sciences. The investigative arc of general natural philosophy occurs at a single generic level of determination in experience. By standing at the extreme of one level of determination of experience and the beginning of another, the first moved mover allows for reflections upon the completeness of general natural philosophy as a science and hence as a possible architectonic.⁴⁹ As an

47. Charles De Koninck, *The Cosmos*, in *The Writings of Charles De Koninck: Volume One*, ed. Ralph McNerny, trans. Ralph McNerny (Notre Dame, IN: University of Notre Dame Press, 2008), 274. In this unfinished monograph, which was never published *in toto* in his lifetime, De Koninck discusses the possibility of cosmic and biological evolution and the relationship of such a cosmology with the classical principles of Aristotelian-Thomistic natural philosophy and metaphysics.

48. *Ibid.*

49. "The perfect natural philosopher at the height of his task will mention also the causes which are unmoved and above nature." Philoponus, *On Aristotle's Physics 2*, trans. A. R. Lacey, *Ancient Commentators on Aristotle* (Ithaca, NY: Cornell University Press, 1993), 109. This view of Philoponus' implicates the inquiry about the first moved mover or first mobile being(s). Also, consider Christopher A. Decaen, "The Existence of Aether and the Refutation of Void in Aristotle: A Critical Evaluation of the Arguments" (Ph.D. Diss., Catholic University of America, 1998). Decaen's comments show how his project and mine are complementary, see 266 and fn. 8: "For Aristotle the aether is the medium or instrumental agent used by the First Unmoved Mover to generate all motion in the terrestrial sphere. The aether transmitted light, heat, and a sort of universal causality in which not only local motion but alteration and even generation (i.e., unqualified coming to be), were effected; it was truly a *sine qua non* of the cosmos. I did not discuss this role of the aether in Aristotle's cosmology in this dissertation simply to avoid extending the inquiry unnecessarily; my

Aristotelian science is a habituated power of the mind (an intellectual virtue), and since the strength of a virtue is shown in its acts, it is a stronger test of the power of the philosophy of nature to test it at its limits—where it is closest to specific sciences—than at its most general and vague beginnings.

§V REFLECTION UPON THE PROCESSES OF INVESTIGATION CONCERNING AN OBJECT MATERIALLY COMMON TO BOTH THE PHILOSOPHY OF NATURE AND THE MODERN SCIENCES PERMITS ONE TO SORT OUT THEIR RELATIONSHIP.

Now, does such a strategy have a chance of success? Why is it preferable to reflect upon an actual attempt at knowing within general natural philosophy instead of using metaphysical or epistemological arguments about the division and methods of the sciences or examining various *a priori* proposals for the relationship between natural philosophy and science?

Logic, the art or science about arguments, was discovered only posterior to the natural genesis of arguments themselves. Plato tells us about this through Socrates in the *Phaedo*.⁵⁰ Hugh of St. Victor likewise reports that the logical arts “were the last to be discovered.”⁵¹ This indicates a certain natural propensity in our reason which is only later guided and perfected by an art or science about reasoning itself.

To advance an argument along analogous lines, this requires that an evaluation of natural philosophy’s possible architectonic role be realized after an actual attempt at interfacing what are only later recognized to be different stages of inquiry. General natural philosophy only later fully realizes its priority with regard to the particular natural sciences. Now, one could begin to suspect that the philosophy of nature itself is modified in the light of scientific

concern was only to establish its existence. . . . It may be a fair objection, however, to say that the need for a physical agent of this sort may itself serve as an argument for the existence of such an entity.” I take this as a sign that my project is neither unneeded nor redundant, and yet, not without precedent.

50. See *Phaedo*, 89c–91c, the passage about misology.

51. Hugh of Saint Victor, *The Didascalicon of Hugh of Saint Victor: A Guide to the Arts*, trans. Jerome Taylor (New York: Columbia University Press, 1991) Book I, ch. 11, 57, and see 57–60.

advances, or it is too much separated from their concerns to be of any effect. Eddington offers us a clue as to where the solution lies:

So when, after laborious research, physics arrives at ‘revolutionary conclusions’ which philosophy claims to have known from its cradle, there are two versions to the story. One is that the physicist is a workman of obstinate disposition who would have got on much faster if he had attended to the advice of philosophers. The other is that the philosopher is an officious spectator who keeps bothering the workman by handing him tools before he is ready to use them. I dare say that, as is usual in such cases, the truth lies somewhere between the two versions.⁵²

The overall mode of argument in this dissertation, therefore, assumes that the full realization of the character of natural philosophy as an architectonic can only occur once a concrete case reveals the existence of such an office. Until an actual achievement of science in general natural philosophy and the actual realization of a need for more determinate natural sciences arises, the discussion of an architectonic or sapiential function of the former over the latter would be empty speculation, even if true.

§VI THE WORK OF CHARLES DE KONINCK IS ESPECIALLY FIT FOR THIS PROJECT.

In the late 19th century, Pope Leo XIII called for a renewed discipleship to perennial philosophy and its preeminent teacher, St. Thomas Aquinas. This call did not exclude examination of the relationship between the perennial study of nature and the modern natural sciences.⁵³ Many Thomists and scholars in related fields have contributed to the study of this relationship during the nearly seven-score years intervening.⁵⁴ An extensive tradition of Neo-Scholastic

⁵². Arthur S. Eddington, “Physics and Philosophy,” *Philosophy* 8, no. 29 (January 1933): 31.

⁵³. See Pope Leo XIII, *Aeterni Patris: Encyclical of Pope Leo XIII on the Restoration of Christian Philosophy* (Vatican, August 1879), nn. 29-30.

⁵⁴. See James A. Weisheipl, ed., *The Dignity of Science: Studies in the Philosophy of Science* (Washington, D.C.: The Thomist Press / The Albertus Magnus Lyceum, 1961). Fr. Weisheipl’s introduction to this *Festschrift* for Fr. Humbert Kane gives a brief history of the Thomistic revival instigated by Pope Leo XIII and its relationship to both the Lyceum in particular and also to the reinvigorated Thomistic study of natural philosophy generally. See also Benedict M. Ashley, “The River Forest School and the Philosophy of Nature Today,” in *Philosophy and the God of Abraham: Essays in Memory of James A. Weisheipl, O.P.* Ed. Raymond James Long (Toronto: Pontifical Institute of Mediaeval Studies, 1991), 1–15, and Leo Elders, *The Philosophy of Nature of St. Thomas Aquinas: Nature, the Universe, Man* (Frankfurt am Main / New York: P. Lang, 1997), 21–24 for historical and theoretical details in this regard.

natural philosophy and cosmology developed in various European schools.⁵⁵ Nor were the Thomists the only group interested in the philosophy grounding the practice of the empirical and mathematical sciences. Both scientists themselves and the two dominant philosophical schools of the academy have advanced their own views.

Among all these researches, those delivered by Charles De Koninck are worth particular consideration. Indeed, his contributions to the philosophy of nature and science have been insufficiently evaluated.⁵⁶ It is an integral part of this dissertation's goal to make the case for Charles De Koninck's vision of the relationship between natural philosophy and the modern sciences under the light of wisdom as a principle of order. De Koninck knew that the method and content of the premodern philosophy of nature could not be simply grafted onto modern physics. If later science determines that the universe necessarily has an evolutionary timeline on the cosmic and biological scales, the soundness of Aristotle's natural path would somehow have to be rediscovered (after having been ignored) and shown to be not a mere graft but the forgotten root system of theories from Darwin to the Big Bang.

Charles De Koninck (29 July 1906–13 February 1965) was a native of Belgium who spent most of his career at the University of Laval in Québec City. He obtained a doctorate of philosophy from the University of Louvain, dissertating on the philosophy of Sir Arthur Eddington under Fernand Renoirte. De Koninck later received a doctorate in theology from Laval. He taught at Laval and Notre Dame, and was the dean of Laval's School of Philosophy from 1939–1956. He died in Rome while serving as conciliar theologian to Maurice Cardinal

55. See John Edward Mulvihill, "The Philosophy of Evolution: The Twentieth-Century Neo-Scholastic Approach, with Special Reference to the Gregorian University, Rome" (PhD diss., Graduate Theological Foundation, 2009), in particular Chapter 2, pp. 30–241. While Mulvihill's study focuses on evolution, its historical survey of the various schools and teachers presents a wide-ranging assessment of the various Thomistic and related thinkers in the field of natural philosophy.

56. See Annamarie Adkins, "Ralph McInerny on a Forgotten Thomist," *ZENIT: The World Seen From Rome*, November 2009, accessed March 15, 2014, an interview in which Ralph McInerny maintains that "[De Koninck's] account of the relation between natural philosophy and natural science still awaits a serious appraisal by philosophers of science." This is beginning to change; see Pascal Ide, "La philosophie de la nature de Charles De Koninck," *Laval théologique et philosophique* 66, no. 3 (2010): 459–501.

Roy. His published work testifies to the breadth of his scholarly interests.⁵⁷

Of particular interest to this project is De Koninck's work on the philosophy of nature and its relation to the modern sciences. McInerny tells us that De Koninck arrives on the scene of Thomism's 20th century encounter with science to find a set of interpretations already in place, the Louvain position (ceding natural philosophy to the modern sciences) and Maritain's position (reestablishing natural philosophy as formally distinct from the modern sciences and modifiable by them in retrospect).⁵⁸ Initially, De Koninck agreed with Maritain's assessment. However, he later changed his opinion. His later view was, in short, that the modern sciences are not formally distinct from natural philosophy but were its natural, dialectical extensions.⁵⁹ McInerny further comments, in no uncertain terms, in the conclusion of his eulogy of De Koninck:

More than ever before, we have need today of the sapiential outlook, a point of view from which we can judge the gains and retrogressions of contemporary thought. That point of view is to be found in the writings of De Koninck, writings which are in great part the products of the contingency of practical demands and academic assignments and which were published for the most part in fairly obscure Canadian periodicals. We would do well to seek them out. At a time when the methodology of the mathematical sciences of nature is leading to undreamt of results and seems effectively to have buried earlier attempts at a science of nature, De Koninck has vindicated the point of view and methodology of the approach to the natural world to be found in the *Physics* of Aristotle. Moreover, he has argued persuasively that unless the vast panorama of modern science be

57. De Koninck's works range from treatments of subjects in natural philosophy (such as the nature of contingency and evolution), to the relationship between natural philosophy and science, the character of metaphysics, the nature of symbols, the philosophy of biology, political and metaphysical reflections on the origin and parameters of modern philosophy, the nature of the common good, and theological reflections and treatises. Recent scholarly work has begun to investigate and exposit De Koninck's contributions in some of these areas. For more complete accounts of De Koninck's life as well as his philosophical and theological work, consult Ralph M. McInerny, "Charles De Koninck: A Philosopher of Order," *The New Scholasticism* 39, no. 4 (1965): 491–516, "The Philosophy of Charles De Koninck," by Leslie Armour, and "Charles De Koninck: A Biographical Sketch," by Thomas De Koninck, which latter two are published in De Koninck, *Writings, Vol. 1*. Yves Larochelle also provides a synopsis of De Koninck's work in a preface to Charles De Koninck, *Oeuvres de Charles De Koninck : Tome I, 1. Philosophie de la nature et des sciences*, ed. Yves Larochelles and Thomas De Koninck (Québec: Presses de l'Université Laval, 2009), xiii–xxix.

58. McInerny, "Charles De Koninck: A Philosopher of Order," 495.

59. *Ibid.*, 498–99.

seen as a prolongation, necessary and fecund, of that ancient and still largely valid beginning, we shall never really appreciate the nature of our accomplishment.⁶⁰

Now, while this dissertation is neither an exposition of all aspects of De Koninck's philosophy nor a complete tour of where the principles he utilizes in the philosophy of science lead, its aim requires an exposition and application of De Koninck's views. From McInerny's own assessment of his teacher's work, we have initial assurances that taking De Koninck as a guide will not be in vain.

De Koninck routinely takes Aristotle and St. Thomas as intellectual authorities in a single, latitudinarian ambit. For instance, his foundational treatment of Aristotelian method in natural science is found in an extended commentary on the *prooemium* to St. Thomas' commentary on Aristotle's *Physics*.⁶¹ Other crucial details of his understanding of this method are found in a précis he wrote to a textbook on Thomistic philosophical psychology, an introduction which, due to this focus on such broad issues, was largely "out of tune with the rest of the book."⁶² The dissonance was caused by De Koninck's thinking "it necessary to update it by discussing points of method taking into account contemporary experimental science and emphasizing in contrast the certainty provided by internal experience, but not without warnings of pitfalls."⁶³ Indeed, De Koninck's eclecticism and a consequent impression of a disdain for scholarly purity has been sharply critiqued.⁶⁴ De Koninck's use of Thomistic

60. McInerny, "Charles De Koninck: A Philosopher of Order," 514.

61. Charles De Koninck, "Abstraction from Matter: Notes on St. Thomas's Prologue to the *Physics*," *Laval théologique et philosophique* 13.2, 16.1, 16.2 (1957, 1960): 133–196, 53–69, 169–188. This study is in three parts, and will be cited by part number in Roman numerals, followed by page numbers; e.g., I:133.

62. Thomas De Koninck notes this in "Charles De Koninck: A Biographical Sketch," in De Koninck, *Writings*, Vol. 1, 85, and see Stanislas Cantin, *Precis de psychologie thomiste*, precede d'une introduction a l'étude de l'ame par Charles De Koninck, Quebec, Ed. de l'Université Laval, 1948.

63. Thomas De Koninck, "Charles De Koninck: A Biographical Sketch," 85.

64. See Charles De Koninck, *The Writings of Charles De Koninck: Volume Two*, ed. Ralph McInerny, trans. Ralph McInerny (Notre Dame, IN: University of Notre Dame Press, 2009), 181, from Fr. Eschmann's "In Defense of Jacques Maritain," published in response to De Koninck's essay on the primacy of the common good: "Will it be granted that it is inadmissible to read St. Thomas with scissors and paste, by cutting the texts out of their literary and historical context and just quoting what, in a particular instance, seems to be suitable?"

commentators such as Cardinal Cajetan and John of St. Thomas is also significant, although it was not without caution or discrimination.⁶⁵

Evidence of De Koninck as a teacher comes from the work he directed while at Laval and the subsequent careers he influenced. Many of the dissertations he oversaw were concerned with Aristotelian natural philosophy and its intersection with modern science.⁶⁶ Several of De Koninck's students published monographs on the subject.⁶⁷ Also notable are De Koninck's relations with the Thomistic academic movements studying the philosophy of nature and science, such as the Albertus Magnus Lyceum. De Koninck published essays in the philosophy of science under the editorship of Vincent E. Smith, wrote an essay for the collection honoring Fr. Humbert Kane, and received essays from Fr. William Wallace and Fr. James Weisheipl in his own memorial volume.⁶⁸ Wallace himself gives due to De Koninck's influence on his understanding of the philosophy of science.⁶⁹

65. Thomas De Koninck, "Charles De Koninck: A Biographical Sketch," in De Koninck, *Writings, Vol. 1*, 74.

66. In particular, Bernard Mullahy, "Thomism and Mathematical Physics" (Ph.D., Université Laval, 1946), Joseph C. Taylor, "The Aristotelian Concept of Natural Philosophy" (Ph.D., Université Laval, 1947), Wilfrid Dufault, "L'Apriorisme dans les termes de la science expérimentale" (Ph.D., Université Laval, 1947), Emile Simard, "L'hypothèse" (Ph.D. Diss., Université Laval, 1948), and George J. McMahon, "Order of Procedure in the Philosophy of Nature" (Ph.D., Université Laval, 1958). Others will be cited in the course of this project.

67. See Richard Connell's various works, "The Character of Natural Philosophy," *The New Scholasticism* 51, no. 3 (1977): 277–302; *Matter & Becoming* (Chicago: Priory Press, 1966); *Substance and Modern Science* (Houston: Center for Thomistic Studies, University of St. Thomas, 1988); *Nature's Causes, Revisioning Philosophy*, vol. 21 (New York: P. Lang, 1995); *From Observables to Unobservables in Science and Philosophy* (Lanham, Md: University Press of America, 2000) as well as Émile Simard, *La nature et la portée de la méthode scientifique: exposé et textes choisis de philosophie des sciences* (Québec: Presses universitaires Laval, 1956).

68. See Charles De Koninck, "The Unity and Diversity of Natural Science," in *The Philosophy of Physics*, ed. Vincent E. Smith (New York: St. John's University Press, 1961), 5–24; Charles De Koninck, "Is the Word 'Life' Meaningful?," in *Philosophy of Biology*, ed. Vincent E. Smith (New York: St. John's University Press, 1962), 77–92, as well as Charles De Koninck, "Darwin's Dilemma," *The Thomist: A Speculative Quarterly Review* 24 (1961): 367–382, appearing also in Weisheipl, *The Dignity of Science: Studies in the Philosophy of Science*, 231–46, and finally (Armand Gagné, ed., *Mélanges à la mémoire de Charles de Koninck* [Québec: Presses de l'Université Laval, 1968]).

69. See William A. Wallace, *From a Realist Point of View: Essays on the Philosophy of Science* (Washington, DC: University Press of America, 1979), 1–21 and William A. Wallace, *The Modeling of Nature: Philosophy of Science and Philosophy of Nature in Synthesis* (Washington, DC: The Catholic University of America Press, 1996), 197–237, especially 227n and 235n.

De Koninck's work also provides a broader context in which to study the capabilities and the limitations of the human mind. De Koninck's analysis of the epistemological shifts in modernity are found most insightfully presented in the second of his two essays treating of the common good.⁷⁰ This criticism is further developed in "one of the centrepieces of his thought," a short essay titled "Concept, Process, and Reality," which De Koninck himself describes as "truth I felt in my very bones."⁷¹ These writings, when read in conjunction with his works against dialectical materialism and his various publications on the nature of symbols, provide a contemporary Thomistic response to the problems of human knowledge and the abandonment of the "natural path" into the philosophy of nature.

The above gives sufficient support that De Koninck's doctrine ought to be attended to and more carefully examined. De Koninck also explicitly argues for the architectonic role of natural philosophy.⁷² Although they are texts fewer in number, he also discusses our central material object of study, the *primum mobile*. In such a mode, I will be following De Koninck regarding *how* to study seemingly outdated points of Aristotelian natural science and find their perennial insight.

§VII THE PROJECT'S MAIN THESES, DIVISION, ORDER OF ARGUMENT, AND MODE ARE AS FOLLOWS.

The demands of my intended argument divide the dissertation into two parts. The first part of the dissertation will present the case for the existence and nature of the *primum mobile*. The second part of the dissertation, based upon these investigations, will defend the sapiential office of general natural philosophy. Specifically, I intend to show that the first moved mover exists and that it has a nature determinable by general natural philosophy (Chapters 1–4).

70. See *The Principle of the New Order* in De Koninck, *Writings*, Vol. 2, 109–47.

71. De Koninck, *Writings*, Vol. 1, 85 and see Charles De Koninck, "Concept, Process and Reality," *Philosophy and Phenomenological Research* 9, no. 3 (1949): 440–447.

72. See Charles De Koninck, "Thomism and Scientific Indeterminism," *Proceedings of the American Catholic Philosophical Association* 12 (1936): 58–76 and Charles De Koninck, "La philosophie des sciences, fonction sapientiale de la philosophie de la nature," *Acta Pont. Acad. Romanae S. Thomae Aq. Acta secundi congressus thomistici internationalis* 1936, 3 (1937): 359–362.

The examination of these determinations in relation to the deliverances of modern cosmology (Chapter 5) forms the basis for demonstrating the sapiential (or architectonic) office of general natural philosophy (Chapters 6–7). The general philosophy of nature possesses a sapiential office with respect to the modern sciences in virtue of its speculative mastery of the “natural path” of the human mind.

This argumentative order is meant to recapitulate the path of the mind from the point of view of philosophical hindsight. It is almost a phenomenology of discovery within the ideal history of general natural philosophy as it is discovered or taught. The term “general natural philosophy” is used to designate that portion of man’s approach to a science of nature which must come first in the order of discovery and which forms the basis for what later becomes the architectonic part of natural philosophy (or natural science). Following De Koninck in this regard, I hold that, ultimately, there is no *formal* distinction between “*philosophia naturalis*” and the modern sciences of nature. The terms “modern science” or “modern mathematical physics” will pragmatically designate those disciplines as they are usually taken in opposition to the Aristotelian science of natural philosophy or, at times, simply “physics.”

By taking De Koninck as a guide, I necessarily touch upon a web of sources. The style of argument I employ is due partly to the sources and content of the project and due partly to its aim: it is doubtless impossible to defend a *rapprochement* between Aristotelian, Thomistic, and modern attempts to rigorously know the natural order while at the same time arguing exclusively within a parlance familiar to strict interpreters of Aristotle or St. Thomas or any modern philosopher or scientist. Therefore, the unifying vocabulary and mode of argument will smack of the eclecticism of a De Koninck but, hopefully, it will also sound the depth of truth that pervades his writing.

The attempt to defend the natural path of the mind into the philosophical knowledge of nature requires a type of desedimentation that recaptures the mode of discovery in its *natura pura*, as it were—without doubt an abstract thing that never fully took place within

the mind of a single man. Caution is in order—Descartes illustrates, using the image of a city built by many hands over the centuries, the individual human mind’s dependence upon instructors, intellectual customs, and personal habits of thought. He hopes instead for an unreal city. His hope of introspectively recovering a counterfactually pure and “entire use of our reason,” as if to hold it apart from possibly erroneous external influences “from the point of our birth,”⁷³ is a rationalism that strains unnaturally against the innate character of the human mind, naturally situated for inquiry within the cosmos. In contrast, the mode of this project seeks to recollect what we are actually warranted to assert and the order in which we are actually required to provide such warrants in answers to questions which, were we docile enough before nature, we could not help but raise. We must strain only somewhat against the second nature of custom to attend to these original questions.

Indeed, this is De Koninck’s own concern:

Nearly everyone holds that whatever interest the *Physics* may now possess can be no more than historical. This we interpret as a challenge, not so much to the particular doctrines it contains but, what is far more important, to the meaning and validity of the kind of questions its author assumes the human mind should be facing.⁷⁴

73. Descartes, *Discours*, AT 6:13.

74. Charles De Koninck, “Random Reflections on Science and Calculation,” *Laval théologique et philosophique* 12, no. 1 (1956): 102.

PART I

The Existence & Nature of the *Primum Mobile*

INTRODUCTION TO PART I

The nature of the universe, the soul
that stills the center and sweeps all things around
begins here, from its origin and goal;
And for this heaven no place is to be found
but in the mind of God, wherein take wing
the love that turns it, and the power it rains.
Light and love comprehend it one ring
as it rings all the rest: and he alone
comprehends this girdling ring, who girdles it.
The motion of this sphere derives from none—
its motion rather measures all the rest,
as two and five combine to measure ten;
And now to you it should be manifest
time grips its roots into this vase, unseen,
while in the rest breaks into leaf and crown.

DANTE
Paradise, XXVII.106–120

Dante reveals the ambit of the medieval cosmos through Beatrice's description of the *primum mobile*. The first moved mover is the moving instrument of the Divine Mind, the cause of cosmic motion, lintel of place within the universe, and principle of the unity and measure of all creaturely time. Surely this is a cosmology as much out of place and time as alchemy! In this first part, consisting of five chapters, I aim to substantiate the overall thesis that by following Aristotle's natural path of inquiry, what is perennial concerning our insight into the fundamental efficient cause within the cosmos can be retained and a modern replacement can be proposed in a dialectical fashion. This will not only reveal how the scientific moments of general natural philosophy begin from common experience (thereby illustrating the plausibility of Aristotle's method) but also show the investigative arc upon which the *Physics* embarks.

CHAPTER 1
**Finding the Natural Path
& the Principles of Mobile Being**

INTRODUCTORY NOTE TO CHAPTER 1

For the beginning is called half of the whole work in the proverbs, and all praise beginning well on each occasion. But it seems to me that it is more than the half and no one has ever praised it enough when it has come to be well.

PLATO
Laws, 753e

Nothing will come of nothing: speak again.

SHAKESPEARE
King Lear, Act I, Scene 1

Book I of Aristotle's *Physics* manifests the beginnings of natural philosophy by meditating upon the Eleatic paradox in light of the axiom that "Nothing comes from nothing." Answers to questions that arise immediately upon the solution to physics' first dilemma are then provided in Books II and III, making the first three books a fundamental unit. In this chapter, I first consider that in Aristotle's order of procedure there is a natural and necessary order (§1). Then (§2), I defend the existence of natural philosophy by solving the Eleatic problem. Along the way, some mention can be made to prepare for natural philosophy's discovery and understanding of the first moved mover.

§1 NATURAL PHILOSOPHY FOLLOWS AN INVESTIGATIVE ARC ALONG THE NATURAL PATH IN OUR KNOWLEDGE THAT PROCEEDS FROM WHAT IS BETTER KNOWN TO US TO WHAT IS BETTER KNOWN IN ITSELF, OR BY NATURE. (*Physics*, BOOK I.1)

So it seemed to me necessary to flee for refuge into the *logoi* and in them to look for the truth of things.

PLATO
Phaedo, 99e

It is first of all necessary to establish a baseline interpretation of Aristotle's chapter on the method of natural philosophy, presented in *Physics* Book I.1.

In every inquiry in which there are principles or causes or elements, understanding and science occur from knowing these. For we think we know each thing when we know the first causes and first principles and have reached the elements. It is clear, then, that in natural science as well one must try to determine first what concerns the principles.

The natural path is to go from things which are more known and certain to us toward things which are more certain and more knowable by nature. For the more known to us and the simply knowable are not the same. Whence, it is necessary to proceed in this way, from what is less certain by nature but more certain to us toward what is more certain and more knowable by nature. But the things which are first obvious and certain to us are rather confused, and from these, the elements and principles become known later by dividing them. Whence, it is necessary to go from the universal to the particular.

For the whole is more known according to sensation, and the universal is a certain whole. For the universal embraces many things within it as parts.

In a way, the same thing happens in the relation of a name to its account. For the name signifies indistinctly some whole, as "circle" [does], but the definition of this divides into the single parts.

And children at first call all men "fathers" and all women "mothers," but later they distinguish each of them.¹

This text is Aristotle's *prooemium*, "in which," notes St. Thomas, "he shows the order of proceeding in natural science."² He and other commentators divide the chapter into two

1. Aristotle, *Physics*, I.1, 1 (184a9–b14). Coughlin's translation will be followed by the Bekker line numbers from Aristotle, *Physica*. The Ross edition of the Greek text of the *Physics*, when referred to directly, will be cited as *Physica* followed by the Bekker numbers.

2. St. Thomas, *In Phys.* lib. I, lect. 1, n. 5 (Leon.2.4).

halves, namely between the first paragraph and the last four paragraphs as given above. The first part indicates the necessity of knowing principles, while the second adds to this the manner in which we arrive at the knowledge of such principles.³

It is also commonly noted that both halves of the *prooemium* are structured around the syllogism contained in each.⁴ Concerning the first syllogism (184a9–a16), Aristotle only explicitly states the major premise in the first sentence, its supporting argument in the second sentence, and then draws not the conclusion of the argument but an “exhortation” which follows from the conclusion.⁵ The full syllogism is as follows: In every inquiry in which there are principles, causes, and elements, one has understanding and science from knowing the principles, causes, and elements. However, natural science is an inquiry in which there are principles, causes, and elements. Hence, natural science gives us understanding and science when its principles, causes, and elements are known. So, for those who wish to achieve a science of nature, they “must try to determine first what concerns the principles.” The argument assumes that natural science *qua* science is of a certain character.

The second part of the *prooemium* is guided by the following syllogism (184a16–a24): The natural path in human knowledge is to proceed from the more known to us to what is more known by nature. However, to proceed in this way is to proceed from the confused to the distinct, which is to proceed from the universal to the particular. Thus, the natural path

3. St. Thomas, *ibid.* See also Philoponus, *On Aristotle's Physics 1.1-3*, 25 and 30 as well as Simplicius, *Commentaria in Aristotelem Graeca edita consilio et auctoritate academiae litterarum Regiae Borussicae: Volumen IX, In Aristotelis physicorum libros quattuor priores (1 - 4) commentaria*, ed. Hermannus Diels (Berlin: Reimer, 1882), (henceforth *In Phys.*, *CAG*) 9.14:30–32. Bolton, in “Aristotle’s Method in Natural Science: *Physics* I,” makes similar observations; see Lindsay Judson, ed., *Aristotle’s Physics: A Collection of Essays* (Oxford: Clarendon Press, 1991), 3.

4. This is noted by Philoponus (who cites Theoprastus), Simplicius, Averroes, and St. Thomas in their respective commentaries on this passage. See also the article on this chapter penned by a student of De Koninck’s, George J. McMahon, “The *Prooemium* of the *Physics* of Aristotle,” *Laval théologique et philosophique* 13, no. 1 (1957): 9–57, which article consists of the fourth and fifth chapters of his dissertation, directed by De Koninck, McMahon, “Order of Procedure in the Philosophy of Nature.” For the reasoning behind our frequent appeal to the work of students of De Koninck or students of those students, see the prooemial materials above, §vii.

5. In particular Simplicius, *In Phys.*, *CAG* 9.9:36–10:2; Aristotle states the incitation following from the conclusion, “τὸ ἐπόμενον τῷ συμπεράσματι.”

in human knowledge is to proceed from the universal to the particular.⁶ Aristotle supports this conclusion with three “signs” (184a25–b14).⁷

1.1 *Self-reflective attention to the sources of philosophy*

In explicating the doctrine contained in the *prooemium*, we will be guided by these two syllogisms, “the best [instruments] we can use in our study of the text.”⁸ There are few chapters more fundamental in all Aristotle’s works than this one, for it captures the method of knowing, the cause of this method, and the object to be found. Indeed, De Koninck is wont to point out as modern witnesses to this method—that we proceed from the indistinct to the distinct—not only Werner Heisenberg but also Bertrand Russell.⁹ They are signs that this principle of natural philosophy is perennially sound.

Indeed, to gloss my method of the argument, consider that if the natural path grounds the claim of general natural philosophy to be a type of wisdom, the natural-philosophical mind must be separate in order to rule and yet related to the particular sciences. The first step is therefore to see that natural philosophy is sufficiently, epistemically independent in its beginnings as a science, even if those beginnings are related to unscientific, “Socratic” encounters with natural beings and need to be guided by a prior grasp of logic. Furthermore, while we utilize Aristotle’s texts and those of his various commentators in this and subsequent chapters of the dissertation, it is only for the sake of having a guiding thread while reasoning through questions that still face us, now and always, when trying to begin inquiry into nature.

6. St. Thomas, *In Phys.*, lib. I, lect. 1, n. 6 (Leon.2.5). See also McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 30ff. It will be shown that Aristotle must mean “the less universal” by “particulars” in this passage.

7. St. Thomas calls them “signs,” although they are rather of a type that must be thought through, as opposed to being immediately clear. The full exposition of these three examples will be taken up below, see p. 44.

8. McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 14.

9. See, for instance, De Koninck, “Three Sources of Philosophy,” 13.

This performative self-reflection is important since a natural path in our knowledge is the secure beginning to natural philosophy, because such a path would be common to all. This is an idea to which De Koninck himself was attentive. It is only posterior to the common and natural sources that the mind turns to proper or private sources for specific investigations.¹⁰ Fully noting the dialectical initiation into the subject matter of the *Physics*, I maintain it begins a scientific inquiry that, while always historically situated, is not historically conditioned.¹¹ I will therefore take care to distinguish between dialectical and scientific achievements in thinking and in what order the mind naturally achieves them.

1.2 What doctrines are presupposed; the first syllogism (184a9–a16)

Even if natural philosophy proves to be an independent science, Aristotle nonetheless presupposes a “Socratic” background (the minor premise of the first syllogism) as well as a logical doctrine of what a science is (the major premise).¹² This first syllogism assumes what Aristotle takes as held in common between himself and his audience.¹³ It is necessary to begin from common assumptions for all teaching and learning come from knowledge held beforehand.¹⁴ However, it is important to understand the character of these common assumptions.

Again, the first syllogism is as follows: In every inquiry in which there are principles, causes, and elements, one has understanding and science from knowing the principles, causes, and elements. However, natural science is an inquiry in which there are principles, causes,

10. De Koninck, “Three Sources of Philosophy,” 13. Recall also the overall mode of the project, see above, p. 21.

11. David Bolotin, *An Approach to Aristotle’s Physics: With Particular Attention to the Role of His Manner of Writing* (Albany, NY: State University of New York Press, 1998), 5–7; thus I disagree with Helen S. Lang, *The Order of Nature in Aristotle’s Physics: Place and the Elements* (Cambridge/New York: Cambridge University Press, 1998), 9 and 26.

12. By labelling this background Socratic, I intend only to draw attention to the fact that before gaining any insight into natural philosophy, our inquiries will be frequently puzzling, dialectical, and inconclusive while facing the initial questions about changing things. However, it is also true that Plato’s Socrates encounters several of these difficulties, as indicated below.

13. Philoponus, *On Aristotle’s Physics 1.1–3*, 25.

14. Aristotle, *Posterior Analytics*, I.1, 71a1.

and elements. Hence, natural science gives us understanding and science when its principles, causes, and elements are known.¹⁵

The minor premise of the syllogism assumes that natural science exists and that it is such as to have principles, causes, and elements.¹⁶ McMahon notes the natural objection to this assumption:

The minor, then, is stating the possibility and existence of a science of nature. . . . [Aristotle] is perfectly justified in doing this for [in *Physics* I.1] he is proceeding *prooemialiter*. He presupposes that there is a science of nature and then proceeds to prove it in the rest of the *Physics* by determining the principles, causes, and elements of mobile being as much as is possible. . . . He is, however, quite conscious of the objections against the very possibility of the science of nature. *The first objection* would come from the very denial of nature and of motion. It is this objection which he meets in the whole of Book One. Strictly speaking, we should expect the study of the *Physics* to start which Book Two where he discusses the subject and middle term of natural science. But before he can do this, he must make sure that he has defended the very possibility of true change and mobility.¹⁷

A second objection is not Eleatic but Platonic: there cannot be science of nature because natural beings are contingent, and there is no scientific knowledge of the contingent, but only of the necessary.¹⁸

Before answering the Eleatic and Platonic objections, we will defend this premise's plausibility.¹⁹ The major premise assumes that having knowledge of such principles, causes, and elements is what constitutes scientific knowledge. As Simplicius points out, this syllogism must presuppose an understanding of the difference between opinion and science, at least at

15. This is not a demonstrative syllogism strictly speaking (proving a property of an essence), but merely the exposition of a movement of thought from a particular instance (natural science) to what belongs to its general kind (inquiries). Note, however, that the Eleatic and Platonic objections against natural science seek to prevent even this movement of thought, and thus it is useful to consider each moment separately in premises.

16. McMahon, "The *Prooemium* of the *Physics* of Aristotle," 25.

17. *Ibid.*

18. *Ibid.*, 26–27. See Plato, *Timaeus*, 27d–28b, 48e–51d, especially 49d: "Now then, since none of these appears ever to remain the same, which one of them can one categorically assert, without embarrassment, to be some particular thing, this one, and not something else? One can't." See also *Cratylus*, 439c–440e.

19. That natural science exists, answering the Eleatic objection, will be defended in §2. That natural science is possible, answering the Platonic objection, will be touched upon in §3 and later in Chapter 6.

a Socratic level, as portrayed in works such as the *Theatetus*.²⁰ The explication of the major premise (which Aristotle himself gives) reveals that a certain doctrine of science, taught by the logical works such as the *Posterior Analytics*, is also assumed background knowledge.

The minor of the first syllogism

The plausibility that natural science is such as to have principles, causes, and elements can be shown in three ways. First, the commentators defend this and, second, even a basic assessment of our experience supports it. Finally, a Socratic, dialectical inquiry into the matter reveals that moving things are analyzable into parts or structures.

First, the defense of the implied minor premise in the commentary tradition can be traced back to Theophrastus.²¹ The argument is that “physical things . . . are either bodies or have their existence in bodies, for example tendencies and capacities and so on; but all bodies and things that have their existence in bodies are composite.”²² Since all composite things have principles or causes or elements, the minor premise is established.²³

Second, this much is also evident from experience, for bodies have, at the very least, limits (principles) and parts (elements). That bodies have a material cause, that they are caused by that out of which they are composed, is also clear. It is also evident that there is a composition within the very motion of bodies (their motions have a beginning, middle, and end). As all philosophy begins in wonder, so also natural philosophy begins in wonder at moving things. This is a natural beginning, as our sense experience is captured by the things which stir into motion, yet at once we are faced with a lack of understanding of why they move as they do.

20. Simplicius *In Phys.*, CAG 9.13:10–13.

21. So reports Philoponus and Simplicius, see Philoponus, *On Aristotle's Physics 1.1-3*, 25–26 and Simplicius, *In Phys.*, CAG 9.9:7–10.

22. *Ibid.*, 26.

23. *Ibid.* Now while Philoponus, following Theophrastus, spends most of his time justifying the harder case (tendencies and capacities are composite) by reasons taken from later discoveries in natural philosophy, the easier case is to maintain that bodies are composite.

Finally, that natural philosophy is such an inquiry can be made more philosophically pressing within a Socratic-style examination. Socrates relates as much in the *Phaedo*, that his investigations into nature were stymied upon beginning to investigate the nature of bodies' and motions' composition.²⁴ The *Parmenides* and the *Sophist* also bear out examples of difficulties involved when we try to understand motion.²⁵ The difficulties encountered by the Pre-Socratics also bear this out: they naturally recognize the composition of bodies and their motions and are naturally drawn to understand that composition, yet they quickly reach various roadblocks. The implied minor premise of Aristotle's opening syllogism, therefore, requires a Socratic examination of the very observation that things move. It becomes clear to the mind that moving things have parts or principles which require explanation, and yet these explanations are not forthcoming. That natural science is possible, therefore, can be made plausible to the learner.

The major of the first syllogism

The possible structure of such a science is known from the background knowledge supporting the major premise. That Aristotle is presupposing a logical doctrine of a science is clear from the explanation he gives, namely, that “we think we know [γγνώσκειν] each thing when we know [γνωρίσωμεν] the first causes and first principles and have reached the elements.”²⁶ This is the goal of every inquiry (μεθόδους) seeking understanding and science (τὸ εἰδέναι καὶ τὸ ἐπίστασθαι), and so also “in natural science [περὶ φύσεως ἐπιστήμης].”²⁷ That this reference is indeed to the doctrine of the logical works of the *Posterior Analytics* can be supported, first, from various commentators, second, the argumentative similarities Aristotle's *Physics* text bears to the *Posterior Analytics*, and finally from logical requirements.

24. Particularly *Phaedo*, 96c–97b, where Socrates discusses paradoxes in relationships between the termini of motions.

25. For example, see *Parmenides*, 136a–c, *Sophist*, 243b and 249e–251a. The *Cratylus* also offers relevant perplexities about the connection between naming, knowledge, and changing being: 439a–440e.

26. Aristotle, *Physics* I.1, 184a12–13.

27. Aristotle, *Physica*, 184a10–14.

First, St. Thomas glosses the two terms “understanding” and “science” (“*intelligere et scire*”) as understanding definitions and the science had by demonstration in clear association with the treatment of the virtues of (*intellectus* and *scientia*) in Book VI of the *Nicomachean Ethics*.²⁸ It seems unlikely that Aristotle is repeating himself in such a laconic *prooemium*, and the verbs are etymologically related to the nouns εἶδος and ἐπιστήμη, respectively alluding, first, to seeing the definable form or species of something and, second, to the science based on such insight.

Second, there is a parallelism with how Aristotle argues for this major premise. McMahon notes this parallelism between the *Physics* and how Aristotle defends his account of science in the *Posterior Analytics*, namely by appealing to a common opinion about what science is: “The proof which he gives is the same proof as that given in the *Posterior Analytics*, common opinion.”²⁹

Yet the keenest connection is the meaning behind St. Thomas’s interpretation of “*intelligere*” and “*scire*.”³⁰ Both are obtained through knowledge of causes: demonstration is obtained through a syllogism setting forth the proper cause of the conclusion, and definitions can be discovered through syllogisms which differ from the definition only in position. Yet these are doctrines argued for in the *Posterior Analytics*.³¹ The type of knowledge implied

28. St. Thomas, *In Phys.*, lib. I, lect. 1, n. 5 (Leon.2.4); and see Aristotle, *Nicomachean Ethics*, VI.4 and VI.6, and St. Thomas, *Sent. Ethic.*, lib. VI, lect. 3 and 5. St. Thomas is not alone in interpreting these words to mean different types of knowing. Philoponus merely alludes to the varying opinions, some saying they are different, others the same, and finally noting that Plato uses the supposedly more basic τὸ εἰδέναι for “the most accurate and scientific cognition,” in the *Phaedo*, 75d. However, he does report an interpretation paralleling that of St. Thomas, viz. that “some people do not take ‘knowledge’ and ‘understanding’ as indicating the same thing, but rather take ‘knowledge’ (*eidenai*) for the simple cognition without demonstration, and ‘understanding’ (*epistasthai*) for that with demonstration.” (Philoponus, *On Aristotle’s Physics 1.1-3*, 28–29.) Simplicius likewise opines that these are not used pleonastically, “οὐκ ἐκ παραλλήλου εἴρηται,” but that εἰδέναι is broader and presupposed by ἐπίστασθαι. See also *ibid.*, 29–30; Simplicius, *In Phys.*, CAG 9.9:27–10:2; Averroes, in *Phys. Aud. Comm.*, 5M-6A; Ross, *Aristotle’s Physics*, 456. Ross refers us straightaway to *Posterior Analytics* I.2, 71b9–12, the definition of scientific knowledge.

29. McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 15.

30. *Ibid.*, 16–17, who treats of this connection as St. Thomas explicates it.

31. St. Thomas, *In Phys.*, lib. 1, lect. 1, n. 5 (Leon.2.4). See in particular Aristotle, *Posterior Analytics* I.2, I.8 (75b31–32), and II.10.

by Aristotle, then, seems to imply what is treated at length in the *Posterior Analytics*.

Charles De Koninck reinforces this line of argument.³² “Science” means demonstrations resolving to the definition of a thing in its most proper terms (its first causes and most specific elements). For instance, knowledge of “what man is,” in this sense, while “likely to remain unaccomplished,” exists as “a limit towards which the ensemble of natural sciences converge.”³³

Merely because Aristotle is presupposing logic, however, does not subordinate natural philosophy to logic. The mode in which natural philosophy uses logic is not as regards content but as to form.³⁴

Concluding remarks on the first syllogism

Aristotle’s first syllogism contains virtually a robust background of wonder at and dialectical consideration of the natural world of changing things. This background is arrived at through inquiries of a Pre-Socratic and Socratic type. It is further complemented by a learner’s grasp of the requirements of a possible science that would resolve such wonder about nature, and this is taught by logic.

32. For instance, see De Koninck, “Abstraction from Matter,” I:134–45.

33. Charles De Koninck, *A General Introduction to the Study of Nature*, a draft manual in natural philosophy, submitted to Prentice-Hall circa 1954; see *The De Koninck Archives*, Folder 34, Part 6, p. 4; *ibid.*: “The fact that we are far from having attained such a limit, or that we shall never do more than approach it, is no reason why we should fail to define it as ideal, if only to remind us of the limitations of what we actually know.” Perhaps this means that natural philosophy as architectonic or sapiential is akin to a “prudence” with respect to a theory; this remains to be established. Convergence on such a limit, however, would require that the modern sciences be ordered by a sapiential outlook which takes such a limit as the completion of its inquiry; I return to this theme in Chapters 6–7.

34. As St. Thomas notes, logic teaches the manner of proceeding common to all sciences, and must be learned first; *In Meta.*, lib. II, lect. 5, n. 335: “Et propter hoc debet prius addiscere logicam quam alias scientias, quia logica tradit communem modum procedendi in omnibus aliis scientiis. Modus autem proprius singularum scientiarum, in scientiis singulis circa principium tradi debet.” This “*modus proprius*” also exists for natural science. This is discussed further in §17 and §22. See also McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 10–12.

1.3 The presupposed structure of a science

If Aristotle is presupposing a logical doctrine of what science is, what exactly does natural philosophy learn from logic?³⁵ Any science presupposes instruction in not only the proper mode of that science but also the mode common to all sciences, namely logic.³⁶ The most important feature about this common mode is that a science requires integral parts: subject, principles, and properties.

This structure of a science arises from the nature of scientific demonstration, knowledge of the cause, that it is the cause, and that the cause cannot be otherwise.³⁷ That this discourse is necessary is a property of possessing knowledge of causes of this sort.³⁸ This necessity demands premises of a certain type in demonstrative syllogisms, since the necessity of the conclusion flows from the necessity of its premises. Thus, *per se* predication must ground scientific knowledge.³⁹ A predicate cannot but belong to a subject if it obtains in every case of that subject, as a *per se* feature of that subject, and as such. One must know, therefore, the genus of the subject term, its connection to various causes or explanations (middle terms) and the connection of these to the predicates of the conclusions at which one aims.⁴⁰

This means that “there are by nature these three things, that about which the science proves, what it proves, and the things from which it proves.”⁴¹ A science must have a subject-

35. In answering this question, this subsection will explicate what some authors note more briefly, e.g., Bolton in “Aristotle’s Method in Natural Science,” Judson, *Aristotle’s Physics*, 3.

36. The proper mode includes not only the manner of logical consideration proper to the science at hand, but also the order of procedure to be followed in that science; see McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 10–12, who details these aspects, following Aristotle and St. Thomas from the discussion in *Metaphysics*, II.3.

37. Compare Aristotle, *Posterior Analytics*, I.2, 71b9–12, 71b21–22.

38. *Ibid.*, 72b1–4.

39. *Ibid.*, 73a34–73b5 and 73b10–17. Although there has been much debate over the precise meaning of Aristotle’s four senses of *per se*, I follow the usual Thomistic interpretation, see *Expos. Po. An.* lib. I, lect. 10; see also James A. Weisheipl, *Aristotelian Methodology: A Commentary on the Posterior Analytics of Aristotle*, ed. John R. Catan (River Forest, IL: Pontifical Institute of Philosophy, Dominican House of Studies, 1958), 15.

40. Aristotle, *Posterior Analytics*, I.6, 75a29–37.

41. Aristotle, *Po. An.*, I.10, 76b21–22. See also *ibid.*, 76b11–15.

genus about which it proves properties or attributes through principles or causes, which in a syllogism are middle terms.⁴² This structure comports with what Aristotle means by principles, causes, and elements in his *prooemium* in *Physics*, I.1.

Aristotle maintains that scientific explanation is obtained through syllogism stating the explanation or cause as the middle term. Further, there are four types of such explanation.⁴³ St. Thomas interprets these four types as the four causes.⁴⁴ If the middle term is a cause, and the causes are four in kind, then middle terms are four in kind. The principles or middle terms which prove certain properties of a scientific subject, therefore, can be any of the four causes.

However, a common interpretation of Aristotle's disjunctive list—causes or principles or elements—maintains that these signify the four causes. Philoponus proposes that by “principle” Aristotle could mean the efficient and final causes or even all of the causes generally; “cause” can also indicate the efficient and final causes, while the material and formal causes are signified by the term “elements.”⁴⁵ St. Thomas maintains the order of extension found in *Metaphysics*, Book V, namely that “principle” contains “cause” but extends further, “cause” contains “element” and more beside, while “element” is the lest extensive term.⁴⁶ The interpretation St. Thomas settles on is as follows:

Therefore, by “principles” [Aristotle] seems to understand moving and agent causes, in which the order of some process is most clear; by “causes,” however, he understands formal and final causes, upon which things depend most of all for their being and coming to be; and by “elements” he properly understands the first material causes.⁴⁷

42. Ibid., II.2, 90a5–6; see also Bolton, “Aristotle’s Method in Natural Science,” 15–17, who refers us to Aristotle, *Metaphysics*, VI.1, 1025b10–18, a passage which describes the fact that a science does not prove its genus of study.

43. Aristotle, *Posterior Analytics* II.11, 94a20–23.

44. St. Thomas, *Expo. Po. An.*, lib. II, lect. 9

45. Philoponus, *On Aristotle’s Physics 1.1–3*, 27–29.

46. St. Thomas, *In Phys.* lib. 1, lect. 1, n. 5 (Leon.2.4–5).

47. Ibid, (Leon.2.5). See McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 17–23 for more details. Furthermore, St. Thomas’ reading seems superior to Philoponus’ understanding, for then we do not demote the final cause to a mere extrinsic principle and we indicate that form is more of a cause than matter, even

Furthermore, as Philoponus and St. Thomas both indicate, Aristotle broadens his reach by introducing these three terms disjunctively.⁴⁸ McMahon summarizes:

Aristotle does not say that we know a thing when we know its principles, causes, and elements. Rather he says that we know a thing when we know either its principles or its causes or its elements. He uses not the copulative “and” but the disjunctive “or.” This he does to indicate that not all sciences demonstrate by all four causes. Mathematics demonstrates only by formal cause; metaphysics principally by formal and final but also by efficient; natural science, however, demonstrates from all four causes.⁴⁹

We can gather the following conclusion: science comes about by having demonstration through middle terms, and these are causes. However, the causes are four in kind, and can be signified through other names, viz. principles, causes, and elements. Thus, in the first lines of the *Physics*, “Aristotle is merely restating in different words the definition of science. Science proceeds from principles, causes, or elements, that is, it proceeds from at least one of the four causes.”⁵⁰

For his part, De Koninck follows this tack when understanding Aristotle’s background premises to the science of nature.⁵¹ In illustrating the meaning of science taken strictly, De Koninck borrows Aristotle’s own example of a “demonstration of a commensurately universal property,”⁵² namely, that in any triangle the sum of the interior angles is equal to two right angles. This is taken to illustrate the notion that a subject, through a principle or middle term, is demonstrated to possess a certain property, where the middle term is the cause of that property: every triangle has interior angles whose sum is two right angles (because every

though both are intrinsic to the substance of the thing and can be called elements, as St. Thomas indicates elsewhere: see *De Principiis Naturae*, cap. 3, nn. 20–24.

48. Philoponus, *On Aristotle’s Physics 1.1–3*, 29 and St. Thomas, *In Phys.*, lib. I, lect. 1, n. 5 (Leon.2.5).

49. McMahon, “The Prooemium of the *Physics* of Aristotle,” 20–21.

50. *Ibid.*, 22.

51. See De Koninck, “Abstraction from Matter,” I:134–39; also, De Koninck’s *A General Introduction to the Study of Nature*, *Archives*, Folder 34, Part 2, pp. 6–12.

52. *Ibid.*, I:137.

triangle is such that its exterior angle is equal to the sum of the corresponding interior and opposite angles).⁵³

De Koninck is aware that natural philosophy cannot proceed from definitions to conclusions *more geometrico*. What he has to say on this score foreshadows the second half of Aristotle's *prooemium*:

Now, when the only knowledge accessible to us is not a proper means of proof, unlike the definitions of mathematics, which are such proper means, our only resource is to look backwards, doing our best to find our way from properties to definition, instead of from definition to properties. In the study of nature this is usually the only way in which we can make progress. For example, we know the alternation of day and night before we know the reason for it—a reason which it took some time to discover. To know that this phenomenon has always taken place, in all recorded experience, is one thing; to know why it takes place, is another; and the expression of the observed regularity, as a general proposition reached by induction, becomes the substitute for the definition required by science in the strict sense.⁵⁴

Furthermore, there is *prima facie* sheer equivocation between the use of the word “science” to name the mode of inquiry explained by the Aristotelians and various modern uses of the word.⁵⁵ Nonetheless, noting *prima facie* equivocation in uses of this term or even proposing certain systematic equivocations or analogical uses of the term does not settle the issue as to whether and (if so) how Aristotelian natural science and its object of inquiry is continuous with the object and mode of inquiry of the modern sciences.

1.4 *On the natural path in our knowledge; the second syllogism (184a16–a24)*

In addition to its own proper mode of demonstrating, natural science possesses its own mode of proceeding.⁵⁶ The second half of *Physics* I.1 is where Aristotle presents this order

53. De Koninck, “Abstraction from Matter,” I:138.

54. Ibid., I:139. Here De Koninck clearly has in mind the distinction between *quia* and *propter quid* demonstrations discussed by Aristotle in *Posterior Analytics* II.13, or what the medievals called the “demonstrative regress.” See Wallace, *The Modeling of Nature*, 300–308.

55. De Koninck, “Abstraction from Matter,” I:134.

56. See McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 11–12.

of procedure, the “natural path.” In this chapter of the *Physics*, Aristotle restricts himself to an argument which depends only upon certain ideas knowable from logic and three signs from common experience. This portion of the chapter is also structured by a syllogism: The natural path in human knowledge is to proceed from the more known to us to what is more known by nature. However, to proceed in this way is to proceed from the confused to the distinct, which is to proceed from the universal to the particular. Thus, the natural path in human knowledge is to proceed from the universal to the particular.⁵⁷ I will examine premises and conclusion in turn before considering them in light of the three signs.

The minor of the second syllogism

The text of Aristotle containing this minor premise is as follows:

The natural path is to go from things which are more known and certain to us toward things which are more certain and more knowable by nature. For the more known to us and the simply knowable are not the same. Whence, it is necessary to proceed in this way, from what is less certain by nature but more certain to us toward what is more certain and more knowable by nature.⁵⁸

The opposition in this premise is between what is more certain and knowable to us (or qualifiedly) and what is more certain and knowable to nature (or simply). This premise can be defended both from logic and metaphysics.

The logical defense is from the nature of inquiry. The natural path in our knowledge is to go from the more known to the less known; however, to go from the more known to the less known is to go from what is more known to us to what is more known by nature; therefore, the natural path is to go from what is more known to us to what is more known by nature.⁵⁹ The first premise here is a point as old as the *Meno* and the first lines of the *Posterior Analytics*:

57. See McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 30, and St. Thomas, *In Phys.*, lib. I, lect. 1, n. 6 (Leon.2.5).

58. Aristotle, *Physics*, I.1, 184a16–21.

59. St. Thomas, *In Phys.*, lib. I, lect. 1, n. 7 (Leon.2.5).

learning only comes about from knowledge held beforehand. It is naturally impossible to learn from nothing, and we can only come to know something based upon what we know already. The second premise of this argument makes clear that this proceeding from what we know to what we do not know has a certain character. What is less known to us is the object upon which we depend for further knowledge, namely “nature.” This premise is clear from discussions such as those in the *Theatetus* or the treatment of how we arrive at first principles of demonstration in *Posterior Analytics* II.19: we realize that our mind is not the measure of things, but the other way round, and depends upon the natures of things for an increase in knowledge.⁶⁰ To this extent, then, Aristotle’s minor premise can be accepted on the merits of logical doctrine alone, without the need for metaphysical argument as such.

St. Thomas explains the deeper reason why what is less known to us is to be identified with what is more known by nature, or more knowable simply speaking. These latter are the separate substances, which are more in act and hence more knowable.⁶¹ This deeper explanation of the truth of the minor premise, in one respect, is clearly *a fortiori*.

What is more knowable to us is the sensible world and that what is more knowable in itself is spiritual reality. However, [St. Thomas] does not point out that within the realm of the sensible world, our knowledge proceeds from that which is more potential and consequently less knowable in itself toward that which is more actual and consequently more knowable in itself. Actually this point comes up in the [major] premise where we learn that the process is from the more universal to the particular.⁶²

60. This latter connection is drawn out by Robert Bolton, “Two Standards for Inquiry in Aristotle’s *De Caelo*,” in *New Perspectives on Aristotle’s De Caelo*, ed. Alan C. Bowen and Christian Wildberg (Leiden/Boston: Brill, 2009), 12–13. The process of moving from the more known to us to the less known, if taken as a kind of dialectical investigation, does not automatically translate into a parallel procession from the less known to the more known by nature. What gives the process this character is following the non-dialectical strictures of thinking given in the *Posterior Analytics*, viz., resolution to explanatory principles.

61. St. Thomas, *In Phys.*, lib. 1, lect. 1, n. 7 (Leon.2.5).

62. McMahon, “The Prooemium of the *Physics* of Aristotle,” 34. What McMahon calls the “minor” premise is actually the major premise, for its predicate is the predicate of the conclusion, and its subject is the predicate of the other premise (the actual minor). I have therefore inserted the emendation to maintain the consistency of my presentation.

That is, while it is true that the separate substances are more in act and hence less intelligible to us, while being more intelligible in themselves, what is more to the point for natural science is the levels of greater and lesser intrinsic intelligibility in natural things themselves. This sustains the minor premise.

The major of the second syllogism

The major premise is expressed in Aristotle's text as follows:

But the things which are first obvious and certain to us are rather confused, and from these, the elements and principles become known later by dividing them. Whence, it is necessary to go from the universal to the particular.⁶³

That is, to proceed from the more known to us to what is more known by nature is to proceed from the confused to the distinct. St. Thomas' exposition of this premise focuses on explaining the implied connections: from the *notiora nobis* to the *notiora naturae*, from the confused to the distinct, and the from universal to the particular. A general logical argument can serve here as my preface: the general must come before the specific in our knowledge because more comprehension means that a term has more actuality. The proof of this is that the integral parts of the more specific term are terms which possess greater extension, so that the term with greater comprehension cannot be known without those parts being known. The more extensive term of necessity must be known beforehand.

St. Thomas explains the connection between "proceeding from the confused to the distinct" and "proceeding from the universal to the particular" by first explaining the reason why the human intellect begins in a type of confusion, and then explaining why this type of confusion is that of a universal.⁶⁴ First, St. Thomas notes the meaning of "confused" in this premise. It does not mean a state of mind where someone is ignorant of their error or unsure, but rather an indistinct grasp of some thing. This means that a "confused" grasp in

63. Aristotle, *Physics*, 184a21–24.

64. St. Thomas, *In Phys.* lib. I, lect. 1, n. 7 (Leon.2.5).

this sense is truthful, albeit “indistinct.” (Hence, I will use the word “indistinct” from now on, to avoid confusion.) His argument is that our intellect naturally proceeds from potency to act. Hence, when we proceed from what is more known to us to what is more known by nature we move from potency to act. This does not only mean that we lose the potentiality for grasping knowledge by gaining actual knowledge but, more directly to the point, what we grasp at any stage compares as potency to stages in knowledge which are posterior in order. Any achievement of knowledge is knowledge in act; but this is insufficient to explain Aristotle’s premise. What is required is that the known thing itself be actually grasped yet still be in potency in some other respect. That is, the mind “proceeding to” an object *already* indicates a level of actuality, hence St. Thomas’ explanation of the premise is not focused on the mind going from potency to act simply (the mind not thinking, then thinking), but in a qualified way (an object potentially knowable, then actually known). For example, to a beginner in geometry who has learned the definition of a right angle, a triangle, and Euclid’s fifth postulate, the actual knowledge that all triangles have interior angles which sum to two right angles is held in an indistinct and potential way. Somebody could point out the diagram for the proposition and he could understand the claim of its enunciation, but the actual truth of the enunciation would elude his distinct grasp. This knowledge of Euclid I.32 would be attained once the beginner resolved the enunciation to the principles and elements of geometry, either by proceeding didactically (by synthesis) through the text, or by attempting through discovery (analysis) to arrive at a proof of the proposition. An indistinct object is known before the distinct object because the intellect becomes the thing it knows, and hence, because a more distinct object has more actuality, the intellect must begin discursively with objects which are more in potency, since it cannot be adaequated without medium to the more distinct object.

Now, this proceeding from an indistinct to a distinct grasp of its object is nothing other

than for the intellect to proceed from what is more universal to what is less universal.⁶⁵ A universal is indistinct because it contains its species within itself in potency or indistinction. This is not to say that species are alloyed together within a more universal conception, but that when one knows only the more universal, one's knowledge of its species is indistinct. To make a distinction is to actualize one's potential knowledge of what the genus contains within it. Because a knowledge of a thing in potency is prior to a knowledge of that thing in act, and because to know animal is to know man in potency, animal is known in act prior to knowing man in act.

However, to know something indistinctly and then distinctly may not seem coextensive with knowing what is more universal and then what is less universal. Some attention to the proper aspect of indistinction and universality is required. For instance, one can grasp that a triangle necessarily has an interior angle sum (because it is a figure) without knowing what that sum is. Hence, one grasps the more generic idea of having such a sum before one grasps the more specific sum which universally belongs to triangle. In the interim there is a demonstration required, an act of reasoning and not simply understanding, that connects the two predicates whose relative universality and distinctness we are now considering. It is not as if one grasps triangle in general first and then discovers a species of the thought of triangle which possesses this property. Indeed, without grasping indistinctly *that* the triangle must have such a property, one would not understand what the property is even in its specific character. The procession from more to less universal is from a more to less universal grasp of that very property itself, and the prior stage does not compare to the posterior as false to true but as indistinct to distinct.

65. Ibid.

Three examples of the natural path (184a25–b14)

Aristotle's three examples at the end of *Physics* I.1 are meant to illustrate that we must first know the indistinct before the distinct as well as the fact that greater indistinction is proportional to greater universality.⁶⁶ St. Thomas explains this text by appealing to the understanding of various types of "wholes," the composed whole, predicable whole, and potestative whole.⁶⁷ Aristotle's text, providing examples towards this same end, is as follows.

For the whole is more known according to sensation, and the universal is a certain whole. For the universal embraces many things within it as parts.

In a way, the same thing happens in the relation of a name to its account. For the name signifies indistinctly some whole, as "circle" [does], but the definition of this divides into the single parts.

And children at first call all men "fathers" and all women "mothers," but later they distinguish each of them.⁶⁸

To understand Aristotle's first example, about the sensible whole, St. Thomas indicates that the Stagirite is drawing upon a likeness between the composed and universal wholes.

66. St. Thomas, *In Phys.*, lib. 1, lect. 1, n. 9: "Deinde cum dicit: *Totum enim* etc., manifestat propositum per tria signa." (Leon.2.6) See Aristotle, *Physics*, I.1, 184a24–b14.

67. The sources for this doctrine can be found in Aristotle's *Metaphysics*, V.25–26, as well as in Boethius' *De Divisione*; for the latter see McMahan, "The *Prooemium* of the *Physics* of Aristotle," 37ff. St. Thomas, along with many other commentators, regularly distinguishes between three types of wholes at this juncture: composed wholes, universal wholes, and the potential or potestative whole; see St. Thomas, *De Spiritualibus Creaturis*, a. 11, ad 2um; *In I Sent.*, d. 3, q. 4, a. 2, ad 1; and *ST*, Ia, q. 77, a. 1, ad 1. Each type of whole is opposed to its own type of part. The composed whole includes both sensible wholes such as integral or quantitative wholes (as stones are the parts of a whole wall) as well as the essential whole (a thing's whole nature or essence, whether in reality, the parts being matter and form, or logically, the parts being genus or species). The composed essential whole could be considered an "intelligible whole," but this must be distinguished from the use of "intelligible whole" that seems equally applicable to the universal whole. The universal whole is also called the predicable whole: triangle is this sort of whole, with its species as parts. The potestative whole is a mean between the composed whole and the universal whole. The reason for this is that the universal whole is present to any of its parts with its whole essence and power, and hence can be predicated of its part, since this presence allows for predicable identity. That is, an equilateral triangle *is* a triangle, lacking nothing of the essence of triangle and nothing of what the triangle is prior to specification by the difference "having all sides equal." The composed whole is *not* present to its parts with its whole essence and power. So, the stone in a wall is not, in its essence, a wall, and neither does it have the power or virtue of a wall (it cannot shield from the elements like a wall or be the side of a house). The potestative whole is present to its parts as to its whole essence but not as to all of its power. The soul is such a whole. Its whole essence belongs to each of its parts or faculties but not its whole power. Thus, the faculties of the human soul are specifically human, but each power does not share in the whole power of the rational soul.

68. Aristotle, *Physics*, I.1, 184a24–b14.

Just as a sensible, integral whole is known prior to a distinct knowledge of its parts, so also a universal whole is known prior to a distinct knowledge of its parts. At first, we apprehend a painting or “take in” a crowded room as a whole. We later see the details and meaning of the arrangement of the painting’s parts as distinct parts of the whole work, and we only later notice the individuals in a room as related to the crowd as a whole—seeing that they are divided into social groups or circles of friends. It seems important to add that the example is driving at knowing a part *as such*; we could be struck by a particularly conspicuous color or figure in the painting, or our eyes could be drawn immediately to the woman in the red dress in a crowd, but such examples merely show that our attention can be captured by some whole as such which is only later compared to a larger whole of which it is a part, not that we see the conspicuous part *as part* of the whole prior to the whole itself *as its whole*. To see the part as part we must know it in relationship to its whole: e.g., we find that the conspicuous figure is indeed the focal point of the painting or that the woman in red is actually the toast of the party. Analogously, we do not know species as parts until we know them in relationship to their generic wholes. A true neophyte in geometry exposed only to figures of equilateral triangles would not know them as such, but see in them only “triangle.” Hence, “the integral whole and the universal whole agree in this, that each is confused and indistinct.”⁶⁹

Aristotle’s second example, using the circle, takes a composed whole as its basis, but this time not an integral whole (something that can be sensed), but the definitional or intelligible whole.⁷⁰ We know the *definiendum* indistinctly and prior to knowing its *definiencia*. Triangle or circle are known indistinctly prior to realizing their defining parts. St. Thomas raises the objection that knowing the “name” prior to the “account” seems to illustrate the opposite of what Aristotle intends, for what defines a thing is more universal than it, and without

69. St. Thomas, *In Phys.*, lib. 1, lect. 1, n. 9 (Leon.2.6).

70. *Ibid.*, n. 10 (Leon.2.6).

knowing these one could never know the thing to be defined.⁷¹ St. Thomas' solution implies the distinction between knowing something in itself and knowing it as a part. A beginning geometer would grasp "figure" and "line" and "equal" prior to seeing the definition of triangle or circle, and hence he could use this prior knowledge to know the definitions of those specific figures. However, the things named by "triangle" or "circle" he would grasp indistinctly, prior to clearly resolving the (in themselves more universal) parts of its definition.⁷² In this way, Aristotle's example still implies that what is more universal is known prior to what is less universal (the defining parts are known prior to the defined). The circle example specifically adds the feature that even universal conceptions, as types of integral wholes, are known indistinctly at first (thus, e.g., one would be unable to distinguish what "circle" names, when presented with an oval and a circle).⁷³

The third example, and the most potent for illustrating the mode of proceeding in natural philosophy when seen in light of the prior two, is the example of children at first calling all men "fathers" and all women "mothers." First, note that the double accusative construction

71. Ibid., and see also Aristotle, *Topics*, VI.4, 141a24–142a9.

72. St. Thomas, *In Phys.*, lib. 1, lect. 1, n. 10 (Leon.2.6).

73. Here I note that Ross provides such an interpretation which sheds more light on Aristotle's example, viz., that the name itself may vaguely or indistinctly name things which have various specific accounts, the way the general word $\acute{\omicron}$ κύκλος names various round things. The resolution of this name then draws out the distinction between the various things named indistinctly. See Aristotle, *Aristotle's Physics*, ed. W. D. Ross (Oxford: Clarendon Press, 1955), 457–58. Coughlin also follows this line of thinking, see Aristotle, *Physics*, "Appendix 1: Method in Aristotelian and Modern Philosophy," 208. This would help answer another objection, viz., that we know what is particular or individual before we know its general commonality with other things, a position taken by John Locke, *An Essay Concerning Human Understanding*, ed. Peter H. Niddich (Oxford: Oxford University Press, 1979), III.3.6–10. Locke's process of deriving more universal ideas depends upon modeling our knowledge of singulars after the integral intelligible whole: the child knows its nurse in all her composedness, and this is the idea of his nurse. By a comparison with other singulars, the child is then able to realize that not all the integral parts of the idea of his nurse coincide with other individuals, and these smaller groups of coincident parts become more general ideas. The general idea left over is thus what was previously a part of the integral whole of the most particular notion. Locke's mistake, then, is conflating the universal whole as a predicable whole and the universal insofar as it is an integral, intelligible whole expressed by a definition. This mistake logically follows upon his failure to distinguish sense knowledge from intellectual knowledge. For a consideration of the inconsistency in Locke's thinking and his implicit presupposition that we begin with vaguer ideas before arriving at the more distinct, see Thomas Hill Green, *Hume and Locke* (New York: Thomas Y. Crowell, 1968), 21–33, in particular 32–33.

of this sentence is in the plural: all *men* are called *fathers* and all *women*, *mothers*.⁷⁴ Hence Coughlin's translation is to be preferred.⁷⁵ The different translations highlight two possible interpretations: is the child misusing a proper name or a common name? Does the example mean to indicate that the child calls any and every man he meets by the name correctly applied only to *his own* father, or that the child calls any and every adult male *a father*?

The former interpretation is that suggested by many commentators: Simplicius, Averroes, St. Albert, St. Thomas, Ross, and Apostle.⁷⁶ The latter interpretation is suggested by Coughlin. This less popular interpretation of Aristotle's example provides clearer support for a point I wish to substantiate through this dissertation, while the former interpretation is more harmful at first. Coughlin comments:

At first, children refer to all men as "fathers," and even refer to adult male animals this way, e.g., "There's a daddy bear." Later, having distinguished being an adult male from an adult male with offspring, they use the name daddy or father for the latter. Earlier, they had confused the notions of adult male and of male parent under a single name; now they distinguish them.⁷⁷

Coughlin's interpretation highlights that, while the child's use of the name contains true and false uses, the use still depends upon an indistinct conception which is, in itself, not fundamentally false, viz. the idea of adult males. The specificity of the name leads the child to say more than the truth, yet only by being based upon a fundamentally true insight into

74. Aristotle, *Physica*, 184b12–14.

75. Sachs translates "Children too at first address all men as father and women as mother" See Aristotle, *Aristotle's Physics*, 33. Apostle has "Children, too, at first call every *man* 'papa' and every woman 'mama,'" See Aristotle, *Aristotle's Physics*, trans. Hippocrates G. Apostle (Grinnell, Iowa: Peripatetic Press, 1980), 8. Hardie and Gaye have "Similarly a child begins by calling all men father, and all women mother" See Aristotle, *The Complete Works of Aristotle: The Revised Oxford Translation, Vol. 1*, ed. Jonathan Barnes (Princeton, NJ: Princeton University Press, 1984), 315.

76. Simplicius, *In Phys.*, CAG, 9.17:14–18; Averroes, in Aristotle, *Aristotelis de Physicu Auditu Libri Octo. cum Averrois Cordubensis Variis in Eisdem Commentariis*, vol. 4, Aristotelis opera cum Averrois commentariis (Frankfurt am Main: Minerva (Venitiis apud Junctas), 1962), lib. I, cap. 3, 8G; Albert the Great, St., *Alberti Magni Opera Omnia v. 3, Physicorum lib. VIII.* (Parisiis: Vivès, 1890), I.vi.13. See also St. Thomas, *In Phys.*, lib. 1, lect. 1, n. 11 (Leon.2.6). See, finally, Ross's comments in *Aristotle's Physics*, 457 and Apostle's *Aristotle's Physics*, 187.

77. Coughlin, Aristotle, *Physics*, "Appendix 1: Method in Aristotelian and Modern Philosophy," 208.

adult males. The distinction which the child makes later does not cause him to reevaluate this fundamental insight but only its reach in comparison to the definition of the name he had been using. This insight is also illustrative of the thesis Aristotle is proposing, for “adult male” is obviously more general than “adult male with offspring.”

By contrast, the more popular interpretation seems to leave the child making a rather foolish and almost unbelievable mistake, that is, that a child with the use of speech simply cannot distinguish his parents from other adults. This is a rather systemic error—this child’s error is more widespread than the former’s. Taken as an interpretation of the example, this leaves us with a negative image of progress in natural science.

Perhaps these two interpretations can be reconciled by considering commentators’ frequent remark that this example illustrates how the mind proceeds in its knowledge of universals, both as to place and as to time.⁷⁸ That is, even in the order of sensible knowledge, we grasp the more universal aspect of a thing before its more specific character.⁷⁹ This can occur in the order of both place and time. If we see something in the distance, we know it is a thing, and if we see it moving toward us, we think it some kind of animal, and then see it is a man, and finally see that it is our friend whom we can name. Likewise, over time, the child in Aristotle’s example gradually distinguishes his experience and arrives at the correct use of a name (whether as a common name or a proper name).

What is important about this emphasis on the interaction, through place and time,

78. St. Thomas, *In Phys.*, lib. I, lect. 1, n. 11 (Leon.2.6). His example of an approaching figure is also given by Simplicius (see *In Phys.*, CAG 9.16:18–20, and St. Albert (who notes he is drawing it from Avicenna, see *Physicorum*, I.vi.15). McMahon also points out a passage from Lord Russell who describes a similar process from the indistinct to the distinct; see McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 53–54. De Koninck later draws upon the same text of Russell’s: see De Koninck, “The Unity and Diversity of Natural Science,” 6. Vincent E. Smith, *Philosophical Physics* (New York: Harper, 1950), 23, has another helpful example: “A visual spotter of aircraft during the war would see a plane first as an object in the sky. When it came closer, he would see it as a plane. A little closer in, he could tell whether it was multi-engined or not, and later on, he could see what kind of plane it was. Finally, when closer still, the plane could be identified by its number, and its individuality could be established.”

79. McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 53: “It will be recalled that the first sign was based on a sensible integral whole. This one is based on a sensible potential whole.”

between our universal conception of sensible things and the correct use of names is that it images the practice of natural philosophy. The child using and misusing the name as a proper name gives us an instance of the development of sense knowledge insofar as it is related to universality. The child using and misusing the name as a common name gives us a clearer instance of the progress of conceptual knowledge itself. Both interpretations therefore illustrate a progression from indistinct to to distinct knowledge, and only in both interpretations do we see an image of progress in natural philosophy.

On the one hand, just as the child using a proper name names things based on an indistinct, primitive, and more extensively erroneous grasp of sensible accidents, so also the natural philosopher begins to name natural beings primarily through their sensible accidents and can frequently err.⁸⁰ On the other hand, just as the child using a common name names things based on an indistinct yet primarily correct grasp of what the thing is, so also the natural philosopher must begin his understanding from a fundamentally correct basis and proceed to make distinctions and progress in his understanding. Because this progress takes place by resolving his judgments to the sensible world, the commentators focus upon sensible universals judged over place and time. The natural philosopher must integrate his more general conceptual knowledge with more detailed experience of the world.

The order of Aristotle's examples is therefore as follows.⁸¹ The order of examples is itself an instance of Aristotle's very method of proceeding from what is more known to us (the order in our knowledge about sensible things) to something lesser known (the order in our knowledge about universals) and lastly to what is least known (the order in our knowledge about universal wholes insofar as we sense, name, and define them). That is, Aristotle's first example is a comparison between the composed, integral whole to the universal, predicable whole (and therefore from the more to the less known). In this, the general point is made

80. Simplicius, *In Phys.*, CAG 9.17:14-25.

81. McMahon raises this question of order but does not answer it, "The *Prooemium* of the *Physics* of Aristotle," 53.

that our intellectual progress is from what is more to less universal. The second example is a comparison between our understanding of a name (which is something sensible) to a clear conception of the name's account (which is something intelligible). This example shows there to be a procession from more to less universal, viz., from the confused understanding of the meaning of the name to a clear understanding of the constitution of that name's account. The third example combines both of these features: it exemplifies the progression from more general to more specific concepts while simultaneously achieving a more adequate use of naming by improving our grasp of the definition of those concepts. The two possible interpretations of the child add complexity to this example and show us an image of the natural philosopher at work.

Concluding remarks on the second syllogism

The natural philosopher therefore has a natural beginning and mode of proceeding; he is placed by nature as a knower in the natural order not only of things but of what he can know. This natural order is in striking contrast to the artificial orders relied upon in modern mathematical sciences. Yet why is Aristotle's argument about the "natural path" not just naive optimism? What prevents "common sense" knowledge of the universe from being deceived in unforeseeable ways, as it was prior to the rise of Copernican astronomy?⁸²

To this objection, Aristotle's use of a child's speech in his last example is telling. Simplicius seizes upon this image and paints a more negative picture of the natural philosopher's quest for the principles, causes, and elements of natural things. He views the child as a foolish and ignorant thing.⁸³ However, such an interpretation is not necessary. Aristotle would have been well aware that, as Heraclitus said, "Man is called childish compared with divinity, just

82. Benedict M. Ashley, "Aristotle's Sluggish Earth," *The New Scholasticism* 32 (1958): 2-3.

83. Simplicius, *In Phys.*, CAG 9.17:14-25.

as a boy compared with a man.”⁸⁴ Naturally possessing knowledge of what is most intelligible in itself belongs only to God. The natural philosopher is as a child in this arena. Instead of betraying pessimism or naiveté about the project of natural philosophy, Aristotle’s example can be read as a calculated attempt to set the beginner on the right track.

In this light, it is important to see that Aristotle’s examples can all be seen as proposing not confused and erroneous conceptual insights but fundamentally correct ones. The difficulty of properly beginning the study of nature, then, is to attend to fundamental or primary experience and not to what is primitive and fallible.⁸⁵ As a consequence, the natural path which Aristotle indicates is not a foundation that is in principle unsound. While it does not eliminate the possibility of error, it contains the only ineradicable ground of natural philosophical knowledge.

1.5 *On the character of the natural path*

This natural road in our knowledge possesses a certain character within natural philosophy. First, while it entails an *a posteriori* mode of demonstration, the procession from what is better known to us to what is better known in itself or by nature primarily indicates what is called the manner of determination, not demonstration. While this natural road begins with what is certain because of its very indistinctness, this beginning still has an appropriate level of determination that leads to further knowledge. Second, this natural road proceeds from the more universal to the less universal in predicable wholes. Now, these points require making precisions about various details: vague and indistinct knowledge over and against clear and distinct knowledge, between primary and primitive experience, common and private

84. Heraclitus, DK 79, Kathleen Freeman, ed., *Ancilla to Pre-Socratic Philosophers: A Complete Translation of the Fragments in Diels, Fragmente der Vorsokratiker* (Cambridge, MA: Harvard University Press, 1983), 30.

85. I shall say more about this distinction between “primitive experiences” and “primary experience” in Chapter 6, §23.3. This distinction harmonizes with what De Koninck holds; the terminology I draw from Van Melsen; see Andreas Gerardus Maria Van Melsen, *The Philosophy of Nature*, 3rd ed., Duquesne Studies. Philosophical Series, 2 (Pittsburgh: Duquesne University, 1961), 12–15, 28–30.

experience, determination and demonstration, and words and symbols. These details will be treated in Chapter 6.

1.6 *Finding the first moved mover*

I note three consequences, based on the above, that constrain the argument in this dissertation. First, our knowledge of the first moved mover must be derivable from within the givens of common, primary experience. Second, this discovery must fall within the parameters of the subject, principles, and properties which natural philosophy studies at this level of generality, prior to further progress to a more specific study. Indeed, it is a common view among Thomists that, along its investigative arc, “natural philosophy discovers its own limits.”⁸⁶ The investigative arc proper to natural philosophy does not dead-end: it turns upwards into the realm of what has no matter and downwards into the realm of cosmology and the other parts of natural science.

Finally, the characteristics of the natural path must not only be compatible with the interface between a general philosophical investigation of the first mobile and a more particular investigation, but these characteristics of the mode of proceeding of natural philosophy, taken together with the manner and content which general natural philosophy demonstrates, must support an architectonic or sapiential function belonging to general natural philosophy.

86. Benedict M. Ashley, “St. Albert and the Nature of Natural Science,” in *Albertus Magnus and the Sciences: Commemorative Essays 1980*, ed. James A. Weisheipl, vol. 49, Studies and Texts, Pontifical Institute of Mediaeval Studies (Toronto: Pontifical Institute of Mediaeval Studies, 1980), 102.

§2 THE REALITY OF MOTION IS ASSUMED BY NATURAL PHILOSOPHY; NONETHELESS, IT DEFENDS THE REALITY OF MOTION AND THEREBY DEFENDS ITS OWN EXISTENCE WHILE DISCOVERING ITS FIRST ULTIMATE CAUSE. (*Physics*, BOOK I.2–9)

Not to think I'm turning into some kind of patricide. . . . In order to defend ourselves we're going to have to subject father Parmenides' saying to further examination, and insist by brute force both that *that which is not* somehow is, and then again that *that which is* somehow is not.

PLATO, *Sophist* 241d

Aristotle's opening argument in *Physics* I.1 assumes the existence of natural science.⁸⁷ Besides the Platonic objection against this assumption (one regarding our knowledge: that we cannot have science of moving things), there is the Eleatic objection against natural philosophy (one regarding the being of things: that moving things cannot exist). Here I will consider this Eleatic objection more closely and answer it (§2.1).

Aristotle's *via media* steers between Eleatic quietism and Heraclitean pankineticism. Philoponus notes that Aristotle's overall strategy also finds a *via media* between Parmenidean-Melissan monism and Anaxagorean infinitism. In this sense, the whole discussion is framed by the initial division of the possible number and type of the principles: either one or many, and if one, mobile or immobile; if many, then either finite or infinite.⁸⁸ After eliminating monism and infinitism, the remaining option is to determine what finite number the princi-

87. See above, p. 30. The opening syllogism was as follows: In every inquiry in which there are principles, causes, and elements, one has understanding and science from knowing the principles, causes, and elements. However, natural science is an inquiry in which there are principles, causes, and elements. Hence, natural science gives us understanding and science when its principles, causes, and elements are known. As McMahon, "The Prooemium of the *Physics* of Aristotle," 27, tells us, "The minor premise then, as stated by St. Thomas is presupposed by Aristotle in the Prooemium. There is a science of nature. The possibility of a science of corruptible beings is proven in the *Posterior Analytics* and the possibility of absolute change is proven in the First Book of the *Physics*."

88. Aristotle, *Physics* I.2, 184b15–22. Consider also Philoponus, *On Aristotle's Physics 1.1-3* 41–42 and 52–53.

ples are. The way forward is found through common notions and common agreement about change.⁸⁹

Aristotle is led to the solution through an innocuous route of analyzing the necessary parameters of speech about change—does this effect a discovery of real principles of being?⁹⁰ His conclusion clearly implicates certain axioms, incorporating what is recognized—as if intuitively—about what is *per se* or natural to change.⁹¹ For instance, the solution to the aporia recognizes that “it is impossible that the contraries suffer by each other,” and hence the difficulty “is solved by the other being the underlying.”⁹² Famously, this underlying nature is not directly knowable. “Primary matter” can be grasped only in its relationship to what comes into being.

Consequently, Aristotle solves the paradox by manifesting the principles of mobile beings.⁹³ Aristotle then places his solution in the context of the definition of nature, as an intrinsic principle and cause of motion and rest; finally, in logical sequence, he defines the very being of motion, since ignorance of motion is ignorance of nature, for nature is a principle and cause of motion and rest.⁹⁴ Consequently, Books I–III form three stages of a complete answer to the Eleatic problem.⁹⁵ Considered in respect of the integral parts of a science,

89. Philoponus, *On Aristotle's Physics 1.1-3*, 54–55; see also Simplicius, *On Aristotle's Physics 1.5-9*, trans. Han Baltussen et al., *Ancient Commentators on Aristotle* (London: Bristol Classical Press, 2012), 20, 23.

90. David Bostock, *Space, Time, Matter, and Form: Essays on Aristotle's Physics*, Oxford Aristotle Studies (Oxford/New York: Clarendon Press/Oxford University Press, 2006), objects, 4: “This doctrine, properly understood, has the sort of generality which one might expect to result from a purely conceptual investigation, and there is no denying that most of the discussion in chapter 7 seems to be conducted on a conceptual level, indeed one that pays much attention to the niceties of linguistic usage.”

91. Aristotle, *Physics*, I.7, 190b17–29.

92. *Ibid.*, 190b33–34.

93. St. Thomas notes that Aristotle clearly intends to draw the conclusion that these principles are principles of both being and becoming; see *In Phys.* lib. I, lect. 13, n. 2: “Et notandum est quod hic intendit inquirere principia non solum fiendi, sed etiam essendi: unde signanter dicit ex quibus primis sunt et fiunt.” (Leon.2.45) This is against other interpretations; see Bostock, *Essays on Aristotle's Physics*, 1–2, who maintains that Aristotle is only interested in the principles of change.

94. Aristotle, *Physics*, III.1, 200b12–15.

95. I return to the idea of this three-stage progression below also, see pp. 92 and 109. I draw out these three stages from a point Brague makes, that it is only with the definition of motion in Book III that Aristotle achieves a complete reply to Parmenides; see Rémi Brague, “Aristotle's Definition of Motion and its Ontological Implications,” *Graduate Faculty Philosophy Journal* 13, no. 2 (1990): 1–22; see 3: “Hence,

these first three books respectively manifest the existence of the subject of physics, specify the principles of this subject through the exposition of nature, and complete our understanding by defining motion, which is the central property about which natural philosophy concerns itself.

Indeed, the “fundamental problem of natural philosophy” initiated by the Greek tradition is to explain motion on a cosmic scale.⁹⁶ The study of physics begins with the existential fact of motion, nature, and their definitions; the existence of motion is our initial phenomenological grip on the universe as an indistinctly known whole.⁹⁷ Without defending the existence of motion as an assumption, we would fail to answer the original question—the question at the origin—of natural philosophy. It is at the origin of the study because it is *naturally* the first question (§2.2). (How this stage of the inquiry belongs to general natural philosophy is a question answered in §2.3.) The question concerns the rational conceivability of the existence of motion, for it seems irrational to Parmenides, an irrationality to which Heraclitus surrenders and Plato avoids only through “brute force” exerted upon the concept of being and non-being. The natural answer resolves to principles of motion that we must claim are perennially sound discoveries so as to contribute in the appropriate way to the goal of this project, defending general natural philosophy as a type of wisdom.⁹⁸

motion for Parmenides is not worthy of being. In the face of Eleatism, Aristotle’s project is to reintegrate motion into being and, in order to do so, to show that it can be defined. This at least is what lies, it seems to me, in the background of Aristotle’s attempt, for the Philosopher does not make his intention explicit.”

96. Auguste Mansion, *Introduction à la physique aristotélicienne*, 2. éd., revue et augm, Aristote: traductions et études (Louvain: Éditions de l’institut supérieur, 1946), 65: “Voilà donc le problème fondamental de la philosophie de la nature: expliquer le devenir cosmique. Et on peut y ajouter cette spécification: découvrir le ou les principes qui sont à la base de ce devenir; c’est à cela, en effet, que revient en fait toute explication de ce genre.”

97. See St. Thomas, *In Phys.*, lib. I, lect. 2, n. 7: “Est autem necessarium motum supponi in scientia naturali, sicut necessarium est supponi naturam, in cuius definitione ponitur motus; est enim natura principium motus, ut infra dicetur.” (Leon.2.9)

98. On this method, recall above, pp. 21 and 28.

2.1 On the intelligibility of mobile being

The Eleatic problem is the one which denies what hylomorphism presupposes, viz. that substances come to be in various ways.⁹⁹ How substances come to be is the original question in natural philosophy. The terms of the solution must obtain intuitive clarity not just at a logical level but at a real level; the theory must propose the adequacy-conditions for change.¹⁰⁰ Aristotle's solution therefore avoids the logical difficulties in a Heraclitean solution as well as the ontological difficulties in a Kantian transcendental phenomenalism.¹⁰¹ The problem can be given in two formulations: the Parmenidean or Heraclitean.¹⁰²

Aristotle states the Parmenidean formulation in *Physics* I.8, the text where he also asserts that his is the only solution.¹⁰³ This formulation focuses on the opposition between being and non-being and the impossibility of their simultaneous being-together in motion. This formulation is "static" because its conclusion is that being is one and immobile.¹⁰⁴ Because Parmenides maintains that "it is the same thing to think and to be,"¹⁰⁵ the contradiction appearing in speech is imputed to the being of things; the fundamental law of thought becomes the fundamental way in which things exist.

The Heraclitean formulation differs from the static, Parmenidean formulation.¹⁰⁶ The Heraclitean sees the contradiction in motion as a being, but admits it can exist if things

99. Sean Kelsey, "Hylomorphism in Aristotle's *Physics*," *Ancient Philosophy* 30, no. 1 (2010): 112–16, and in particular 116–17.

100. Sarah Waterlow, *Nature, Change, and Agency in Aristotle's Physics: A Philosophical Study* (Oxford/New York: Clarendon Press/Oxford University Press, 1982), 9.

101. See Kant, *Critique of Pure Reason*, B48–49, A210/B256.

102. See Freeman, *Ancilla to Pre-Socratic Philosophers*, 43 and 31, respectively.

103. Aristotle, *Physics*, I.8, 191a23–33. See also Aristotle in *On Generation*, I.3, 317a33–b6, for a similar formulation of the problem. Aristotle is generally molded in his thinking here from such dialogues as Plato's *Sophist*; it is ignorance of the logic of predication which led the Eleatics to ignorance of the physical world: see Harold Cherniss, *Aristotle's Criticism of Presocratic Philosophy* (New York: Octagon Books, Inc., 1964), 61, 63, 73.

104. Aristotle, *Physics*, I.8, 191a27–33. See also the gloss provided by a student of De Koninck's, Connell, *Matter & Becoming*, 39. This consequence can be drawn from fragments DK 6–8, see Freeman, *Ancilla to Pre-Socratic Philosophers*, 43–44.

105. *Ibid.*, 42.

106. It could be drawn from various arguments Aristotle presents in the *Metaphysics*, Book IV.5, 1010a1–15.

are “substantially” motion; the Parmenidean sees the contradiction and then denies the existence of motion and multiplicity.¹⁰⁷ De Koninck articulates the Heraclitean formulation of the problem as follows:

It is *mobile being as given* which raises a problem in our minds. Apparently, a mobile being is a contradictory being. In order to be, it must be successively other. But if it is always other, how can it be what it is? And if it is not always the same across the succession, how can it succeed itself continuously? Mobile being must be a being which changes and which does not change.¹⁰⁸

The dilemma arises when we inspect the moving thing in respect to its sameness. To be *in motion* the being must be other than it is, but this is clearly impossible. Likewise, there must be some aspect remaining the same about the changing thing, otherwise *that thing* is not changing. Yet then we are really asserting a dualism: a part that stays the same and a continuously other part, which latter is the original problem. Hence De Koninck states, after the passage quoted above, “Are we going to say that mobile being is composed of two parts, one of which changes and the other of which is immobile? This solution is too easy. And yet it is necessary to arrive at a distinction.”¹⁰⁹ This Heraclitean formulation of the problem works well with local motions or alterations, yet it also problematizes substantial change from this very perspective of identity over time: how can we say that this being is destroyed or comes to be if it is always other at any given instant?

107. The Heraclitean commits the error of sensationalism, the Parmenidean, rationalism; see Cherniss, *Aristotle's Criticism of Presocratic Philosophy*, 81, 83.

108. De Koninck, *The Cosmos*, in *Writings*, Vol. 1, 259. De Koninck seems to have been influenced in this Heraclitean formulation of the problem both by Bergsonianism and by a dissertation on Bonaventure's theory of universal hylomorphism written by one of his students, later published; Patrice Robert OFM, *Hylomorphisme et devenir chez saint Bonaventure* (Montréal: Les Éditions de la Librairie Saint-François, 1936); see x–xii of De Koninck's preface.

109. Ibid. This successive otherness prompts some thinkers to propose as a solution the view that motion is simply a succession of “being here's”—a “frame-by-frame” view of motion; Coughlin, “Introduction,” xvii in *Physics*, refers us to the views of Bertrand Russell. This merely restates the problem, for by rendering a thing successively destroyed and generated it can never be the same thing in a real sense. For a consideration of this cinematographic—yet ultimately quietistic—view of motion and the notion of integral calculus required to substantiate it in Russell's thought, see John Francis Nieto, “Continuity and the Reality of Movement” (PhD diss., University of Notre Dame, 1998).

The beginnings of the solution

A solution to this problem must be proposed if one is to save the possibility of a physical and cosmological theory.¹¹⁰ A variety of refutations could be proposed. One is a dialectical refutation that points out a performative self-contradiction. The expression of Parmenides' theory requires a multiplicity in our thinking and speech as beings which he does not grant them. Likewise, the truth of Heraclitus' theory requires a permanence of things expressed which he does not grant them.¹¹¹

Aristotle's solution is found in *Physics* I.5–9. He relies upon six axioms or common notions; noting what these are helps us to realize what Aristotle takes to be more known to us initially along the natural road in our knowledge.¹¹² These axioms preserve the epistemic independence of one's initiation into natural philosophy.

The first axiom is held by all the interlocutors in *Physics*, Book I: nothing comes from nothing. This has also been called the most known principle in the study of nature.¹¹³ An indication of this axiom's epistemic priority is Aristotle's remark that his solution preserves

110. See Friedrich Solmsen, *Aristotle's System of the Physical World: A Comparison with His Predecessors* (Johnson Reprint Corp., 1970), 3, and 5: "Clearly on this basis *no return to physical and cosmological theory was possible*. For this the minimal requirements were the reality of movement and the existence of a plurality of things." My emphasis.

111. See also Aristotle, *Metaphysics*, IV.5, 1010a5–15.

112. Philoponus, *On Aristotle's Physics 1.1-3*, 54–55, who calls some of these common notions "axioms" and "common intuitions." Simplicius calls them axioms also, because they are "views credible on account of their obvious clarity." See Simplicius, *On Aristotle's Physics 1.5-9*, 23, as well as 129–30 about Aristotle's dependence upon axioms. The solution also relies upon basic aspects of experience which Aristotle does not explicitly raise, viz., epistemological realism and the existence of substances and accidents and their changes. See Connell, *Matter & Becoming*, 1–36.

113. Aristotle, *Physics*, I.4, 187a27–29. Parmenides is included because it is the very premise of his dilemma. See also Cherniss, *Aristotle's Criticism of Presocratic Philosophy*, 78; Simplicius, *On Aristotle's Physics 1.5-9*, 139; St. Thomas, *In Phys.*, lib. I, lect. 9, n. 2: "[Anaxagoras] accipiebat communem opinionem omnium philosophorum naturalium esse veram; hanc scilicet, quod id quod simpliciter non est, nullo modo fiat." (Leon.2.27) See John of St. Thomas, *Cursus Philosophicus Thomisticus*, ed. Beatus Reiser (Taurini: Marietti, 1930), (hereafter *Curs. Phil.*, with the volume indicated by Roman numerals, followed by page and line numbers), II:37b44–54: "Et ad investiganda principia ipsa rerum naturalium duplex patet via Philosophiae Secunda ex illo principio notissimo, quod ex nihilo nihil fit per naturam." Hesiod implicitly denies this principle, claims Bolotin, *An Approach to Aristotle's Physics*, 23. However, this poetic or imaginative account is not a viable alternative, for the imaginable is not necessarily indicative of the real or possible, see *Physics* III.8, 208a14–19.

the law of the excluded middle and by implication the principle of contradiction. One cannot assert that something comes from nothing (non-being) without asserting a contradiction.¹¹⁴ This can be seen in comparison to a problem from *Physics*, Book VIII: which substance exists in the “now” of destruction–generation? Taking his lead from this problem, Parmenides could ask us: What being exists in the moment when a being comes from non-being? Is a previously “existing” non-being now simultaneously a being? Or if being passes away, is being in that moment the same as the non-being, and must we now say that non-being exists when the being passes away? In either case, being would both be (viz., be itself) and not be. To assert that being comes from non-being is thus to deny the principle of contradiction.¹¹⁵

The second axiom is the distinction between what is *per se* and what is *per accidens*. Aristotle speaks of what things are “naturally apt” to do or suffer when coming to be by nature and “not accidentally.”¹¹⁶ The third of these common notions is that the principles of change are contraries. Aristotle notes that this opinion is common to all his predecessors.¹¹⁷ They do so reasonably because this realization is rooted in the very notion of what it means to be a principle; viz., the principles of change must be “neither from each other nor from

114. Aristotle, *Physics*, I.8, 191b26–27, noting that “we do not do away with [the claim] that everything either is or is not.” See also Cherniss, *Aristotle’s Criticism of Presocratic Philosophy*, 78. Note that this does not mean that creation *ex nihilo* is a contradiction in terms because “from nothing” has more than one sense. See St. Thomas, *De Pot.*, q. 3, a. 1, ad 7.

115. See Aristotle, *Physics*, VIII.8, 263b9–15. This passage inspired many medieval theological difficulties concerning transubstantiation besides ordinary logical difficulties. Charles De Koninck, “Un paradoxe du devenir par contradiction,” *Laval théologique et philosophique* 12, no. 1 (1956): 49–51, relates the theological difficulties as a concluding section to his discussion of the problem in general. See also Richard Sorabji and Norman Kretzmann, “Aristotle on the Instant of Change,” *Proceedings of the Aristotelian Society, Supplementary Volumes* 50 (January 1976): 69–114; and Paul Vincent Spade, “How to Start and Stop: Walter Burley on the Instant of Transition,” *Journal of Philosophical Research* 19 (1994): 193–221. This further dilemma in Book VIII is a logical consequence to the fact that the Eleatic paradox is not a *problem* for Hegel but rather an *illustration* of his views; see De Koninck, “Un paradoxe du devenir par contradiction,” 9.

116. *Physics* I.5, 188a31–34, 188b25–26; I.6, 189a22–23; I.7, 190b17–20. That this is assumed is clear from what Aristotle says about the principles in *Physics* I.7 as well as the distinction he draws to solve Parmenides’ dilemma in I.8.

117. Aristotle, *Physics*, I.5, 188a19–27. See Cherniss, *Aristotle’s Criticism of Presocratic Philosophy*, 97, who also calls this “Aristotle’s axiom, that interaction can occur only when agent and patient have contrary qualities.”

others, and all things must be from them.”¹¹⁸ However, contraries are such, and most of all first contraries, for “through being first things, they are not from others; through being contrary they are not from each other.”¹¹⁹

The fourth common notion is that a subject is required for change. The defense of this axiom proceeds dialectically and is motivated by realizing that it is not enough to merely have contraries for the principles of change. Contraries cannot work on each other, as such. Moreover, contraries cannot be absolutely first (if contraries are always predicated of something and substance itself is not a contrary).¹²⁰ Aristotle thus announces: “Whence, if someone thinks the first argument is true and this one too, it is necessary, if he intends to save them both, to assume some third thing.”¹²¹ The “first argument” is the position arrived at in I.5, that the principles are first contraries.¹²² Thus, Aristotle supports the idea that change requires a subject, some underlying. While this leaves his proceedings in I.5–6 in aporia (which are the first principles: the contraries or the subject?), they are not without worth because it indicates partial truths leading to the true resolution.¹²³

In the course of his exposition of the aporia, Aristotle indicates two further common notions about principles, their priority and permanence.¹²⁴ Were there a principle of the principles, they would not in fact be first principles, and our analysis would have to proceed further. Did the principles not remain, we would be obliged to seek for an explanation for their failing or running out through some other principle or limiting factor.

118. Aristotle, *Physics*, I.5, 188a27–28.

119. *Ibid.*, 188a29–30. See also St. Thomas, *In Phys.*, lib. I, lect. 10, n. 3 (Leon.2.33–34).

120. Aristotle, *Physics* I.6, 189a21–34.

121. *Ibid.*, 189a34–189b1.

122. St. Thomas, *In Phys.*, lib. I, lect. 11, n. 12 (Leon.2.38–39). See also *ibid.*, n. 9: “Videtur ergo quod oporteat poni aliquod tertium, quod sit subiectum contrariorum, ad hoc quod ex contrariis alia possint fieri.” (Leon.2.38) Kelsey calls this the problem of production; “The Place of I 7 in the Argument of *Physics* I,” *Phronesis: A Journal of Ancient Philosophy* 53, no. 2 (January 2008): 188–91; he helpfully cites *On Generation Corruption*, 323b25–29. See also Waterlow, *Nature, Change, and Agency*, 10–11, who indicates the strength of this aporia.

123. See Kelsey, “The Place of I 7 in the Argument of *Physics* I,” 191–92.

124. Aristotle, *Physics*, Book I.6 189a19–20: “But the principles must always remain,” and compare 189a29–30: “But the principle must not be said of something underlying. For there will be a principle of the principle.”

However, these axioms are useless if one does not already grant the existential premise that substantial and accidental changes exist. Yet would this assumption beg the question? It is not question-begging because the Eleatic problem itself assumes the existence of such changes only to deny it based upon a supposed incoherence: if substantial change or change generally exists, then there would be nothing self-contradictory about it, but there is something self-contradictory about it, therefore, etc.. The strategy is to take away the power of such *modus tollens* thinking. This is not to commit a further fallacy of *affirmatio consequentis*, if the reality of substantial change is already admitted. That it exists is given; what it is and the specifics of how it occurs are unclear.¹²⁵

The reality of the various types of change, and most importantly substantial change, are difficult to defend by retorsion, but this can be done.¹²⁶ To manifest the existence of substantial change we must turn to cases which are more known to us. This is most of all evident in living things.¹²⁷ The evidence of our common experience gives us the qualitative distinctiveness between living things and the non-living as well as their numerical individu-

125. A related issue is whether it is sufficient to note that substances and accidents exist even if we cannot fully explain the what and wherefore of their difference. See Connell, *Matter & Becoming*, 16–36. It is indeed sufficient to note *that* they differ. The basic distinction between a thing and its features is first of all present in our speech and thinking about things. Yet philosophers such as Locke and Hume have denied that what is present in our speech is paralleled by a real distinction in things. All we know directly are the features of substances, not the substances themselves; see Locke, in Locke, *Essay*, Book II, ch. 23, n. 2, and David Hume, *A Treatise of Human Nature*, ed. David Fate Norton and Mary J. Norton (Oxford: Oxford University Press, 2000), Book I, Part I, sect. 6, as well as Book I, Part IV, sect. 3. As Connell notes, philosophers like Hume and Kant extend this conclusion to our knowledge of the substantial self. Such arguments, however, do not conclude to the non-existence of substance, but would only conclude (if they were successful) that substance is known through the mediation of its proper accidents; Connell, *Matter & Becoming*, 28. But this can be granted. Indeed, Hume and Locke's positions really amount to a denial of accidents and not substances, for they deny the reality of any substratum for qualia; see *ibid.*, 29, as well as Berquist, "On Substantial Form," in the Appendix to this dissertation. Accidents, on their schema, becomes substances, and are even spoken of in such a way, although this passes unnoticed; see Thomas Hill Green, *Hume and Locke* (New York: Thomas Y. Crowell, 1968), 42.

126. Connell's own defense is a lengthy argument against a mechanistic or atomistic position, viz., that non-elementary bodies are merely aggregate arrangements of elements (whatever these are) and thus differ only in arrangement and not substance; see Connell, *Matter & Becoming*, 58–98, a summary is presented on 96–98. This defense, which has its merits, nonetheless relies upon claims which are posterior in the order of discovery to *Physics* Book I. Indeed, the denial of the existence of substantial change itself relies upon claims which are from the lesser known—i.e., the existence of unchanging ultimate elements.

127. Marcus Berquist, "On Substantial Form," given in the Appendix.

ality (which latter is particularly clear in ourselves).¹²⁸ The certitude we have of our unity and life as well as those things around us, and of their coming into being and destruction, is the sort of vague fact which natural philosophy identifies as a starting point.

That is, the unity of substances which are non-elemental is found in common experience, most importantly ourselves but also in other beings and especially living beings. To deny our own unity—"I am not one being."—raises more self-referential problems than it provides solutions. Such a denial arises from the lesser known, viz., that there are unobservable beings which always exist and are ingenerable and incorruptible; the changes we observe are thus made mere appearances. The beginning natural philosopher must rely upon his common experience to assert the existence of substantial change. The next question cannot be overlooked: is our experience of substantial change a primary or a primitive experience?¹²⁹ Is it one which always endures or one which is later shown to be inaccurate?

To which I answer: it is vague, but primary. To deny substantial change requires that we deny our own unity between our conception and our death.¹³⁰ While it is clear that such unity and finitude is difficult to explain (answer *why*), the *fact* of such features cannot be denied without contradicting the order of what is more known. A claim *that* some other substance besides the one of common experience is actually one and is either corruptible or incorruptible is a claim that merely reassigns the signification of the word "one" which we already (if vaguely) experience (namely in ourselves) to something of which we know not what, thereby assuming what we deny in the process. All more detailed claims affirming or denying substantial generation and corruption draw upon and specify the vague notion with which common experience already provides us. To choose this as our starting point is a crucial point of philosophical strategy, and one which divides interpretations of arguments

128. De Koninck, "Introduction a l'étude de l'âme," 11ff.

129. See above, fn. 85.

130. De Koninck, "The Unity and Diversity of Natural Science," 16: "The doctrine of prime matter, for instance, is essential to save the unity of the human individual."

for prime matter.¹³¹

Perhaps this attention to the meaning of words drawn from primary experience and how

131. Berquist, “On Substantial Form,” (reproduced in the Appendix, see p. 502): “But if one looks back beyond [the picture in one’s imagination of a unified living thing that one’s imagination must represent as a composite of distinct entities], and consults the direct experiences which stand at the beginning of natural philosophy, quite a different reality comes into view. We then see that the very concept of individuality arises from our internal experience of unity. (In ordinary usage, “an individual” means “an individual man”.) This experience does not arise in spite of the distinction and spatial separation of our bodily parts, but in our very experience (i.e. sensation) of these bodily parts. For they are perceived as parts, as we experience various passions within them. And this internal experience of them as parts fits with our external experience that they come to be as parts. There is a perfect harmony between what one experiences in oneself (and in others, by signs) and what one observes in the coming to be and passing away of others.”

From such remarks, we should note two related difficulties: (1) from what experience of change should we begin to solve the Eleatic problem? and (2) does the solution result in a primary matter that is “pure indetermination”? Regarding the first, we should note that one could either appeal to the evidence of substantial generation and corruption at an elemental level (a very specific experience) or appeal to evidence of living things rooted in our own experience of being unified (as Berquist suggests). If one chooses the former, this tends to lead one to answer (2) in the negative, for elemental generation and corruption seems to require only a determinate range of potency. If one chooses the latter, it seems to require a potency of a much more ample scope. However, one might have various difficulties regarding how this latter strategy of answering (1) defends the view that prime matter is pure indetermination in answer to (2). The worry is that one fallaciously infers from a generality of conception to a generality of a principle of being. I address this difficulty below, §2.5.

These two options for answering (1) are present in the literature, and can be exemplified by Solmsen (who follows the latter, “top-down” or general before specific approach) and by Cherniss (who follows the former “bottom-up” approach). On the one hand, Solmsen, *Aristotle’s System*, 74–75, 79, 87–89, and 331, argues that the problem of elemental coming to be is too specific for the general consideration of the *Physics*, and so it must be investigated again, in its specificity, in a different part of natural philosophy. However, he consequently infers that this requires that the solution of the *Physics* is not a true solution, 331. That the solution lacks specificity is clear; however, at its level of determination—an indistinct but certain grasp of substances—it is true and complete. On the other hand, Cherniss maintains that it is only in the elemental case where Aristotle could possibly defend evidence of substantial generation and corruption; see *Aristotle’s Criticism of Presocratic Philosophy*, 116–17, where he notes that Aristotle, apart from the dialectical coopting of his predecessors, advances no empirical evidence. Cherniss points us to a text in *De Caelo* which he interprets to mean that “the truth of [Aristotle’s] doctrine he explicitly stakes upon the ultimate reality of this fact [that the simple primary bodies change into one another].” However, the text from *De Caelo*, III.1, 298b9–11 reads as follows: “For if there is generation anywhere, it must be in these elements *and things composed of them*.” My emphasis. The “things composed of them” are clearly substances closer to our primary common experience. In context, Aristotle is contrasting the study of the first element of the heavens with the other substances, and even names generable and corruptible substances such as animals and plants. So it is not at all clear that Aristotle stakes his entire theory of substantial generation and corruption on elements alone.

Again regarding (2), there is a sizable recent literature concerning Aristotle’s doctrine of primary matter. A large group of authors are members of a debate, ranging over five decades, concerning the very notion of prime matter itself at both a textual and philosophical level. This debate originates in opposition to the received or “traditional” view that prime matter is pure substantial potency. While this debate is modern, it is not without precedent, as one can see given the sampling of ancient views such as those of Philoponus and Simplicius.

Hugh R. King initiates the modern stage of the debate, a mostly textual analysis eradicating the notion that Aristotle’s natural philosophy teaches the existence of a purely indeterminate prime matter; see Hugh R.

they are usable or unusable in the specific sciences is part of the sapiential office of general natural philosophy. The natural philosopher attends to the fundamentals of experience and

King, "Aristotle without Prima Materia," *Journal of the History of Ideas* 17, no. 3 (1956): 370–389. King is himself replying to comments in Joachim's notes to the translation of *De Generatione et Corruptione*, see *Aristotle on Coming-to-be and Passing-away*, (Oxford, 1922); King also refers us to L. Robin, *Aristote* (Paris: Presses universitaires de France, 1944), 73–80, as well as Dermot O'Donoghue, "Aristotle's Doctrine of 'The Underlying Matter'," *Philosophical Studies* 3 (1953): 16–39. O'Donoghue's is the article excerpted from a dissertation directed by Fernand Renoirte, De Koninck's own dissertation director. King's article receives direct, separate replies from Friedrich Solmsen and A. R. Lacey, see Friedrich Solmsen, "Aristotle and Prime Matter: A Reply to Hugh R. King," *Journal of the History of Ideas* 19, no. 2 (April 1958): 243–252 and A. R. Lacey, "The Eleatics and Aristotle on Some Problems of Change," *Journal of the History of Ideas* 26, no. 4 (1965): 451–468. Joseph Owens defends an indeterminate notion of primary matter, "Matter and Predication in Aristotle," 79–93, Ernán McMullin, ed., *The Concept of Matter in Greek and Medieval Philosophy* (Notre Dame, IN: University of Notre Dame Press, 1965), and see the comments by Lobkowitz, 96–99, in the same volume, who claims the arguments from motion to an indeterminate primary matter fail. McMullin's volume in general is very useful regarding the debate. Separately, Robert Sokolowski, "Matter, Elements and Substance in Aristotle," *Journal of the History of Philosophy* 8, no. 3 (1970): 263–288, proposes an interpretation that the ultimate material substrate in Aristotle possesses some form of extension: 278: "For Aristotle the underlying matter is simply formless, unqualified, space-filling stuff. Its extension is not an attribute, quality or predicate, but is as primary as matter itself." Paul Studtmann, "Prime Matter and Extension in Aristotle," *Journal of Philosophical Research* 31 (2006): 171–184, replies to Sokolowski's view.

From these more foundational works spring several strands of argument: those in support of that traditional view, those against the traditional view of prime matter as pure indetermination, and (as a sub-set of these) arguments concerning whether or not prime matter is extended. William Charlton, in his appendix to his translation of *Physics*, William Charlton, "Did Aristotle Believe in Prime Matter?," in *Aristotle Physics: Books I and II* (Oxford : New York: Clarendon; Oxford University Press, 1970), 129–145, develops a position similar to King's, based on individual textual refutations, but independently of King's, as Charlton claims in a later article (see below). H. M. Robinson argues against Charlton, and he is joined by Russell Dancy (who argues against both Charlton and King); see H. M. Robinson, "Prime Matter in Aristotle," *Phronesis* 19, no. 2 (1974): 168–188 and Russell Dancy, "On Some of Aristotle's Second Thoughts About Substances: Matter," *The Philosophical Review* 87, no. 3 (1978): 372–413. Barrington Jones mounts another attack against the existence of prime matter as pure indetermination; he claims his is an independent inquiry, although he acknowledges Charlton as a predecessor. Brenner and Code attack Jones' position that Aristotle's analysis does not conclude to pure potency or to a persisting substratum of change, respectively; see William Brenner, "Prime Matter and Barrington Jones," *New Scholasticism* 50, no. 2 (1976): 223–228 and Alan Code, "The Persistence of Aristotelian Matter," *Philosophical Studies: An International Journal for Philosophy in the Analytic Tradition* 29, no. 6 (1976): 357–367. Brenner's article also receives some criticism, see Lewis S. Ford, "Prime Matter, Barrington Jones, and William Brenner," *New Scholasticism* 50, no. 2 (1976): 229–231. Charlton mounts a defense of his original position against "the friends of prime matter" (Solmsen, Lacey, Robinson, and Dancy) and attempts to shift the debate from textual proof to prime matter's systematic relevance to Aristotle's natural philosophy; see William Charlton, "Prime Matter: A Rejoinder," *Phronesis* 28, no. 2 (1983): 197–211. Sheldon Cohen also joins in the attack against prime matter; his article usefully recapitulates the debate and attempts to branch out on its own; see Sheldon Cohen, "Aristotle's Doctrine of the Material Substrate," *The Philosophical Review* 93, no. 2 (1984): 171–194.

In following years, a slew of papers against the traditional conception of prime matter appeared, more or less following Charlton's lead: see Daniel W. Graham, "The Paradox of Prime Matter," *Journal of the History of Philosophy* 25, no. 4 (1987): 475–490, Christopher Byrne, "Prime Matter and Actuality," *Journal of the History of Philosophy* 33, no. 2 (1995): 197–224; Christopher Byrne, "Matter and Aristotle's Material Cause," *Canadian Journal of Philosophy* 31, no. 1 (March 2001): 85–111, and Kathleen C. Cook, "The Underlying Thing, the Underlying Nature and Matter: Aristotle's Analogy in *Physics* I 7," *Apeiron* 22, no. 4 (2011):

105–120. See also Bostock, *Essays on Aristotle's Physics*, chs. 1, 2, 3, and 6. In more recent scholarship, Sean Kelsey has written a series of expositions on *Physics* I.7–9 much more amenable to the traditional understanding; see Sean Kelsey, "Aristotle *Physics* I 8," *Phronesis: A Journal of Ancient Philosophy* 51, no. 4 (January 2006): 330–361; Sean Kelsey, "The Place of I 7 in the Argument of *Physics* I," *Phronesis: A Journal of Ancient Philosophy* 53, no. 2 (January 2008): 180–208; Sean Kelsey, "Hylomorphism in Aristotle's *Physics*," *Ancient Philosophy* 30, no. 1 (2010): 107–124. Margaret Scharle has also written a fresh take on the synchronic justification for prime matter, and Andrew Jaeger a defense of substantial potency for an analytic audience; see Margaret Scharle, "A Synchronic Justification for Aristotle's Commitment to Prime Matter," *Phronesis* 54, nos. 4/5 (2009): 326–345 and Andrew J. Jaeger, "Back to the Primitive: From Substantial Capacities to Prime Matter," *American Catholic Philosophical Quarterly* 88, no. 3 (2014): 381–395. Yet the opponents still endure: a minimalist reading of Aristotle's solution to the dilemma by Anagnostopoulos nonetheless denies that Aristotle has discovered an enduring *per se* substratum; see Andreas Anagnostopoulos, "Aristotle's Parmenidean Dilemma," *Archiv für Geschichte der Philosophie* 95, no. 3 (2013): 245–274, in particular 272–73.

It is not to the current purpose to examine this debate extensively—even though its origin happens to bear some relation to De Koninck and its outcome would clash or support his own view. De Koninck would take the latter strategy to answer question (1) above and thus answer (2) in the affirmative; again, see De Koninck, "The Unity and Diversity of Natural Science," 16: "The doctrine of prime matter, for instance, is essential to save the unity of the human individual." (That De Koninck would answer (1) and (2) in such a fashion will be clear from Chapters 6 and 7.) Nor will we engage in addressing the points regarding the textual *loca* of Aristotle about which the authors wrangle over various interpretations. It is enough, first, to note that the existence of primary matter (in the text of Aristotle, even) is a difficult issue; second, the debate raises issues that contain specific points which De Koninck's own arguments and interpretation of St. Thomas and Aristotle can address.

Pertinent philosophical issues which this lineage of dispute brings to bear, centered around answers to (1) and (2), are as follows. One could object and say that prime matter, understood as pure indetermination, is an incoherence. To say this is to admit that it is not real enough to be a principle (see Sokolowski, "Matter, Elements and Substance in Aristotle," 284–85; also, see Graham, "The Paradox of Prime Matter," 480 who states that unless matter is something determinate, "Aristotle cannot answer the Eleatic challenge." Also, Byrne, "Prime Matter and Actuality," 220–23 maintains similar objections, in particular 220: "If we are to avoid the difficulties involved in the traditional doctrine of prime matter, then we must abandon the view that something has a discernible nature only if it has a formal cause."). Unless a principle possesses or *has* some determination, it cannot exist sufficiently to materially cause the being or becoming of substances—a pure potency or sheer indetermination is a non-determinate thing. The usual proposal for this minimal determination is either that one must appeal to extensive evidence of elemental generation and corruption, or maintain that prime matter be extended in some fashion (see Sokolowski, "Matter, Elements and Substance in Aristotle," 276–78; Byrne, "Prime Matter and Actuality," 207–209; Byrne, "Matter and Aristotle's Material Cause," 106 fn. 51, and 111). Further objections can be made concerning whether prime matter can be discovered through an analysis of change. If prime matter persists through substantial change, yet receives all its determination from form (on the supposition that prime matter is pure indetermination), then substantial change becomes a moment of total annihilation and creation (see King, "Aristotle without *Prima Materia*," 375 and Byrne, "Prime Matter and Actuality," 204). This is because its loss of determination by the form *a quo* cannot be continuous with the determination received by the form *ad quem* (this problem factors into Aristotle's use of seed in the key argument of *Physics* I.7, as well as his preliminary considerations of substantial change in *Physics* I.8. See also *Metaphysics* IX.7). Prime matter is thus not a perduring substratum. Finally, if prime matter is really one and common to all changes, then this eliminates Aristotle's position that for each form there is a proper matter (see Aristotle, *Physics* II.2, 194b9; also, Cook, "The Underlying Thing, the Underlying Nature and Matter: Aristotle's Analogy in *Physics* I 7," 115). To these

identifies that which cannot be denied without asserting what is less known.¹³² Among these fundamentals are the existence of substances, accidents, and change—including substantial change. The natural philosopher is thus free to answer the original question, the question at the origin of our understanding of the natural world of mobile beings: how is change possible?

The solution

De Koninck proposes two solutions in *The Cosmos*.¹³³ The first solution must presuppose the real distinction between essence and existence and shows that, because beings exist in temporal duration, their essences must be resolved into one principle of determination and another (really distinct) principle of indetermination. In the same text, De Koninck also proposes a proof for a material principle based upon the need for individuation of kinds. This solution resolves to that principle commonly named individuating matter.¹³⁴ Since De Koninck's solutions are heavily qualified by his context, it is better to turn to the archetypal solution proposed by Aristotle, which agrees more with the order of discovery, the method

we can add, following Bolotin among others: why can't anything come from anything if prime matter is pure indetermination? Why isn't prime matter (since it is imperishable) the true being of things? How can privation be a principle or "inhere" in the underlying called prime matter?

Yet, if prime matter is not the purely indeterminate, persisting, common substratum of change, then the Eleatic dilemma has not been successfully addressed, nor the existence of natural philosophy successfully defended, for the very existence of change and its principles would still be subjected to Parmenides' rationalistic paradox. We must, then, identify a way to defuse the paradox from a philosophical perspective regardless of what textual interpretation of Aristotle that we propose.

132. A substantial amount of work is required to reorient philosophical attention upon such experience; consider Jaeger, "Back to the Primitive: From Substantial Capacities to Prime Matter," for a lapidary argument for prime matter in the analytic tradition. Jaeger's view relies on an "intuition" akin to what Berquist indicated above; see 12: "When I (or any other substance) go out of or come into existence, the number of material objects changes."

133. De Koninck, *Writings*, Vol. 1, 260–61. De Koninck, at the time of writing *The Cosmos* in drafts, seemed to favor this solution as a dialectical foil. This is clear from his published preface to his directee Fr. Patrice Robert's published dissertation, where De Koninck gives the same solution in the context of commenting on Thomistic refutations of Bergsonian cosmology; see Robert, *Hylemorphism et devenir chez saint Bonaventure*, x-xii.

134. De Koninck, *Writings*, Vol. 1, 261. Simplicius also gives this type of argument, viz., that there must necessarily be a principle beside the Form if a Form is to be multiplied. He refers us to *Timaeus* 52a–d; see Simplicius, *On Aristotle's Physics 1.5-9*, 106–107.

natural philosophy must follow.¹³⁵ Indeed, we do well attend to the main lines of Aristotle's solution to determine whether there is a reasoned path to primary matter available to us today.

Aristotle opens his consideration by noting differences in our descriptions of substantial and accidental changes.¹³⁶ It will not be quoted at length here. He concludes his investigation of speech by noting that in every coming to be there must be a subject and that this subject or underlying is two in account. Yet where do we see this in reality and not just in speech?¹³⁷ This approach towards natural principles through how we speak about change might seem too primitive or inefficacious.¹³⁸ Perhaps, in the face of the Eleatic dilemma framed in terms of our inability to name change truthfully, he merely attempts to attack the problem in kind? Is it therefore rather the case that Aristotle is pointing out what is necessarily expressed in any description of change?¹³⁹

Indeed, by clearly showing how we must speak about changes, Aristotle shows that the Eleatic problem is not just an esoteric worry, but one which arises from ordinary approaches to knowledge.¹⁴⁰ If the thesis of Aristotle's *prooemium* carries any weight, we cannot but consult our speech about change in general as a first step. Like the child who calls (and thinks) every man a father, we describe all changes according to a certain structure or

135. St. Thomas, *In Phys.*, lib. I, lect. 12, nn. 1–2 (Leon.2.41). De Koninck notes that there are considerable difficulties which his summary solutions gloss over, *Writings*, Vol. 1, 336, fn. 29.

136. Aristotle, *Physics*, I.7, 189b30–190a13; see St. Thomas, *In Phys.*, lib. I, lect. 12, n. 4 (Leon.2.41).

137. See Bostock, *Essays on Aristotle's Physics*, 7: "Aristotle very often seems to take no account of the distinction between an empirical and a conceptual enquiry, and certainly he makes no attempt in this passage to draw the distinction as I suggest."

138. *Ibid.*, 4–5; also McMullin, "Matter as a Principle," in *The Concept of Matter*, 188–189. Connell replies to this objection in *Matter & Becoming*, 127–28.

139. John J. FitzGerald's "'Matter' in Nature and the Knowledge of Nature: Aristotle and the Aristotelian Tradition," in McMullin, *The Concept of Matter*, 63: "The question thus becomes: What is it that anyone asserts necessarily and inescapably when he truly asserts that something (whether in respect to its accident or to its substance) comes to be?" See also Dennis Des Chene, *Physiologia: Natural Philosophy in Late Aristotelian and Cartesian Thought* (Ithaca & London: Cornell University Press, 1996), 23, who characterizes the Aristotelian result of Book I a "scheme," which is (*ibid.*, fn. 2): "not an explanation or an explanation-type; it is instead a form that through specification yields appropriate descriptions of purative *explananda*." See also *ibid.*, 57.

140. Waterlow, *Nature, Change, and Agency*, 15.

schema. Later we may make specifications or distinctions and avoid a misapplication of this schema, but these cannot occur while overthrowing what we knew before—they will be clarifications. It is also proportionate that the solution begin with an analysis of speech, when the dilemma about change proceeds from a denial of our ability to describe change using rational speech.¹⁴¹ Aristotle's solution must give the lie to Empedoclean despair, which says to speak of birth and death is merely to follow custom.¹⁴² The argument cannot rest in this necessary structure of change in our speech, it must turn to our experience of changing things themselves. At some point, Aristotle must return Socrates' gaze from the reflections of things in speech back to the things; coherent speech seems not enough on its own, for we want to understand the real possibility of change.¹⁴³

Aristotle concludes that in every coming to be there must be a subject, and that this subject or underlying is two in species. The proof that there is a subject in every change is undertaken by induction.¹⁴⁴ Aristotle's induction is much clearer at the level of accidents.¹⁴⁵ Because accidental changes accrue to the subjects of those accidents, it is impossible to deny that these changes have a subject without denying the existence of substance outright. Yet Aristotle's inductive arguments concerning substantial change are much more difficult to follow.¹⁴⁶ From the text, the two arguments are as follows:

But it would become apparent by looking into it that substances and whatever else are simply beings also come to be from something underlying. For there is always what underlies, from which what comes to be [comes to be], as plants and animals [come to be] from seed.

141. Waterlow, *Nature, Change, and Agency*, 12.

142. Freeman, *Ancilla to Pre-Socratic Philosophers*, 52, DK 11, 12, 8, and 9.

143. Waterlow, *Nature, Change, and Agency*, 15 and 19.

144. St. Thomas notes that the proof of this belongs to metaphysics; see *In Phys.*, lib. I, lect. 12, n. 10: "Et hoc quidem per rationem probare pertinet ad metaphysicum, unde probatur in VII Metaphys.; sed hic probat tantum per inductionem." (Leon.2.42)

145. Aristotle, *Physics*, I.7, 190a31–190b1.

146. Several types of complaints could be made; for instance, see Bostock, *Essays on Aristotle's Physics*, 7: "Aristotle very often seems to take no account of the distinction between an empirical and a conceptual enquiry, and certainly he makes no attempt in this passage to draw the distinction as I suggest."

Things which come to be simply, however, come to be either by change of shape, like statues from bronze, or by addition, like things which grow, or by subtraction, like the Hermes from the stone, or by composition, like a house, or by alteration, as things which turn [into something else] due to their material. But it is apparent that all things which come to be thus come to be from something underlying.¹⁴⁷

The difficulties with the first argument consist in the fact that a seed is neither the underlying for the animal or plant which comes to be nor does it remain after the change.¹⁴⁸ Furthermore, Aristotle's enumeration in the second argument does not list substantial changes, but accidental ones; how does this induction indicate that there is an underlying in substantial changes?

Helpful interpretations of both the first and second arguments, respectively, are provided by Coughlin:

What Aristotle probably means is that there is a "prepared" or "disposed" matter from which the plant or animal comes to be. A seed is a good example of such a disposed matter. If the term from which the change begins and the term to which the change tends had nothing in common, no common material element, there would simply be the annihilation of what was at first and the creation, *ex nihilo*, of what comes next. Whence, if there is *nothing* underlying the change, there could be no explanation of the need for a disposed matter. . . .

Perhaps, then, it is best to understand the examples not as examples of substantial change, but of ways in which substantial change can occur. Aristotle uses examples from accidental change because they are more manifest to us. Do things change substantially in the ways mentioned? Yes: one can destroy an animal or plant by changing its shape too much; one can change food into an animal by "adding" it to the animal, causing growth; by removing parts of an animal we can destroy it; by composing things, e.g., by putting together egg and sperm, we can generate something new; and we can destroy or generate new things by changing the quality of a substance, e.g., by heating it or electrifying it. . . . [W]e may understand Aristotle to be giving an argument akin to the preceding one. For the mere fact that there are *ways* of substantial change (alteration, etc.) implies that what comes before the term at which the substantial change terminates is of

147. Aristotle, *Physics*, I.7, 190b1–10.

148. Nor is St. Thomas' usually indispensable commentary of help at this juncture. St. Thomas merely states: "Sed etiam in substantiis, si quis consideret, manifestum fit quod fiunt ex subiecto: videmus enim quod plantae et animalia fiunt ex semine." *In Phys.*, lib. I, lect. 12, n. 10 (Leon.2.42).

some importance to the fact that there *is* a substantial change, and the fact that it is *this* substantial change. . . . Thus what comes before the substantial change determines what comes after, and that can only be because there is something in what comes after which is linked with what came before. Again, if this is not so, there would be no reason for determinate means to produce determinate changes, but heating a piece of paper might produce, not ashes, but an elephant or any other chance substance (even a new piece of paper).¹⁴⁹

It is important to recognize that Coughlin is pointing out the necessary core of Aristotle's induction, what we must attend to in our primary (not primitive) common experience. This core realization is that things are naturally apt to affect things or change in a certain way, viz., *per se* and not *per accidens*. Aristotle's investigations have already averted to such natural aptitude.¹⁵⁰ If this intuition, as it were, sustains the argument for the necessity for a subject, we can indicate in thought what it is that becomes a new substance, viz., the underlying.¹⁵¹

In such an argument, are we leaning upon a full understanding of the meaning of "nature" or "natural"? Do the arguments in Book I require knowledge of Book II's contents? The two topics, nature and motion, are correlative as principle and principled.¹⁵² On the one hand, Aristotle does say in the latter place that it is laughable to prove that nature exists. Yet on the other hand, to be ignorant of motion is to be ignorant of nature, says Aristotle at the opening of Book III. So which comes first in our understanding? Perhaps such names as "natural" in Book I are vague but certain enough, and become progressively more distinct.¹⁵³

149. Coughlin, fn. 53 and 54, in *Physics*. Consider also Connell, *Matter & Becoming*, 128–30, who offers a similar explanation of the first argument.

150. Consider *Physics* I.5, 188a32–33, as well as 189a22–23 and 190b17–18.

151. This would answer qualms that Aristotle's doctrine is somehow *a priori* in its requiring an underlying; see Bostock, *Essays on Aristotle's Physics*, 9. It is not *a priori* but rather responds accurately to our primary experience about change; for something to change, it is somehow still there. Were it not, we would have annihilation and creation, and Parmenides' problem would win out: there would be no intelligible connection through all natural changes. In any event, Bostock thinks the argument for the underlying fails; see *ibid.*, 15–17.

152. Ross, *Aristotle's Physics*, 461, notes that Aristotle has the definition of nature in mind from the beginning of the book.

153. In unpublished lecture material on *Physics* Book I, concerning Aristotle's conclusion in ch. 7, De Koninck notes this dilemma briefly and proposes that in Book I we know nature under a vague idea which is made

After Aristotle has argued from inductive experience about simple and qualified coming to be, he draws his intended conclusion:

It is apparent that, if there are causes and principles of things which are by nature, from which things they first are and come to be, not accidentally, but what each is according to its substance, all things come to be from the underlying and form. For musical man is in some way composed from man and musical. For you resolve the accounts into the accounts of these. It is clear, then, that things which come to be would come to be from these.¹⁵⁴

Now, since Aristotle introduces the key statement with an “if” clause, some authors have drawn the conclusion that he does not really mean what he says or does not intend his conclusion as such.¹⁵⁵ Yet it is clear that the conclusion is definitive. Aristotle has resolved the problem of coming-to-be and determined the principles of change as well as the principles of being of changing things.¹⁵⁶ His support in the above argument is also clear: that the very account or definition of things resolves into the two principles. The principle of privation is, moreover, accidental. The *terminus a quo* of the privative term does not remain through the change, and hence cannot characterize the nature of the underlying as such, nor can it signify the underlying for the same reason.¹⁵⁷

What this allows Aristotle to conclude in *Physics* I.8 is that the previous philosophers were stymied due to the nature of “non-being” as a *ratio* of the underlying. The Eleatic

more precise in Book II; see *The De Koninck Archives*, Folder 5, Part 4, p. 9: “The first thing to be pointed out now is that there are two per se principles of nature. (Just what does the word ‘nature’ mean, in this context? For it is to be noted that nature will not be defined until the beginning of Book II. Meantime, we currently use the word ‘nature,’ and distinguish nature from art as we distinguish eyes as being from nature, and spectacles from art. *All the names and their corresponding notions become gradually more determinate and distinct.*)” My emphasis.

154. Aristotle, *Physics*, I.7, 190b17–24.

155. Bolotin, *An Approach to Aristotle’s Physics*, 22.

156. St. Thomas, *In Phys.* lib. I, lect. 13, n. 2.

157. Connell, *Matter & Becoming*, 117–18. At this point, it is only *logica docens* and experience driving the argument: logically, change requires a subject, and inductively, all change requires an underlying from which the thing which comes to be does so *per se*. This subject, as Aristotle proves, is non-being only accidentally, under the *ratio* of privation. This is manifested by the fact that the subject term remains before and after the change; the privative term in the change is present only at the *terminus a quo*. Hence, the contrary or privative term cannot *signify* the underlying as such (indeed, this is part of the problem driving the Parmenidean dilemma—for “non-being” is thought to signify the subject *per se*); see *ibid.*, 126, who makes this point about the signification of the privative term.

dilemma is dissolved because it makes a false dichotomy.¹⁵⁸ Because Parmenides could not distinguish between the *per se* and the *per accidens* senses of non-being, he could not see that the underlying was an existing subject and only non-being accidentally. In this way he was ignorant of matter as potency, which is what matter is *per se*. Thus, he was taken in by the fallacy of the accident. As John of St. Thomas notes, even though privation is a *per accidens* principle, it is *per se* required for generation—by necessity, a thing cannot come to be what it is without beforehand not being such.¹⁵⁹ In this respect, one must attend to what the privation is accidental: to the matter as the underlying, *per se* cause of what comes to be. However, in the order of being constitutive of the change from one kind to another, the privation is necessary.¹⁶⁰ Once one sees that the matter is not essentially the privation, the mind can resolve from this accidental relation to what matter is essentially with respect to the becoming thing. This is crucial, for to explain coming to be through what is accidental to matter, its not-being what it comes to be, is insufficient.¹⁶¹

Indeed, the matter underlying substantial change must be not only primal but pure potency or pure indeterminacy. The pure indeterminacy of prime matter is a point which De Koninck emphasizes strongly in his early writings.¹⁶²

Prime matter *insofar as it is pure indeterminacy* unites all material beings in the same matrix which is common to them. It is impossible that there should be several pure potencies. They could only be opposed by some determination. Matter, having no proper determination, cannot subsist alone: it is always associated with a form. It is only given at the outset in a composed thing.

It is again by matter and form that we explain generation and corruption. The cosmic beings which appear and disappear, one after the other and the one from the other, are drawn from the potency of matter by beings already existent, and

158. St. Thomas, *In Phys.* lib. I, lect. 14, nn. 4–7; see also Mansion, *Introduction à la physique aristotélicienne*, 75ff.

159. John of St. Thomas, *Curs. Phil.*, II:52a8–16, and 31–38.

160. *Ibid.*, 52a:17–31; see also St. Thomas, *In Phys.*, lib. I, lect. 13, nn. 3–4.

161. St. Thomas notes that this makes the specific refutation of Parmenides which Aristotle provides insufficient, viz., pointing out the fallacy of the accident which he commits; see *In Phys.* lib. I, lect. 14, n. 7. One must provide the *per se* principle.

162. *The Cosmos* and the papers on indeterminacy in De Koninck, *Writings*, Vol. 1.

they are reduced to it by corruption. Prime matter is not a kind of reservoir containing in a latent state determined forms which only await a chance to be released. Prime matter is pure indetermination.¹⁶³

De Koninck points out two features of prime matter. The first is that it is the same in all things. The second is that it is the origin of all things which come to be. These aid us in resolving the first problem in natural philosophy, on pain of remaining in the intellectual state of continual contradiction vis-à-vis our understanding of change.¹⁶⁴ Consider the latter feature, which is the more important. Were prime matter not pure indetermination and thus the origin of all generable things, it would have some determinate character. Thus, Parmenides' dilemma would reappear. Whether this character were an elemental form or a simple organic form—the form of a substance of whatever type—it would prevent us from saying that one new substance of a different kind came to be. This would clash with the primary experience we possess of change. Thus, rather than draw back from “this nature” and its unintelligibility, we must remain with it, for it preserves the fundamental given of experience of substantial change.

163. De Koninck, *The Cosmos*, in De Koninck, *Writings, Vol. 1*, 262; emphasis in original. It is a typical Thomistic position that prime matter is pure indetermination or pure potency; for a survey of St. Thomas' texts on this issue, see John F. Wippel, *The Metaphysical Thought of Thomas Aquinas: From Finite Being to Uncreated Being* (Washington, DC: Catholic University of America Press, 2000), 313–20.

Note, however, that De Koninck has modernized St. Thomas by eliminating a wavering dualism about prime matter present in the Angelic Doctor's view since, apart from the existence of the ingenerable and incorruptible heavenly bodies, prime matter is a principle of all material beings without distinction. For a catalog of thirty-two texts on the distinction between terrestrial and celestial matter in St. Thomas, see Thomas Litt, *Les corps célestes dans l'univers de Saint Thomas d'Aquin*, vol. VII, *Philosophes médiévaux* (Louvain/Paris: Publications Universitaires/Béatrice-Nauwelaerts, 1963), 52–80. St. Thomas most clearly affirms the duality of “prime matters” in *In II Sent.*, d. 12, q. 1, a. 1, c: “*Nulla modo in materia convenient superiora et inferiora corpora: et hoc videtur probabilius, et magis consonum dictis Philosophi,*” with my emphasis. The reasoning is that, given the theory of the heavens, it is impossible for the terrestrial elements to become the fifth element and vice versa, and thus their potencies must be irreducibly other. However, note that St. Thomas moderates this dualism with the language of analogy later in his career; see *ST*, Ia, q. 66, a. 2, c.: “*Et sic non est eadem materia corporis caelestis et elementorum, nisi secundum analogiam, secundum quod conveniunt in ratione potentiae,*” with my emphasis (Leon.5.157).

164. De Koninck, *Writings, Vol. 1*, 260–61 and De Koninck's prefatory notes in Robert, *Hylemorphism et devenir chez saint Bonaventure*, ix–xii. Such a contradiction would be admitted by Bergson, see *ibid.*, x–xi; also Connell, *Matter & Becoming*, 30–32.

Consider the former feature. Prime matter is the same in all beings because it *is* not essentially any one of them. Were it such, it could not provide the reason for why those types of individuals came to be (for it would already be such). This dissolves one horn of the Eleatic dilemma. Because prime matter is the origin of all substantial change, it provides the potentiality for the substance which comes into being. Yet because that substance (necessarily) does not exist before it comes to be, prime matter has the notion or account of privation—which Parmenides mistook for non-being *per se*. Thus, only prime matter dissolves both horns of the Eleatic dilemma. Aristotle says we can know this principle only by analogy to a composite substance: this is not quite “insist[ing] by brute force that *that which is not* somehow is, and then again that *that which is* somehow is not.”¹⁶⁵ Further, because prime matter remains “what it is” without generation or corruption it solves the Heraclitean formulation concerning identity over time.

Because the Platonists make the underlying (the Nurse) a *per se* non-being and not pure potency, Aristotle is able to offer a correction.¹⁶⁶ It is in *Physics* I.9 that Aristotle gives his definition of matter and indicates the conditions of prime matter: one,¹⁶⁷ ingenerable and indestructible, and itself desire for form.¹⁶⁸ The definition of matter—“the first thing underlying each thing, present in it, from which something comes to be, not accidentally”¹⁶⁹—unifies these features and calls for the name “primary matter.”¹⁷⁰ The definition unifies them

165. Plato, *Sophist* 214d.

166. Aristotle, *Physics*, I.9, 191b35; St. Thomas, *In Phys.*, lib. I, lect. 15, n. 1. Simplicius, *On Aristotle's Physics 1.5-9*, 129–30, attempts to save his master Plato from this charge. See also Solmsen, *Aristotle's System*, 40–52.

167. But not one in the sense of a “this” or individual, independent substance; see Aristotle, *Physics*, I.7, 191a12.

168. Respectively, see Aristotle, *Physics*, I.9, 192a31–32, 192a25–34, and 192a13–25. John of St. Thomas, *Curs. Phil.*, II:76, calls these “conditions” of prime matter. The difficulty of thinking and speaking about primary matter is well noted; it can only be known by analogy, as if by a “bastard reasoning”—see Owens, “Matter and Predication in Aristotle,” 91–92, Harry A. Nielsen, “The Referent of ‘Primary Matter,’” 248–56 and Wilfrid Sellars, “Raw Materials, Subjects and Substrata,” 259–72, all in McMullin, *The Concept of Matter*.

169. Aristotle, *Physics*, I.9, 192a31–32.

170. Some point out that Aristotle never terms this underlying “prime matter.” It is clear that the commentators do so denominate it. Yet there is some reason why we can call this ultimate substrate prime matter. In

by the note of its being the *first* from which a thing is generated (and thus ingenerable and indestructible), and not the form or the privation which are the other principles of change (this requires it be a pure potency ordered to or “desiring” form).¹⁷¹ This primal character indicates that matter under such a definition is knowable only by analogy as Aristotle claims.¹⁷²

2.2 On the existence of natural philosophy

Changing being is not a contradiction in terms and is intelligible since we have defended its principles. This means that Aristotle has implicitly defended the existence of natural philosophy by defending the reality of the physical world. We must reach this solution if we are to proceed adequately in the study of nature, speaking of mobile being as real beings.

The ancients were stymied by a puzzle posed by Parmenides Given that the physical world is the world of nature and change, Parmenides, if not refuted, will have proven that there is no physical world; the physical world, then, belongs to the realm of mere opinion.¹⁷³

We can expand on this from Aristotle’s own description of his relationship with his predecessors:

On Generation, II.1, 329a23–24, Aristotle does in fact use the expression “primary matter” albeit in reference to Plato’s Nurse: “[A]nd it is impossible for ‘the Nurse’ (i.e. the primary matter) to be identical with the planes [ἀδύνατον δὲ τὴν τιθήνην καὶ τὴν ὕλην τὴν πρώτην τὰ ἐπίπεδα εἶναι].” Aristotle all but applies this name to his ultimate, ingenerable underlying, given the lines following (329a24–32). Taken in conjunction with the interpretation that in *Physics* I.9 Aristotle is correcting Plato’s “Nurse,” a like name could also be assigned to Aristotle’s replacement.

171. See Coughlin, *Physics*, 24, n. 82, commenting on the definition: “‘Present in it’ excludes the agent cause; ‘from which it comes to be’ excludes the formal cause; and ‘not accidentally’ excludes the privation.” The note of “desire” for form is discussed by St. Thomas, *In Phys.*, lib. I, lect. 15, nn. 8–10 (Leon.2.53–54); see also *De Pot.*, q. 4, a. 1, ad s.c. 2: “Appetitus formae non est aliqua actio materiae, sed quaedam habitudo materiae ad formam, secundum quod est in potentia ad ipsam, sicut Commentator exponit in primo *Physic.*” De Koninck makes much of this note of prime matter in his *Cosmos*, 263ff.

172. Aristotle, *Physics*, I.7, 191a7–8; see also St. Thomas, *In Phys.*, lib. I, lect. 13, n. 9 (Leon.2.46).

173. Coughlin, “Matter and the Reality of the Physical World,” in Aristotle, *Physics*, 223. In other words, the alternative to a real science of nature is a purely mechanical explanation of phenomena by laws of correlation, an advanced ‘opinion,’ possibly enhanced by mathematical methods; see Mansion, *Introduction à la physique aristotélicienne*, 79.

After these things we should say that the difficulty of the ancients is solved in this way alone. For the first ones who sought the truth and the nature of things went astray, as if they went off on some other path [ὁδὸν τινα ἄλλην], due to inexperience.¹⁷⁴

The students of nature before Aristotle strayed off the natural path. For instance, Democritus and Empedocles, in order to solve the Parmenidean problem in regard to substances, denied that the visible things of common experience were substances. Yet their resolution of the paradox (appealing to the rearrangement of parts) fails, for the dilemma encompasses innovation taken as such.

Aristotle's solution clears the way for a real science of the world of changing being. Without it, we cannot assert the existence of changing being without falling into a contradiction. To ignore this solution is to leave irrationality at the core of one's study of the natural order and to ignore what would seem to be the explanatory principle at the heart of everything one says later about the natural world.¹⁷⁵ The question about the intelligibility of change is the question at the very origin of the study of nature.¹⁷⁶ All perennial philosophy flows from the answer to this original question insofar as it is philosophizing about being, and we know changing being before any other kind of being.

This question is the original question because it is naturally the first question to ask about changing being. It is naturally first because it is a dilemma that arises based on what we first experience and know: changing being. Since our knowledge begins with the senses and proceeds to a rational understanding of things, we naturally know things as mutable and changeable in the sensible order. However, because the mind cannot hold a contradiction, we are struck by the contradiction which appears when we try to understand changing being. It

174. Aristotle, *Physics*, I.8, 191a23–27.

175. See Coughlin, "Matter and the Reality of the Physical World," in Aristotle, *Physics*, 227–28; Waterlow, *Nature, Change, and Agency*, 15.

176. See Berquist, "On Substantial Form": "They foresake this question [about substantial change] (even though it is the *original* question) and retreat to the theoretically simpler assumption that there is in truth no substantial becoming." Emphasis in original.

is clear that we sense and experience motion, but this seems to imply to our understanding that “being is and cannot not be” is not true about the beings which we sense precisely because of the fact that those beings are changing and to change is to be other, to be what one is not. Thus, since the sources at hand are our foundational sense experience about changing things and its apparent conflict with the most foundational principle of reason, the question produced in this conflict between senses and reason is naturally first.

Further, in answering the original question, we have also followed the procedure proposed by Aristotle which is to be followed in natural philosophy. At first, the principles of change were hidden underneath the confusion caused by the Parmenidean dilemma (as well as the partially true beginnings proposed by the other Pre-Socratic natural philosophers). After resolving them, however, we advanced to a more distinct grasp of the truth about change. To miss answering this original question, then, is to miss the origin of perennial natural philosophy.¹⁷⁷

2.3 *How Book I belongs to natural philosophy*

Aristotle gives us indications of where his solution is located with respect to natural philosophy as a discipline. It does not belong to the natural philosopher as such. This is reinforced by the indications he gives of what is the most known at the outset of physics.¹⁷⁸ What is most known when one begins to investigate nature is the fact of the existence of motion. St. Thomas compares this passage to the discussion of nature: just as the existence of motion is assumed, so also is the existence of nature, the knowledge of which (as indicated earlier) cannot be apart from knowledge of motion.¹⁷⁹ For this reason, the proper object of investigation

177. See also McMahon, “The *Prooemium* of the *Physics* of Aristotle,” 55.

178. Aristotle, *Phys.*, I.2, 185a12–20. Solmsen notes that it is due to his teacher’s work that Aristotle can more confidently accept the givens of physical and human experience; see Solmsen, *Aristotle’s System*, 20–21, 322; see also Cherniss, *Aristotle’s Criticism of Presocratic Philosophy*, 75–76.

179. St. Thomas, *In Phys.*, lib. I, lect. 2, n. 8: “Est autem necessarium motum supponi in scientia naturali, sicut necessarium est supponi naturam, in cuius definitione ponitur motus; est enim natura principium motus, ut infra dicetur.” (Leon.2.10)

in natural science is “mobile being.”¹⁸⁰ Because this is the first thing known in the science, and hence known without demonstration, it is not for the natural scientist to dispute with someone who denies the existence of motion or nature. Such a denial would have to be dealt with “either by a different science or to one common to all,” perhaps either metaphysics or dialectic.¹⁸¹

Nonetheless, the Eleatic problem is still about things in natural philosophy, so they do belong to such a discussion in some way.¹⁸² Now, it should give us some pause when Aristotle states in the beginning of *Physics* I.8 that his is the *only* solution possible, because towards the end of I.8, Aristotle calls his solution “*one way* to solve the difficulty,” referencing “another” way, viz., “that the same things can be spoken of according to potency and according to act. But this has been determined with greater precision in other works.”¹⁸³ The coherence of Aristotle’s own categorization of his solution is at stake here. Who provides the solution: the metaphysician, the dialectician, or the natural philosopher? If we say it is the metaphysician, then we would require a knowledge of metaphysics prior to beginning natural philosophy. If we say that it is the dialectician, this seems to fall short of the certitude required of such a solution. If we say it is the natural philosopher, this contradicts what Aristotle says in I.2 and elsewhere: no science proves its own subject.

180. *In Phys.*, lib. I, lect. 1, n. 4: “Non dico autem corpus mobile, quia omne mobile esse corpus probatur in isto libro; nulla autem scientia probat suum subiectum.” (Leon.2.4) The proof to which St. Thomas is referring is found in *Physics* VI.4, 234b10–20. See also Tommaso de Vio Cajetan, *Tractatus De Subiecto Naturalis Philosophiae*, 1st ed., ed. Charles De Koninck and R. P. E. Guadron (Québec: Éditions De L’Université Laval, 1939).

181. Aristotle, *Phys.*, I.2, 185a2–3. St. Thomas interprets these options to be that “a different science” would be the surordinate science to a subalternate one; the common science is logic or metaphysics; see *In Phys.*, lib. I, lect. 2, n. 4 (Leon.2.4). Philoponus is also of this opinion, see Philoponus, *On Aristotle’s Physics 1.1-3*, 47. Apostle suggests that it is first philosophy; see Aristotle, *Aristotle’s Physics*, 188.

182. Aristotle, *Physics*, I.2, 185a17–20. Cherniss, *Aristotle’s Criticism of Presocratic Philosophy*, 75–76, notes that Aristotle’s reliance upon his logical doctrine allows for the solution to take place at the beginning of his physics; 76: “It is this connection of the matter of generation and of thought, this equivalence of the proposition of logic and the description of physical change which makes Aristotle think the *Physics* an appropriate place to discuss the Eleatic doctrine which on his own reckoning falls outside the sphere of physics.”

183. Aristotle, *Physics*, I.8, 191b27–30. This determination “with greater precision” (δὲ ἀκριβείας μᾶλλον) is one of the marks of wisdom; see §26 and §27.1.

Materially, although not formally, the solution belongs to the natural philosopher. One requires dialectical work to arrive at the solution (that is, pre-scientific work), but the insight itself is the first boundary point in natural science. Preceded by no other portion of natural philosophy, the insight is not a scientific conclusion but it is still certain. It is the principle of science (understanding) but not itself science (a conclusion). This insight is a threshold: unless you start here, you are not on the correct path. Thus, in the order of discovery, the defense of the starting point is not executed formally by metaphysics, but by dialectic leading into physics, insofar as physics is, in the order of discovery, the first and only philosophy of being.

The solution, then, is that there is in a way one solution and in another way two solutions: there is one conclusion, but it is twofold with respect to the possible disciplines which can attain it. Metaphysics possesses the solution simply speaking, insofar as it treats of act and potency simply speaking. However, to the discoverer or the student, only one of these routes is possible, viz., a dialectically attained insight into what belongs to natural philosophy *formally* (its principles). Thus, the solution belongs to natural philosophy in a qualified way, viz., as the principle of its whole inquiry.¹⁸⁴

2.4 *The physicist's knowledge of prime matter*

This insight into the existence and nature of prime matter is the first ultimate cause which the natural scientist discovers, even if, in the hierarchy of being, it is the least impressive ultimate cause. Yet this seems to clash with the above claim that this discovery is the boundary point into the investigative arc of the natural philosophy.

184. I take this to agree with what St. Thomas says, see *In Phys.*, lib. I, lect. 14, n. 7 (Leon.2.50). St. Thomas calls Aristotle's resolution of Parmenides' fallacy of the accident an insufficient solution, because the full solution must resolve to the principle which is *per se*. This can only be done by metaphysics as such. However, the natural philosopher, having "touched upon" the nature of the underlying and remained there, has gained insight into this *per se* essence of matter, viz., its potency. See also Coughlin, in Aristotle, *Physics*, 223, fn. 65.

Based upon his definition of matter, Aristotle is able to draw several of its quasi-properties.¹⁸⁵ Aristotle points out in *Physics* I.9 that this ultimate substrate can neither suffer generation or corruption in the strict sense: “For if it came to be, there must be some first underlying thing, present in it, from which [it came to be]: but this is its own nature, whence, it will be before it comes to be.”¹⁸⁶ Since nothing can be before itself, nor after itself, were matter to undergo generation or corruption, it would come to be before or after itself. Yet this means that there is no substratum which is prior to it, making it the ultimate principle in this order, viz., of material causality.

We could also assign another reason from Aristotle’s comments about the science which studies separable forms, in the closing lines of Book I. Studying the destructible forms which exist with matter as their co-principle belongs to the inquiry at hand. It belongs to a different inquiry or science to study forms which can exist without matter (if indeed such forms exist). Thus, the presence or absence of this principle, prime matter, makes the difference between the formality of one science or another. This is a sign that it is an ultimate principle of the science at hand, and hence “prime” matter.¹⁸⁷

2.5 After prime matter, inquiry about form and agency

One could object that prime matter is too indeterminate to be an ultimate principle, and this in two ways.¹⁸⁸ First, because prime matter is in potency to every form and is pure

185. John of St. Thomas, *Cursus Phil.*, II:58b6–35, and II:76–83; see also Simplicius, *On Aristotle’s Physics* 1.5-9, 138ff.

186. Aristotle, *Physics*, I.9, 192a29–31, and see 192a25–34. In this text, Aristotle also provides us with a definition of matter, *ibid.*, 192a32–34: “I call ‘material’ the first things underlying each thing, present in it, from which something comes to be, not accidentally.”

187. While Aristotle does not name this underlying “prime matter” in the *Physics*, there is good reason why we can call this ultimate substrate prime matter. In *On Generation*, II.1, 329a23-24, Aristotle does in fact use the expression “primary matter” albeit in reference to Plato’s Nurse: “[A]nd it is impossible for ‘the Nurse’ (i.e. the primary matter) to be identical with the planes.” Aristotle all but applies this name to his ultimate, ungenerable underlying, given the lines following (see 329a24–32, beginning with “Our own doctrine . . .”). Taken in conjunction with the fact that in *Physics*, I.9, Aristotle is proposing the correct replacement for Plato’s “Nurse,” a similar name could also be assigned to this underlying.

188. The first of these ways was indicated to me by Richard Hassing; I was led to the second through a conversation with Andrew Seeley and David Grothoff. John of St. Thomas also raises this issue; see *Curs.*

substantial indetermination in itself, it can possess no inclination to one specific substantial form rather than another. Without this inclination, prime matter cannot supply an ordering principle from one form which passes away and another form which comes to be. Therefore, it seems, anything can come to be immediately from anything: a leaf could be burned and an elephant born.

Second, one worries that the argument fallaciously infers from a generality of our conception of change (“not-this-being to being”) to a generality of a principle of being, viz., that prime matter is pure indetermination. To understand this objection, we must note that the pure indeterminacy of prime matter is one of the quasi-properties discovered by Aristotle’s investigation. This corollary manifests how prime matter as “disposed” matter is not ordered to only certain types changes of itself (a seed, by contrast, is so ordered), but by other principles. This pure potency of prime matter is a point which De Koninck emphasizes strongly in his early writings.¹⁸⁹

Prime matter, understood as pure indetermination, seems to be an incoherence.¹⁹⁰ Yet this is merely to remain stuck on the horns of the dilemma about change. Prime matter is only complete indeterminacy *per accidens* if this indetermination is taken as *absence of a positive being*. Rather, its indetermination is the correlative to form, and this indetermination understood as a privation is not the reason for prime matter’s potency, but rather vice-versa. This means that to posit prime matter as pure indetermination is not to posit some “unreal” principle at the root of the cosmos. Part of the difficulty is that there is no further species which differentiates potency from act as if they were things: “[P]eople look for a unifying formula, and a difference, between potentiality and actuality,” when there is none.¹⁹¹

Phil., II:53a28–b25; he argues that only determinate generations are possible because matter in this case is already under determinate forms.

189. See above, p. 72.

190. Mentioned above, fn. 131, p. 65.

191. Aristotle, *Metaphysics*, VIII.6, 1045b16. The point about prime matter is a *positive* being while still not a *determinate* one is brought out nicely by Owens, “Matter and Predication in Aristotle,” 92. Byrne wants prime matter to have determinateness, see Byrne, “Prime Matter and Actuality,” 219; this is merely to assert

Thus I reply to the second objection that the vagueness in our conception of it is not the pure potency that belongs to prime matter. Prime matter is in reality indeterminate and known only by analogy to the composite with form. Still, apart from knowledge of substantial form, prime matter, known as it is by the end of *Physics* Book I, is not a sufficient principle of knowledge for the natural philosopher. Since we know the underlying by analogy to the composite, we can gain more insight into the potency of this principle only by studying things insofar as they have form. That is, the more we learn about form, the more we see determinately the potency of prime matter. It is a principle of our knowledge correlatively with form.

The first objection is to be conceded along similar lines. The inquiring natural philosopher has discovered hylomorphism, if not in its details (under the notion of determinate forms) then in its origins. This is an instance of the natural road of inquiry, where we progress from the more to the less indistinct. The answers form provides belong to more determinate stages of inquiry which arise naturally after the close of Book I.¹⁹² The investigation must proceed to study the form which is the *terminus a quo* of this change. All the questions which arise in regard to the defense of substantial form stem from this point forward: How is the form one? Are there many substantial forms in more complex things? Are there simpler substances and more complex compounds, and how are the former “in” the latter—actually or potentially or somehow in between? Such questions can only be answered by inquiring into form.

However, the discovery of prime matter not only raises questions about form but also about moving causes. In a change from something to something, the species that comes to be is necessary but insufficient to explain the change because nothing can be prior to itself.¹⁹³ Since nothing comes from nothing, it seems that some being is prior even to the underlying

that prime matter *has* a nature; instead, the correct view is that it *is* a nature, see Scharle, “A Synchronic Justification for Aristotle’s Commitment to Prime Matter,” 331–32.

192. Aristotle, *Physics*, I.9, 192b1–4.

193. This would be available even to the beginning student of natural philosophy, granting that he had studied Aristotle’s treatment of the senses of “prior to” in the *Categories*.

and the species which constitute the new being.

In Aristotle's historical context, suspicion would have immediately fallen on agent causes, all the way up to the ultimate origin of agency and motion. Such a mover was already in the dialogues of his teacher.¹⁹⁴ If it is also natural to wonder about such ultimate sources, then the discovery of primary matter prepares for a later recognition of the activity of efficient causality answering to the pure potency of prime matter. De Koninck claims that "it is prime matter, the potency of every natural being which as such and in advance calls for this corresponding active power."¹⁹⁵ It is the pure potency of prime matter as the material, passive principle of the whole order of changing being which leads us to wonder about the corresponding mover or efficient cause of that entire order.

The student (much less the discoverer) could give in advance few determinate notions on such matters. However, the experience granted any wondering student of nature would not be exclusive in scope—they are wondering about "the all" and "the genesis of the cosmos."¹⁹⁶ Once the student of nature hits upon such a fundamental, potential, and passive principle as prime matter, he naturally sees its inability to completely explain the genesis of things; yet he also sees that such matter must be a principle in *all* change. The explanation he is seeking, he can reasonably suspect, must be just as great in scope.

194. Plato, *Statesman*, 269b–270b, 272e; *Phaedrus*, 245c–e; *Timaeus*, 28a–31a; *The Laws*, 893b–899c. Consider also Solmsen, *Aristotle's System*, 28–29.

195. De Koninck, *The Cosmos*, in *Writings*, Vol. 1, 273. De Koninck then supplements his argument with a passage from the *ScG*, II.22. This text was quoted above in §iv. Consider also St. Thomas, *ST*, Ia, q. 115, a. 1, ad 2um: "Sciendum est tamen quod, cum Avicbron sic argumentatur, est aliquid quod est movens non motum, scilicet primus Factor rerum, ergo, ex opposito, est aliquid quod est motum et patiens tantum, quod concedendum est. Sed hoc est materia prima, quae est potentia pura, sicut Deus est actus purus. Corpus autem componitur ex potentia et actu, et ideo est agens et patiens." (Leon.5.539) Some of the other quasi-properties of prime matter will concern us later in the dissertation. For instance, because prime matter is a desire for form, De Koninck argues, it is essential for the definition of the cosmos as such (in comparison to whatever other separable substances might exist). Prime matter enters into the essential account of the "destructible species" of the cosmic order.

196. Aristotle, *Metaphysics* I.2; see also Simplicius, *On Aristotle's Physics 1.5-9*, 142–43.

CONCLUSIONS AND OBSERVATIONS FROM CHAPTER 1

In this chapter, I have defended the existence of the natural path in our knowledge, which proceeds from what is more known to us to what is more known in itself, or by nature. This implies that we first have an indistinct grasp and later a distinct grasp of changing being, or, that our knowledge proceeds from the more to the less universal. However, Aristotle presupposes in his *prooemium* that natural philosophy is a possible science. Hence, this chapter also defended the possibility of natural philosophy against the objections of Parmenides and Heraclitus. This defense also allowed us to note the characteristics of primary experience to which the first natural philosopher attends. The resulting discovery of the principles of changing beings, and in particular primary matter, gave us insight into several points. First, it defended the existence of natural science by manifesting how change is possible. It also initiated the investigative arc of natural philosophy while simultaneously providing it with the discovery of an ultimate principle. Finally, because of the passivity of this principle, the mind is naturally led to wonder about other causes in nature—even ultimate agent causes.

CHAPTER 2
**Nature & Cosmos, Motion & Action,
& Some Clues about the First Mobile**

INTRODUCTORY NOTE TO CHAPTER 2

In this chapter, I will present the basic principles which lead us to more determinately inquire about the existence of efficient causality on a cosmic scale as well as the features of mobile beings which provide us with indications or clues concerning the nature of such an efficient cause. First (§3) I will examine nature as a principle and cause in contrast to chance as a principle or cause. This leads to a question about whether the cosmic whole exists by chance. Second (§4), I will examine the definition of motion and the relationship between motion, mobile, action, and passion. This motivates the natural philosopher to inquire into chains of agent causality, since the mobile as such is passive. Finally (§§5–8), I will examine some of the concomitants of motion and properties of mobiles which Aristotle discusses in *Physics* Books III–VI. These topics provide various indications or clues about the existence and character of the first moved mover.

§3 NATURE AS A PRINCIPLE AND CAUSE OF MOTION MUST BE ASSUMED BY PHYSICS, YET ITS INTELLIGIBILITY IS MANIFESTED FROM THE CERTAINTY OF COMMON EXPERIENCE, ORIENTING THE PHYSICIST MORE DETERMINATELY TOWARDS QUESTIONS ABOUT ULTIMATE CAUSES; IN PARTICULAR, THE QUESTIONS OF EFFICIENT CAUSALITY AND THE PRIORITY OF PER SE AS OPPOSED TO CHANCE CAUSES OF THE WHOLE ARE RAISED AT THIS JUNCTURE. (*Physics*, BOOK II)

Nature loves to hide.

HERACLITUS, DK 123

Things in motion sooner catch the eye than what not stirs.

SHAKESPEARE
Troilus and Cressida, III.3

In this section, I defend Aristotle’s definition of nature as a principle of our knowledge in order to note the connection between the definition of nature and the order of the cosmos as a whole. The need for a cosmic, *per se* efficient cause raises the stakes concerning what is required for the integrity or completeness of general natural philosophy.

There are three passages which form the backbone of my exposition: Aristotle’s definition of nature with his comment that “to try to show that nature exists is laughable,” his discussion of the student of nature seeking ultimate causes in the cosmos, and his indication of the “cosmological thesis” when discussing chance (*viz.*, that the cosmos came into existence through a *per se* cause and not by chance).¹ The first shows us that just as the existence of motion is not demonstrated but rather clarified by resolving a natural dilemma which arises when we first try to understand it, so also the existence and definition of nature is clarified, not demonstrated, by attending to what is more known in our experience of natural things. The second notes that the student of nature will demonstrate using all four causes, but adds that one principle of natural motion is itself not natural. Such a suggestion could not be

1. See, respectively, Aristotle, *Physics*, II.1, 192b21–23, 193a3–9; II.7, 198a27–b5; and II.4, 196a24–28 with II.6, 198a5–13. I will also consider, briefly, Aristotle’s distinction between natural philosophy’s mode of inquiry and mathematics’s at II.2, 193b22–194a12, 194b14–15.

made by someone following the order of discovery. Aristotle nonetheless indicates by this remark that we naturally look for a first mover, an efficient cause which terminates our line of questions.² The third moves from considerations of luck to the idea that chance cannot be a first cause of the whole cosmos. This is a grand conclusion from such inauspicious beginnings: can the consideration of human actions such as going to the store or activities of living things like horses escaping death lead to insight regarding the whole cosmos?

The topics introduced here flow from what is central to Book II: nature as a cause of the being of natural things and, consequently, as a principle of our knowledge of those things.³ If nature is a cause *per se*, and if there are many causes, Aristotle must explain how these causes relate to each other and to what they cause (up to and including the cosmic whole, it would seem). Since nature is not a cause *per accidens*, Aristotle must account for whether and how chance is a cause in the natural order and whether everything, something, or nothing occurs by chance. Throughout the entire discussion, if we follow Aristotle's methodology, we must begin with what is more known to us. Yet the scope of the discussion (up to and including knowing the order of the cosmos) seems motivated by very primitive resources, viz., the more familiar and local. With this in mind, I will defend the following points:

1. Nature is a principle and cause of motion and rest in that in which it is, primarily, in virtue of itself, and not accidentally. The discussion of causes this definition introduces points the physicist's investigation towards ultimate first causes.
2. The discussion of causes indicates that the existence and nature of the first mover (and hence the first moved mover) would be the answer to the question as to whether *per se* causality has ultimate explanatory priority when it comes to the cosmos.
3. Aristotle properly distinguishes the mode of explanation in physics from that of mathematics in Book II.

2. Aristotle, *Posterior Analytics*, I.3 and II.2, 94a36–94b7.

3. See St. Thomas' remark that Book II is about the principles of the science while Book I was about the principles of being; *In Phys.*, lib. II, lect. 1, n. 1 (Leon.2.56). The principles of mobile being, taken up as they are into a definition, become principles of our knowledge; the same is true of the four causes insofar as these are principles of being and becoming. On this, see Coughlin, "Principles of Things, Principles of Sciences," Appendix 3 in Aristotle, *Physics*, 230–33.

3.1 The definition of nature and the natural path

Nature is a principle and cause of motion and rest in that in which it is, primarily, in virtue of itself, and not accidentally. Following Coughlin's translation, nature should be understood as a principle of "moving" (κινεῖσθαι) and "resting" (ῥεμεῖν) where these are taken in an intransitive sense.⁴ This is grammatically rarer in the Aristotelian corpus.⁵ Despite its infrequency, it is the philosophically sound understanding, because it allows nature as a principle and cause to have both active and passive manifestations; without this, one would be defending "a theory inadequate to the phenomena."⁶ The adequate definition of nature

4. Consider Sean Kelsey, "Aristotle's Definition of Nature," *Oxford Studies in Ancient Philosophy* 25 (2003): 59–87, for a treatment that tries to steer a way between exclusively active and passive renderings of the definition while clarifying Aristotle's contrast of the natural with the artificial. Sachs translates the former term in a more passive sense: "[N]ature is a certain source and cause of being moved and of coming to rest in that to which it belongs primarily, in virtue of itself and not incidentally." Likewise, Apostle: "So nature is a principle and a cause of being moved or of rest in the thing to which it belongs primarily and in virtue of that thing, but not accidentally."

5. Lang, *The Order of Nature*, 42.

6. Edward Macierowski and Richard F. Hassing, "John Philoponus on Aristotle's Definition of Nature: A Translation from the Greek with Introduction and Notes," *Ancient Philosophy* 8 (1987): 81. To maintain that nature is a principle or cause only in an active sense or only in a passive sense would exclude obvious cases of natures that are passive or active, respectively. Aristotle's position that nature is both matter and form (*Physics*, II.1, 193a10–b21) seems to demand both passive and active senses, and the considerations of Book I prepare for this recognition insofar as the constituent principles of the being and becoming of natural things are active and passive principles of motion. (John of St. Thomas notes this in his comment concerning the shift of focus from Book I to Book II, *Cursus Phil.*, II:171a31–b12.) A passive translation would conflict with the very sense of nature Aristotle establishes later in *Physics* II.1, which argues nature is both matter and form, through such arguments as "nature . . . is the road to nature" and "man comes to be from man."

Both the passive and the active renditions of the definition should be briefly considered. On the one hand, the exclusively passive reading of the definition of nature has a source in Simplicius, *On Aristotle's Physics* 2, trans. B. Fleet, *Ancient Commentators on Aristotle* (Ithaca, NY: Cornell University Press, 1997), 41–43. Consequently, only inanimate bodies have natures in this sense, and therefore, *ibid.*, 42, "nature would not be soul." Nature is restricted to a passive principle of being moved or acted upon. While this reading has difficulties with the usual interpretations of Aristotelian soul that identify soul as part of an organism's nature, it has the advantage of recognizing that being moved can still be caused by the nature of a thing—it allows for what were later termed passive potencies. Passive potency covers difficult cases such as the changes of the simple bodies, although these present various difficulties in conjunction with the principle that everything in motion is being moved by another; St. Thomas, *In Phys.*, lib. II, lect. 1, nn. 3–4 (Leon.2.56); James A. Weisheipl, "The Concept of Nature," *The New Scholasticism* 28, no. 4 (1954): 393–94. Anthony F. Beavers, "Motion, Mobility, and Method in Aristotle's *Physics*: Comments on *Physics* 2.1.192b20–24," *The Review of Metaphysics* 42, no. 2 (December 1988): 360–64, also defends a passive translation and notes the importance of determining the precise voice of the key terms.

On the other hand, the exclusively active translation of the definition arises in Philoponus and has modern counterparts, see Philoponus, *On Aristotle's Physics* 2, 12; Lang, *The Order of Nature*, 41–42 lists Guthrie,

allows us to name both active and passive phenomena, both action and passion, “natural.”

The definition of nature can be known with certitude in the order of discovery. The primary experience upon which Aristotle draws to manifest the definition of nature is the distinction between natural and artificial things.⁷ Since *what a thing is* is prior to what it can become, nature can be seen to be prior to the artificial. That natural things have a principle of motion and rest prior to artifacts is manifested by the fact that artificial objects can only take on patterns of motion or rest of which their natural parts are capable (knives

Rist, Charlton, Waterlow, and Cohen as following this interpretation. Philoponus’ interpretive move leads him to identify nature with both the formal and agent causes as well as the final cause. This yields a very non-Aristotelian physics, note Macierowski and Hassing, “Philoponus on Aristotle’s Definition of Nature,” 75 and 78, for matter is a *per se* principle of motion, and thus a physics which studies only form as nature cannot study motion—consequently chance, which is caused by the indeterminacy of matter, is also eliminated from the science. On the question of the motion of Aristotle’s simple bodies, this interpretation leads one towards a type of panpsychism that eliminates the need for the final causality of natural place—*ibid.*, 80–81. St. Thomas, *In Phys.*, lib. II, lect. 1, n. 5 (Leon.2.57), vehemently argues against the error of making nature an active cause, on the basis that nature is not something absolute but relative (nature does not act, but the composite which has the nature acts): “Ponitur autem in definitione naturae principium, quasi genus, et non aliquid absolutum, quia nomen naturae importat habitudinem principii. Quia enim nasci dicuntur ea quae generantur coniuncta generanti, ut patet in plantis et animalibus, ideo principium generationis vel motus natura nominatur. Unde *deridendi sunt* qui volentes definitionem Aristotelis corrigere, naturam per aliquid absolutum definire conati sunt, dicentes quod natura est vis insita rebus, vel aliquid huiusmodi,” with my emphasis (Leon.2.57).

Nonetheless, this notion of nature as a “vis insita rebus” continued to plague interpretation long after St. Thomas, and provides substance to the anti-scholastic commonplace that Aristotelian natures were mysterious “occult qualities.” Weisheipl, “The Concept of Nature,” 398–400, notes that the attempt to distinguish nature as active from nature as an efficient cause ended in a verbal dispute; see also *ibid.*, 405: “The linguistic inadequacies of expressing both the natural spontaneity of physical bodies and the obvious fact that they are not living produced considerable confusion among later scholastics. Duns Scotus, following Avicenna, describes nature as an active principle which in a sense moves itself to activity. Dominic de Soto (1494–1560) insists that in no sense can nature be called an ‘active principle’ for this is the prerogative of living things. By the 17th century John of St. Thomas (1589–1644) could refer to the ‘celebrated difficulty,’ whether natural bodies are moved by an intrinsic active or passive principle. But the difficulty was more verbal than real. Even Dominic de Soto proposed the now common distinction among Thomists, that the nature of inanimate things is a *principium ‘quo’* of their activities, while the cause of the nature is the *principium ‘quod’*.”

On the whole, then, the intransitive sense, following the middle voice of the pertinent terms for “moving” (κινεῖσθαι) and “resting” (ἠρεμεῖν), is to be preferred. Nature as a principle and cause must encompass both activity and passivity; St. Thomas, *In Phys.*, lib. II, lect. 1, n. 4: “Et ideo dicendum est quod in rebus naturalibus eo modo est principium motus, quo eis motus convenit. Quibus ergo convenit movere, est in eis principium activum motus; quibus autem competit moveri, est in eis principium passivum, quod est materia. Quod quidem principium, in quantum habet potentiam naturalem ad talem formam et motum, facit esse motum naturalem.” (Leon.2.56)

7. Aristotle does say that beings come to be by nature and by other causes; this would include causes like violence or chance. However, examples from art are the focus of Aristotle’s exposition in *Physics* II.1.

cannot be made from water or loose sand, etc.). Another more general meaning of nature is “what a thing is,” and the word etymologically descends from the verb signifying birth, itself a natural process which comes from within a thing. This “interiority” in the meaning of nature is part of the original imposition of the word, and it is crucial to our recognition that natural motions are spontaneous or arise from an interior source that is not being affected by our volition or *techne*.⁸

The meaning of the interiority intended by the definition must be understood by a comparison to our interior senses. This is required because such interiority is more than mere spatial interiority, which is not sufficient to establish a meaning of nature different from a mechanism that possesses spatial interiority of moving principles.⁹ Our interior senses provide a sufficient distinction from what the external senses provide, for externally sensed interiority is spatial, part outside of part. Our interior senses are aware of some principle that is the source of motion and activity, and consequently begins to provide us with the meaning to the words “in that in which it is” in the definition of nature. This interior experience is not the ground from which we know *what* the natures of other substances are (this would lead to anthropomorphism or panpsychism).¹⁰

This meaning is completed by relying on Book I’s investigation of substantial change. The discovery of the principles of change show us some type of interiority besides spatial interiority, for the principles of substances which come to be simply are not related to each other as integral, quantitative parts (for prime matter is prior to quantity, since it underlies

8. Two of De Koninck’s students wrote extensively on the order of imposition of the name “nature” and the basis of our understanding of nature in interior experience, viz., our own experience of motions and rest in the human organism: R. L. Cunningham, “Aristotelian Notion of Nature” (Ph.D., Université Laval, 1951) and John D. Warren, “Natura agit propter finem” (Ph.D., Université Laval, 1953). Consider Aristotle, *Metaphysics* V.4 for this order of imposition.

9. This interior experience of our natural substance is discussed by De Koninck, “Introduction à l’étude de l’âme,” 13ff, whom Cunningham follows, Cunningham, “Aristotelian Notion of Nature,” 54ff. This involves the *sensus communis* and the *vis cogitativa*; see St. Thomas, *Sent. De Anima*, lib. II, cap. 26–27 and cap. 13 (Leon.45/1.120–22), respectively.

10. *Ibid.*, 119.

substantial and not just quantitative change). Aristotle himself notes this transference of the meaning of the term “in.”¹¹

Each of the elements of the definition require reflection based upon common, primary experience of natural things. As opposed to artificial things, it is an intrinsic principle. The natural motions and rests of things are spontaneous or from an interior source, requiring no human intervention from the outside. It is also intrinsic in a *per se* fashion—that is, it is intrinsic by definition and not by happenstance, as in the example of Aristotle’s self-healing doctor. That nature is in something primarily indicates that there is something which is natural to a thing first of all, and others secondarily. The usual explication of this addition is through examples such as an animal and the animal’s heaviness; e.g., a rabbit hopping uphill against gravity.¹² The animal has characteristic patterns of motion and rest which are unique to its kind (i.e., belong to it primarily, or properly), while its heaviness is secondary (or common) to other natures.¹³ Thus, Aristotle’s definition is not an imposition from a

11. Aristotle, *Physics* IV.3, 210a14–24. Consequently, the sense of “interiority” in modern accounts of an organism—for instance, in Descartes—differs from this ancient sense of hylomorphic interiority. The differences between Aristotelian and Cartesian accounts of a whole organism and its parts are set out by Richard F. Hassing, *Cartesian Psychophysics and the Whole Nature of Man: On Descartes’s Passions of the Soul* (Lanham: Lexington Books, 2015), 4–8, 15–17, and 55–56. Descartes’ account relates “unextended thought” to “thoughtless extension” via a hypothesized “pineal-gland ensoulment” and thought-motion association bridging mind and matter. The bodily aspects of the behavior of an organism are rendered explicable in terms of the laws of mathematical physics and thus require only geometric interiority. By contrast, I note, hylomorphic interiority recognizes analogous meanings of the term “in.” A nature is “in” that which has the nature in a non-imageable sense: the form and matter (whether of a living or non-living natural substance) cannot be captured by the imagination in quantities related to each other as part outside of part or containment (and even these two are distinct senses of “in,” according to Aristotle). So, if my line of argument is cogent, it eliminates worries such as those in Waterlow, *Nature, Change, and Agency*, 49–52, based upon assimilating organisms to complex arrangements of parts or automata.

12. The example is drawn from Connell, *Nature’s Causes*, 306. See the whole context, *ibid.*, 293–310, an appendix defending the definition of nature.

13. St. Thomas interprets the “primarily” in this way; *In Phys.*, lib. II, lect. 1, n. 5 (Leon.2.57). This follows Aristotle’s understanding of commensurately universal properties from *Posterior Analytics*, I.4, 73b25–74a3; see also Connell, *Nature’s Causes*, 309. Apostle’s commentary interprets “primarily” as an integral whole–part relationship and not in terms of the commensurately universal, that is, universal whole–part relationships. He explains in Aristotle, *Aristotle’s Physics*, 204, n. 7: “When a man falls, also his finger falls, but this falls in virtue of its being a part of the man and not primarily. It is like coffee which is in the cup primarily but in the room secondarily.” The important difference here is that the universal whole interpretation is more directly tied to claims of essentialism and contrary to reductionism. The essentialist can more easily link his interpretation to the account of the soul as a potential whole, which type of whole is a “mean” between the

metaphysical doctrine of substance, but a recognition based upon experience of the natural order, and most of all the recognition of the interiority of principles of motion.¹⁴

This much of the definition of nature is clear from common experience alone.¹⁵ St. Thomas calls nature “*per se notam, in quantum naturalia sunt manifesta sensui.*”¹⁶ That Aristotle thinks the *definiendum* is manifest can be seen from his comment about the blind man. It is laughable to attempt to demonstrate that nature exists because this would be to confuse “what is known through itself and what is not known through itself.”¹⁷ There are actually two possible mistakes here: to treat the unknown as if known (this is the mistake of the syllogizing blind man), and to treat the known as if unknown (this would be the mistake of the one attempting to demonstrate the existence of nature).¹⁸ To demonstrate the existence of nature would inevitably presuppose what one is attempting to show, for one could only appeal for evidence to things which exist due to nature. The “through itself” that must come first in a science, then, is here identified by Aristotle through a *reductio ad absurdum*. What the above exposition attempted is to show how the *definienda* are also known prior to the *definiendum*, if in an indistinct way.

We can confirm this against a misunderstanding as follows. Nature relies upon the notions of being a principle or cause, being *per se*, and motion and rest. Motion, in turn, relies upon act and potency.¹⁹ Now, the notions of causes and principles is investigated in Book I. Further,

composed and universal whole.

14. Pace Waterlow, *Nature, Change, and Agency*, 37. Still, since nature is both form and matter, the definition of nature is in harmony with Aristotle’s understanding of substance in the *Metaphysics*.

15. Weisheipl, “The Concept of Nature,” 388: “The fundamental assumption in the Aristotelian conception of nature is that natural phenomena, that is, those arising from neither art nor chance, are intelligible; there is a regularity, a determined rationality about these phenomena which can be grasped. This must be the basic assumption of all science, for without it science itself is impossible.” The fundamentality of this assumption is also noted by Waterlow, *Nature, Change, and Agency*, 31.

16. St. Thomas, *In Phys.*, lib. II, lect. 1, n. 8 (Leon.2.57).

17. Aristotle, *Physics*, II.1, 193a5–6.

18. St. Thomas, *In Phys.*, lib. II, lect. 1, n. 8 (Leon.2.57). Treating the known as if unknown is Descartes’ error; compare De Koninck, “Introduction a l’etude de l’âme,” 19–20.

19. Without relying upon our immediate experience and concepts, if vague, drawn from an analysis of motion, the definition of nature would be unreachable. Cunningham brings this out when dealing with an objection from Cassirer; Cunningham, “Aristotelian Notion of Nature,” 39–40: “Cassirer writes in *Language*

being *per se* is a topic Aristotle has manifested in his logical works, and can, consequently, be assumed in Book II.²⁰ Act and potency are the very notions at issue in Book I. Thus, insofar as the problem of motion in Book I, for its complete resolution, requires us to see that potency is a real principle of things and this, in turn, requires us to see that things come to be *per se* and not by happenstance, Aristotle's order of procedure is not at risk. His induction relies only upon insight into the logic of natural changes based upon our experience. In the definition of nature, the prior notions are those which were encountered in Book I, namely, act and potency and what is *per se*.²¹ The crucial notion which is added is interiority, which, as argued above, is named from something better known, viz. our internal experience. This shows that Aristotle is still following the natural path. It does not show that from common experience we can identify every instance of nature infallibly (this would conflate the intension of the definition with its extension), nor does it show that we can intuit the specificity of any given nature (such a mistake would take primary experience of the existence of nature for experience of what a nature is specifically, which at the outset can only be a primitive guess).²²

and Myth: 'But although language and art both become emancipated, in this fashion, from their natural soil to mythical thinking, the ideal, spiritual unity of the two is reasserted upon a higher level. If language is to grow into a vehicle of thought, an expression of concepts and judgments, *this evolution can be achieved only at the price of forgoing the wealth and fullness of immediate experience*. In the end, what is left of the concrete sense and feeling content it once possessed is little more than a bare skeleton.' That is, the imposition of the word "nature" (against what Cassirer would suggest) must rely upon the "wealth and fullness of immediate experience" as a foundation. In the case of the definition of nature, this foundation includes the immediate experience of motion. Cunningham points out, *ibid.*, 42-43: "We can now see that the first imposition of a word refers us to sensible reality, and to that which is most striking in sensible reality, namely movement. Hence, when we come to consider the meanings of the word 'nature,' we shall be able to see why Aristotle tells us that 'nature' in its first imposition has to do with movement. Further, it is now evident that the objection made by Cassirer loses much of its force if we keep in mind the relation between the first imposition and the other meanings. There is no need to lose the 'wealth and fullness of immediate experience' in later uses of the word; if we use the first imposition of a word and its common use as principles to manifest its later, more abstract meanings, we lose nothing. In short, it is a dangerous thing, as Cassirer points out, to allow the concrete meaning of a word to become entirely separated from a later, more abstract meaning; but, as we have seen, this is not necessary, nor will we find that Aristotle in his treatment of the meanings of 'nature' falls into this error."

20. See Aristotle, *Posterior Analytics*, I.4.

21. In Book I when "naturally" or "naturally apt" were used, they were conceived under the notion of what is *per se* and not *per accidens*.

22. The first problem hinges upon the intersection between our experience, the notion of the *per se*, and

the necessary. That is, under what conditions can we conclude that something which is in motion or resting *per se* is doing so “by nature” and thus recognize what belongs to it necessarily? On the one hand, we could say that we somehow first recognize a subject’s “being in some way” is such in virtue of itself, and then conclude that it is such necessarily. An objector, like Epimarchus in *Ancilla to Pre-Socratic Philosophers*, 35, might reply: “Now look at human beings in this way: one grows, another wastes away, and all are in process of change all the time. But that which changes its nature and never remains in the same state, must also be different by now from that which has changed. So both you and I were yesterday other men, and we are other men now, and again [we shall be] other men [in the future], and never the same.” That is, I am not today (by virtue of myself sober) the person who contracted a debt yesterday (drunk and gambling), so is not “my” nature today now different? On the other hand, if we say that we can somehow first identify a feature as necessarily belonging to a thing and thus conclude that it is *per se* to that thing, then the objector becomes more Humean: how can a finite number of observations made of things acting for the most part deliver this necessity? What prevents the feature from being accidental? To resolve this dilemma somewhat, we should first note that Epimarchus’ objection is Heraclitean—the solution to the problem of change allows us to defend principles of change (vaguely grasped) that permit us surety of personal identity. (Self-referential difficulties also assure us *that* the objector cannot be right.) Second, Epimarchus conflates two different senses of *per se*: he relies upon the claim that the “me” today, “by virtue of myself sober,” is something that *exists per se*—which is the third sense of *per se* given in *Posterior Analytics*, I.4, 73b6ff—and then he concludes that because this changes as the subject (which exists *per se* in that third sense) changes, then that subject is different as to how it is defined *per se*—which is the first sense of *per se*, *ibid.*, 73a34–35. Third, we must then note that saying we can know the intension of “nature” is not to know its extension (is “X” an instance of a nature?). This is why the Humean problem of induction has its force. Indeed, the canons of demonstration Aristotle sets out in *Posterior Analytics* as a whole are geared towards the careful recognition of what things are through inductive investigation. (Difficulties arising due to the very denial of the existence of natures are a separate problem.) We must circumvent the Humean problem by reconsidering the character of human experience and its arduous progress from the indeterminate to the determinate. I return to this topic in Chapter 6, §23.

The second problem crops up in Mansion, and is dealt with by Warren. Mansion, noting the parallelism between the defense of the existence of motion in Book I and that of the existence of nature in Book II, is hesitant to accept the latter; Mansion, *Introduction à la physique aristotélicienne*, 101: “In a previous passage of the *Physics* (I.2, 185a12), [Aristotle] had posed the hypotheses against the Eleatics that he had to take as a point of departure, under pain of destroying physics along with its object, that natural beings were in motion, whether all or at least some of them: he thereby appealed to experience or induction. That was, in effect, the ascertainment which was imposed. But here the thesis goes much further and reaches the existence of a principle that, in short, transcends experience. Only, the inference by which he arrives there is so immediate to common sense that Aristotle was led to make it obvious. The fact remains that all that which he adds later to his theory of nature partakes in the weakness of the beginning and, to be honest, will be, as a last foundation, but the very brief analysis of daily experience and of ordinary language that we have summarized. Now this experience, translated into language, implies an interpretation that goes beyond the facts. It is important to note this point before continuing in what follows in the master’s study of nature.” (My translation.) Against this, Warren, “*Natura agit propter finem*,” 25–26, replies: “It is possible to be certain of the existence of nature without knowing precisely what it is. Our external and internal experience distinguish some mobile beings, whose principle of movement is intrinsic, from others whose principle is extrinsic; in other words, it distinguishes natural things from artifacts. In manifesting the existence of beings in motion, and concomitantly the fact of motion, our experience discloses further the existence of an intrinsic principle of the motion—the principle we call nature. But what exactly is nature is not so evident, a condition that Aristotle and St. Thomas recognize and for that reason discussed nature in detail. It is only by reflecting on our experience that we can come to know what nature is. Our external experience differentiates natural from

3.2 The essential efficient causality of the cosmos

The general discussion of causes in Book II anticipates the need for an argumentative resolution to determine the existence of a first universal mover. This can be highlighted by attending to details of Aristotle’s discussion of chance. There, Aristotle advances a “cosmological thesis” that nature and mind are prior and *per se* causes of the cosmos: “[C]hance and luck are posterior to mind and nature. . . . [I]t is necessary that mind and nature is the prior cause both of many other things and of the all.”²³

Aristotle raises this issue in his examination of the opinions of his predecessors concerning chance. He notes that “there are some who say chance is the cause of this heaven and of all cosmoses [τῶν κόσμων πάντων]. For they say that the vortex and the motion which distinguished and arranged the all into this order comes to be from chance.”²⁴ This is “mightily to be wondered at”²⁵ for two reasons: the same thinkers claim that the terrestrial, biological realm is not caused by chance but by nature or mind—but this gives the inferior realm the putatively superior cause.²⁶ Further, what these theorists see occurring in the heavens (regular and not irregular motion) is not consistent with what they say about how it came to be, viz., by chance, for chance seems rather the cause of the irregular changes experienced

artificial things, and our internal experience presents us with an interiority, which we recognize as proper to natural things, having once compared them to *artificiata*.” Given this cautious investigation, we avoid the implication that we are entitled to assume “that whatever seems an instantiation [of a nature] is one in fact.” Waterlow, *Nature, Change, and Agency*, 48.

23. Aristotle, *Physics*, II.6, 198a9–10, 11–13. My discussion here is guided by a segment of Richard Hassing’s course on Aristotle’s *Physics*.

24. Aristotle, *Physics*, II.4, 196a24–28, translation slightly modified, following Hassing. Ross in his commentary, Aristotle, *Aristotle’s Physics*, 515, points out that Simplicius identifies the target of this criticism as Democritus, and that Aristotle makes a similar critique in *On the Parts of Animals*, 641b15–23; consider Simplicius, *On Aristotle’s Physics 2*, 90. Democritus’ “whirl” or “vortex” is seen as generated by chance: Themistius, *On Aristotle Physics 1-3*, trans. Robert B. Todd (London: Bristol Classical Press, 2011), 64; Philoponus, *On Aristotle’s Physics 2*, 72–73. This is despite the apparent determinism in the Democritean system. Simplicius, *On Aristotle’s Physics 2*, 87 also adds Anaxagoras.

25. Aristotle, *Physica*, II.4, 196a28, following Hassing translation.

26. Themistius, *On Aristotle Physics 1-3*, 64; Philoponus, *On Aristotle’s Physics 2*, 73–76; Simplicius, *On Aristotle’s Physics 2*, 90–92; he notes that Aristotle’s censure might indicate that the natural line of inquiry about the cosmos resolves to a *per se* efficient cause. See also *ibid.*, 118–19.

in the biological realm.²⁷

Aristotle's proposal for an adequate causal account of the cosmos (through his four *per se* causes and chance, a *per accidens*, and therefore derivative, efficient cause) has three immediate competitors.²⁸ "Empedoclean" indeterminism would maintain that individual events happen by chance, but the sum total of results is determinate once all the available permutations of events have occurred—as in the case of Empedocles' universe, where the man-faced ox-progeny do not survive.²⁹ The genesis and order of the universe, then, would be locally indeterminate but globally determinate. "Democritean" determinism would maintain that individual events happen determinately, but their global confluence is by chance. The genesis of the universe on this account would be locally determinate but globally indeterminate.³⁰ The third option is a clean resolution of the tension in the second option: both local and

27. Aristotle, *Physics*, II.4, 196a26–196b5.

28. I draw two of these from Coughlin, in his translation of Aristotle's *Physics*, 44, n. 26.

29. Aristotle, *Physics*, II.8, 198b29–32; consider Empedocles, DK 17, 57, 59, 61 in Freeman, *Ancilla to Pre-Socratic Philosophers*, 53–54, 58–59.

30. This latter position seems in tension with itself. This position cannot be Democritus' consistent position for it is at variance with the fact that Democritus' system seems to demand a Laplacian-style determinism, as his elder Leucippus held, that "Nothing happens at random, everything happens out of a reason and by necessity." DK 2, *ibid.*, 91. Ross refers to a resolution of the apparent inconsistency in Democritus' system in his commentary, Aristotle, *Aristotle's Physics*, 515, a resolution given by Cyril Bailey: "[T]here is no inconsistency; the whirl for Democritus 'is produced as the inevitable outcome of natural processes, but it is ἀπὸ τῶντοῦματὸν in the sense that it is (1) undesigned and (2) unpredictable." That is, the natural process of individual lines of causality is determinate but the whole is indeterminate. Simplicius, *On Aristotle's Physics 2*, 90, seems to confirm this when he comments that "[E]ven if [Democritus] seems to have used luck in his cosmogony, in particular instances he denies that luck is the cause of anything, tracing things back to other causes; for example, he says that the cause of finding treasure is digging or olive-planting, or that the cause of the bald man's fractured skull is the fact that the eagle dropped a tortoise so that the shell should smash. This is Eudemus' account." This is paralleled in G. S. Kirk, J. E. Raven, and M. Schofield, eds., *The Presocratic Philosophers: A Critical History with a Selection of Texts*, 2nd (Cambridge: Cambridge University Press, 1984), 413–27. Thus, Democritus' consistent view would deny chance, as does Laplace, chalking it up to human ignorance (akin to an *endoxon* Aristotle notes, *Physics*, II.4, 196b5–7.) De Koninck, "Abstraction from Matter," III:183, maintains that Democritus conflates chance in the sense of "luck" with the accidental cause *removens prohibens*: "Now notice what can result from an easy confusing of one type of accidental cause with another. If the accidental cause termed chance . . . be identified with that called *removens prohibens* . . . , the result will at once be a case of causality, *per se*, necessary, yet utterly fortuitous If I draw your chair away just as you are about to seat yourself, yet by some sort of curious reasoning can maintain that, though I foresee the result quite clearly, I do not in the least intend it, then I become *per se* cause of your fall, necessary cause of it, yet chance cause of it. Democritus seems to be in this position, since he holds that a concourse of atoms formed the whole universe by chance and that all happens of necessity."

global determinism (Laplacian determinism). The remaining fourth option (local and global indeterminism) is “Heraclitean” and can be counted as eliminated (no intelligibility would remain in the natural order).³¹

Now, what the three alternatives leave us with are three questions concerning the priority among the four causes: is the material cause prior to the other causes or not (Democritean determinism), is the final cause prior among all the causes or not (Empedoclean indeterminism), and is there a *per se* cause to “the all” prior to the *per accidens* causes of chance posited by both theories? The first question is addressed by Aristotle through his treatment of hypothetical necessity in *Physics* II.9.³² The second question is addressed by Aristotle in his treatment of the final cause in *Physics* II.8.³³ The final question is treated by considering the posteriority of chance to *per se* causes, at the conclusion of which discussion Aristotle advances his cosmological thesis, that mind and nature are prior to the whole.

Aristotle attempts to resolve this problem of the whole in two broad steps: by arguing that luck is posterior to mind and nature (*Physics* II.5) and that chance, the broader category, is posterior in like manner (*Physics* II.6). Aristotle defines chance in reference to *telos*: “[I]n things which come to be for the sake of something simply, when things whose cause is outside come to be not for the sake of what happens, then we say [they come to be] by chance.”³⁴ That is, chance is conceived of as the cause *per accidens* which realizes a *telos* that could have otherwise been realized *per se*. This is what the “whose cause is outside” means in the definition. The accidentally realized outcome is not included by definition in the notion of

31. See Coughlin’s “Appendix 4: Chance and Indeterminacy in Nature,” for a reply to Laplacian determinism. An Aristotelian-Thomistic position would generally defeat these options as based on false dichotomies, because teleology belonging to the cosmos and its individual substances is a different type of necessity ruling individual acts within a global order.

32. Democritean determinism, then, is not a threat to teleology as such because being determined to an end is not opposed to having a *telos* but rather compatible with the strongest expression of it; Michael Augros, “Nature Acts for an End,” *The Thomist: A Speculative Quarterly Review* 66, no. 4 (2002): 563–64.

33. Empedoclean indeterminism, therefore, is an opponent to teleology, but upon examination is insufficient to explain the facts which teleology can explain.

34. Aristotle, *Physics*, II.6, 197b18–20.

the outcome which nature was aiming at—it was, rather, outside of or “beside” the intention of nature. Were the chance effect not outside the original end, then that original end could never be realized without the “chance” effect also coming to be.³⁵

The priority between nature, mind, and chance can be more easily seen in cases closer to home.³⁶ Chance as an accidental cause, rooted ultimately in the potency of matter, opens up the space where the forms aimed at (as those for the sake of which) are accidentally joined to other forms and *these* results are what come to be by chance. In properly human outcomes these are said to happen by luck. We can clearly distinguish between the intended and the accidental in the area of luck (in fact the former must be prior in our knowledge given our ability to identify the latter), and without a human nature that gives rise to individual purposes, the lucky outcomes could bring neither accidental benefits nor accidental harms (hence the lucky is posterior in nature or being).

Aristotle’s example of chance events in biological phenomena is also clear: the horse who wanders away (say, for the sake of a drink of water) is saved from a predator by chance (an end the horse could otherwise realize *per se* by running away at the proper time). However, Aristotle’s examples of chance events in non-living terrestrial things (the tripod falls such that one can sit on it; the stone falls and strikes an enemy) seem to conflate the natural

35. The cause of luck is also “outside” because the voluntary intention involved is outside the natural intention of the thing involved in the lucky effect. However, matter is also the interior condition for chance. This is a source of interpretive confusion when Aristotle compares chance and luck at *Physics*, II.6, 197b32–37. If one follows the parallelism in the text, Aristotle is maintaining that the cause of what comes to be by chance is “inside.” See St. Thomas, *In Phys.*, lib. II, lect. 10, n. 10 (Leon.2.85). How is chance both outside and inside? One must distinguish between the *casual* as cause and the casual effect; see De Koninck, *Writings*, Vol. 1, “The Problem of Indeterminism,” 384ff. Indeed, the chance outcome of two *casually* intersecting series is itself a determinate effect once the lines of causality are in place. Chance as a cause is that indeterminacy due to which the constellation of those lines of causality is not necessary—it could have been otherwise. What allows for the existence of chance as a cause, then, is what is “interior” viz., the indeterminacy or contingency of matter, and radically, prime matter; see *ibid.*, “Reflections on the Problem of Indeterminism,” 417–20. Consider also St. Thomas, *Exp. Per.*, lib. I, lect. 14, n. 8.; and Coughlin, “Appendix 4: Chance and the Indeterminacy of Nature,” in *Physics*, 235–37. Still, to the extent that mind or nature is prior to chance, they are prior to chance as an accidental *efficient* cause; see St. Thomas, *In Phys.*, lib. II, lect. 10, n. 11 (Leon.2.85–86).

36. Aristotle, *Physics*, II.6, 197b13–18, 197b30–32.

end of the elements (being down) with an end realizable only within the realm of human purposes (the need for chairs or weapons). However, *any* outcome in the case of elemental motion seems to fall within the end intended by nature (the heavy tripod, upon falling in *any* “chance” position, would be “down”), and hence *no* end would be “outside” in such a way that the definition of chance could apply.

The distant intelligibility of the good or that for the sake of which in the elements—which is magnified *a fortiori* in the case of a primitive understanding of celestial motions—makes these hard cases indeed. The cosmological thesis is, at this early stage in the order of discovery, a dialectical argument at best. St. Thomas paraphrases:

[C]hance and luck are *per accidens* causes of those things of which mind and nature are causes *per se*. However, a *per accidens* cause is not prior to what is *per se*, just as nothing *per accidens* is prior to that which is *per se*. It follows that chance and luck are causes posterior to mind and nature. Whence, if it were held that chance be the cause of the heavens, as some have maintained (as said previously [196a24–26]), it would follow that mind and nature were causes first of some other things and afterwards causes of the whole universe.

Even the cause of the whole universe seems to be prior to the cause of some part of the universe, since what part soever of the universe is ordered to the perfection of the universe. However, it seems unfitting that some other cause be prior to that which is the cause of the heavens: whence it is unfitting that chance be the cause of the heavens.³⁷

The stronger argument—from the priority of the *per se* to the *per accidens*—is given in the first paragraph. It is striking that what St. Thomas takes as a possible contention (someone could insist that the heavens came to be by chance) is now taken as an established fact. Yet he would merely counter by drawing the conclusion that mind and nature are prior to a chance process forming what we see in the sky.

The argument from fittingness given by St. Thomas in the second paragraph amounts to maintaining that it is incongruous that the part is not by chance but the whole is so.

37. St. Thomas, *In Phys.*, lib. II, lect. 10, n. 12 (Leon.2.86).

We would need a strategy to take this argument beyond mere fittingness. The strategy for establishing the cosmological thesis despite the existence of the cosmologically casual would be twofold. First, if what comes to be by chance exists on a cosmic scale and if there are ends at the cosmological scale, then mind or nature would necessarily be prior causes, by the first argument given by St. Thomas. Alternately, a direct proof of the existence and nature of the causality exercised by a first *per se* mover of the cosmos (whether itself moved or unmoved) could establish the cosmological thesis.³⁸

One avenue to shore up the first strategy is to argue that the good of non-living matter is to be matter for the living. And this would obtain whether determinism or indeterminism is a cause of individual events in the astronomical order. The former is true because determinism as such is not incompatible with being directed towards an end.³⁹ The latter could be true if the indeterminate as such can be contained within a higher intention that is *per se*. This is clear in art as well as nature: the hunter does not care which pellet brings down the bird, but the many pellets from the shotgun are intended *per se* for such an end.⁴⁰ Likewise, nature intends the survival of sea turtles, but not *all* of the hundreds of sea turtles that hatch on the beach. Given either option, then, one would argue that the living are prior by nature to the non-living in the order of final causality and would thus encompass them in the *per se* order of substances within the cosmos.⁴¹

38. Simplicius, *On Aristotle's Physics 2*, 117, indicates the distinction between these two strategies and notes the *a fortiori* character of the former type of argument: "But perhaps we do not need the primary causes of the primary entities of the universe to be efficient causes in order to strengthen our belief that the heavens came into being as a result of mind and nature. For this advocacy needs another which shows that the heavens are the first of all entities. Yet the argument of Aristotle's is self-advocating, which shows not simply that mind and nature are causes prior to luck and chance, but that where luck and chance are causes, there mind and nature are the causes prior to them. . . . So the heavens, if they are the product of luck and chance, would be the product of mind and nature in a considerably prior sense." Philoponus, *On Aristotle's Physics 2*, 102–104, also comments on this *a fortiori* strategy.

39. Augros, "Nature Acts for an End," 563–64.

40. De Koninck discusses this example as well as its natural analogs in the "calculated waste" of nature in the process of reproduction. See *The Hollow Universe* (Québec: Presses de l'Université Laval, 1964), 106; "Nature of Possibility: Some Meanings of 'Chance' and 'Indeterminacy,'" *Laval théologique et philosophique* 19, no. 2 (1963): 291, n. The various meanings of "chance" here should be distinguished, as "the laws of chance" use "chance" in a sense extended from that of Aristotle's; see De Koninck, "Abstraction from Matter," III:179.

41. This is De Koninck's contention in his *Cosmos*, where he attempts to make sense of the evolutionary

A second avenue is based on the order of matter to form. In his defense of teleology, Aristotle maintains that matter is for the sake of form.⁴² If this is the case, then there exists a teleology within the hylomorphic compound itself. This entails that wherever hylomorphic composition is found, order to an end is also found within the very substance of the thing. This teleology within substance would be the condition for any further ordering to an end, whether achieved by that substance according to its kind or insofar as it benefits substances of other kinds. Teleology would be universal.⁴³

The issue of whether chance or indeterminism is operative in the heavens plays a crucial role in theories of the first mobile being and cosmic-scale causality. Perhaps with appropriate evidence one could discover that indeterminate causes are operative not only in the biological realm but also in the cosmological. If chance or indeterminate causality is operative in the cosmos at large, then the account of chance in the biological realm might be analo-

cosmos in terms amenable to a neo-Aristotelian-Thomistic philosophy of nature. Simplicius, *On Aristotle's Physics 2*, 118, connects Aristotle's dialectical, and briefer, *a fortiori* cosmological argument to what Plato argues at length in *The Laws*, Book X, viz., that soul is prior to the chance formation of the cosmos and its elements, in a passage that indicates at least a nascent cosmic teleology where the inanimate is for the sake of the animate: “[The elemental bodies] drifted casually, each in virtue of their several tendencies; as they came together *in certain fitting and convenient dispositions*—hot with cold, dry with moist, soft with hard, and so in all the inevitable casual combinations which arise from blending of contraries—thus, and on this wise, they gave birth to the whole heavens and all their contents, and, in due course, to all animals and plants, when once all the seasons of the year had been produced from those same causes” (Emphasis mine.) Sachs in his commentary on *Physics* II.8, 198b16–23, the passage about Zeus sending the rain for the sake of the destruction of crops, in Aristotle, *Aristotle's Physics*, notes, 71, that rain as an “activity of the cosmos” opens up the space for a great deal of chance “since fostering wheat is incidental to the end that belongs to the cosmos. Rain is that for the sake of crops in at most the secondary sense of final causality, the ‘for which’ as opposed to the ‘of which.’ The incidental ruining of one harvest by rain that comes just too late, or of another by a dry spell that comes too early, is in either case a result subordinate to the true and primary causes at work in the cosmos and in wheat.” Perhaps the analog to “rain” and “wheat” in the modern cosmological picture is the Big-Bang nucleosynthesis of elements in the early universe and the consequent life cycle of stars ordered to the end of producing the elements requisite for life (I return to this in Chapter 5, §19, p. 325). This would instantiate St. Thomas' conditional claim at the end of his first argument, (see p. 99).

42. Aristotle *Physics*, II.8, 199a30–32; II.1, 194a28–b9; I.9, 192a12–25.

43. This is contrary to many interpreters of Aristotle: Christopher Byrne, “Aristotle on Physical Necessity and the Limits of Teleological Explanation,” *Apeiron: A Journal for Ancient Philosophy and Science* 35, no. 1 (March 2002): 21; Michael Bradie and Fred D. Miller, “Teleology and Natural Necessity in Aristotle,” *History of Philosophy Quarterly* 1, no. 2 (April 1984): 143–44; Wolfgang Wieland, *Die aristotelische Physik: Untersuchungen über die Grundlegung der Naturwissenschaft und die sprachlichen Bedingungen der Prinzipienforschung bei Aristoteles* (Göttingen: Vandenhoeck & Ruprecht, 1992), 256.

gously applied to the cosmological realm, provided that the definitive part in the notion of chance—that it is not incompatible with things coming to be for the sake of something—has some analog in the apparently purposeless regularity of astronomical phenomena. With these determinations, the student of natural philosophy, at this point in his inquiry, awaits an argument for the being or beings *per se* responsible for the cosmos, whether they are natural or intellectual in character.

3.3 *The distinction between natural philosophy and mathematics*

As a final note, we should observe that the mode of explanation of physics is distinct from that of mathematics. The distinction is properly made by Aristotle in *Physics* II because its topic concerns the sources of knowledge to which the natural philosopher attends.⁴⁴ Aristotle raises the issue in the form of two different questions. First, what is the relationship between the way in which the mathematician studies surfaces, solids, lengths, and points and the way in which the natural philosopher does so? Second, what is the relationship between natural philosophy and mathematically-informed sciences of natural things, such as astronomy? These questions contain in embryonic form the entire domain of the debate between natural philosophy and mathematical physics, revolving around a central question.⁴⁵

The central question is this: is it required for truth that the way we know things be the way that things are? The question asks about the sameness of the mode of existence of our knowledge in connection to the object of our knowledge. A Platonic account answers the question affirmatively and maintains that we can truthfully conceive the forms of things

44. See Coughlin, “Appending 3: Principles of Things, Principles of Sciences,” in *Physics*, 230–33. Philoponus, *On Aristotle’s Physics 2*, 32: “Now since the study of nature is a section of the theoretical part of philosophy, . . . he wants next to distinguish [what pertains to] the study of nature from [what pertains to] mathematics and [what pertain to] theology; *for it belongs to the man with special knowledge to set apart, when delineating the matters which are relevant to him, those which seem to be relevant but are not really so. . . .* So for this reason it is fitting that he makes the distinction between these branches of knowledge.” Emphasis mine.

45. Aristotle, *Physics*, II.2, 193b22–25 and 193b25–30. Duane H. Berquist, in a private lecture, pointed out the centrality of this question. It is a central question because competing philosophical theories must all answer the question in some fashion or other, and by doing so their differences become more evident.

(what things are) apart from matter only if they exist apart from matter.⁴⁶ A nominalist account answers the question in the negative and then maintains in addition that despite conceiving of the forms of things without time or change, they do not exist in that way—the forms are not present in things or in another realm.⁴⁷

Aristotle, characteristically, offers a *via media*. He answers in the negative but does not go as far as the nominalist. That is, the same manner of existence is not required for the objects of our knowledge as they exist in themselves and as they exist when we know them. Nonetheless, we do know something of the existing things themselves. This realization is the Aristotelian theory of abstraction from matter.⁴⁸ This account of separation relies on the idea that one thing can be thought without another and no falsity arise.⁴⁹ The quantity of mathematical objects can be thought of apart from certain qualitative accidents or their material constitution and (hence) capacity to move. The triangle in the geometer's mind cannot be heated nor can it move from place to place. This does not falsify the mathematical object, if Aristotle is correct, because this matter-less mode of existence belongs to triangularity only in thought.⁵⁰ Aristotle explains this by attending to the terms of the definitions of mathematical objects.⁵¹ Odd and even, straight and curved, and the like, do not appeal to motion in their definitions (and *a fortiori*, do not appeal to matter). It is different for terms like “flesh and bone and man.” Just like the definition of “snub nose,” these terms require matter as a part of their definition. However, “curved” (the mathematical analog to “snub”) does not.

46. Thus Aristotle indicates that “For these thinkers separate natural things, which are less separable than the mathematical.” *Physics*, II.2, 193b36–194a1.

47. For the sake of further illustration, Kant would also answer the question negatively. The truth of our thinking about objects implies nothing about their mode of existence, because objects conform to concepts.

48. *Ibid.*, 193b31–35.

49. Consider also Aristotle, *Metaphysics*, Book VII.4–5; see St. Thomas, *In Meta.*, lib. 7, lect. 4. St. Thomas relies on this notion of abstraction when explaining natural philosophy's object of consideration; see *In Phys.*, lib. I, lect. 1, nn. 2–3 (Leon.2.4); also, *SBdT*, q. 5, aa. 1–3, especially q. 5, a. 2, c., ad 2, and ad 4.

50. Hence Aristotle adds, *Physics*, II.2, 193b35–36: “But this escapes the notice of those who speak about and make the Ideas.”

51. *Ibid.*, 194a1–7.

The natural philosopher himself makes this distinction between his mode of conception and that of the mathematician in a negative manner. The natural philosopher is content to indicate that the mathematical mode of conception is not his own, and needs not explain with completeness how the mathematical itself fits into the whole of knowledge.⁵² So, just as the natural philosopher—even as a student—can recognize that the principles of mobile being require both matter and form and thus a consideration of beings which are *only* form would fall outside his study, so also can he recognize that mathematics, defining as it does without sensible matter, is not the same type of study. Without making this distinction, the natural philosopher could be in danger of ignoring or mischaracterizing how his object of study exists and behaves. This is precisely because the mathematical mode of thinking ignores what most characterizes the natural order—motion (and by consequence, matter)—and what most characterizes the order of our thinking about it, viz., from effects to causes.

What about Aristotle's second question? How does natural philosophy relate to "the more natural of the mathematical sciences" for instance, optics, harmonics, or astronomy?⁵³ Since the natural philosopher can distinguish his study from the mathematical, it will be the natural philosopher who rules over the proximate study of the natural order and any mathematical tools used to study the natural order. Aristotle's discussion of the architectonic artist at the end of *Physics* II.2 will later bear this out.⁵⁴ If mathematics is used for the sake of the study of natural things, then it will be related to natural philosophy as the art which makes what is usable to the art which uses—as the carpenter who makes the rudder to the pilot who uses it.⁵⁵

52. At the end of *Physics*, II.2, 194b15, Aristotle also negatively distinguishes physics from metaphysics. Philoponus, *On Aristotle's Physics 2*, 32: "But he does not distinguish [them] all from each other, but the rest from the study of nature alone without distinguishing the others among themselves."

53. *Ibid.*, 194a7–8.

54. *Ibid.*, 194b2.

55. *Ibid.*, 194a36–194b8. I return to this theme below in Chapter 7, §26.

§4 THE DEFINITION OF MOTION AND THE DEMONSTRATION THAT ACTION EXISTS IN THE MOBILE SHOW THAT THE MOBILE AS SUCH IS PASSIVE; THIS MOTIVATES FURTHER INVESTIGATION INTO THE EFFICIENT CAUSES OF MOTION. (*Physics*, BOOK III.1–3)

This I tell you is a path that cannot be explored; for you could neither recognize that which is not, nor express it. For it is the same thing to think and to be.

PARMENIDES, DK 2–3

There remains, then, the way said: that [motion] is a certain act, but the sort of act we said, difficult to know, but able to be.

ARISTOTLE
Physics, III.2

Nature is a relative term. It cannot be understood unless that to which it is relative—motion—is understood.⁵⁶ While Aristotle’s definition of motion has been subject to a wide variety of interpretations and difficulties, it remains a feat with no predecessor and perhaps no real successor.⁵⁷ Perhaps it is even impossible to define motion otherwise than Aristotle has defined it.⁵⁸ This achievement allows Aristotle to proceed to inquire about concomitant realities to motion—infinity, place, void, time, continuity, and the nature of mobiles and movers—in the remainder of the *Physics*.⁵⁹ The definition of motion is therefore a prerequisite for our overall inquiry about the first mobile being.

56. Aristotle, *Physics*, III.1, 200b12–15. Here I add that motion itself cannot be understood except in terms of rest, the potential goal-state of which it is, as such, the actuality; Weisheipl, “The Concept of Nature,” 405–406. Nature as principle and cause of rest is teleological; see William A. Wallace, “Is Finality Included in Aristotle’s Definition of Nature?,” in *Final Causality in Nature and Human Affairs*, ed. Richard F. Hassing, vol. 30, Studies in Philosophy and the History of Philosophy (Washington, D.C.: The Catholic University of America Press, 1997), 62–63.

57. See Brague, “Aristotle’s Definition of Motion and its Ontological Implications,” 2 and Sachs in comments to *Aristotle’s Physics*, 78.

58. St. Thomas, *In Phys.*, lib. III, lect. 2, n. 3: “Et ideo omnino impossibile est aliter definire motum per priora et notiora, nisi sicut Philosophus hic definit.” (Leon.2.105)

59. This arc of investigation has been noted also by other authors; for instance, Lang, *The Order of Nature*, 34–39, discusses the interconnection between nature and motion and the related topics of Books III–VI. The central topics of Books III–VI Lang calls teleologically dependent upon the definitions of nature and motion, insofar as it is their end to more fully explicate nature and motion, whose basic definitions are presupposed.

Aristotle devotes the first three chapters of Book III to defending his definition of motion, “the actuality of what exists in potency, as such.”⁶⁰ Aristotle, following the natural path, grounds his approach on distinctions which are prior in our knowledge to the definition of motion.⁶¹ Once Aristotle defines motion, he then demonstrates that to which motion belongs, namely the subject of motion.⁶² Another key detail in this discussion of the realities belonging to mover and moved is that if every mover were subject to motion insofar as the mover was

60. Aristotle, *Physics*, III.1, 201a10–11. The translation of the definition of motion has recently been subject to controversy. This indeterminate being of motion is the reason why it is so difficult to define as a being; Aristotle, *Physics*, III.2, 201b27–202a2. Because motion is indeterminate, it fits neither “act” nor “potency” in a straightforward fashion. As Philoponus, *On Aristotle’s Physics 3*, trans. M.J. Edwards, Ancient Commentators on Aristotle (Ithaca, NY: Cornell University Press, 1994), 39, states: “[I]t is not the same thing to know that change is occurring and to know what it is. For the occurrence of it is knowable to everyone, but what it is even we are now inquiring.” While both key terms ἐντελέχεια, τοῦ δυνάμει, as well as ἡ τοιοῦτον have given interpreters difficulty, the key knot is the term translated “actuality” above, viz., ἐντελέχεια. Some contend that here, and here only, the word means “actualization.” Others maintain a position closer to the translation as “actuality,” calling motion a type of state rather than a process. Others yet claim that the word eventually coincides with the meaning of the analogical term ἐνέργεια and that translating it as “actuality” hides its meaning, see Sachs’s comments in *Aristotle’s Physics*, 78–79.

The debate over whether ἐντελέχεια is a state or a process is somewhat misplaced. Motion, to be defined as a being, requires a word which, in its analogical senses, signifies a “state,” but one with an order to potency such as to define the being of a “process.” (In this respect, the medieval commentators’ debates over whether motion itself is a *forma fluens*—a succession of states—or a *fluxus formae* are more to the point; see Des Chene, *Physiologia*, 30–31 and fn. 22.) One of the first sources for the modern debate is Ross, in Aristotle, *Aristotle’s Physics*, 537, and in *Aristotle*, 6th edition (London / New York: Routledge, 2004), 84. Ross proposes that ἐντελέχεια be translated as actualization. James Kostman, “Aristotle’s Definition of Change,” *History of Philosophy Quarterly* 4, no. 1 (1987): 3–16, defends this “process” view, taking issue with commentators such as L. A. Kosman, “Aristotle’s Definition of Motion,” *Phronesis* 14, no. 1 (1969): 40–62, who defend the “state” interpretation. Mary Louise Gill, “Aristotle’s Theory of Causal Action in *Physics* III 3,” *Phronesis* 25, no. 2 (1980): 129–147, addresses Kosman in part. Interpreters such as Robert Heinaman, “Is Aristotle’s Definition of Change Circular?,” *Apeiron: A Journal for Ancient Philosophy and Science* 27, no. 1 (1994): 25–37, question whether the definition is circular; Heinaman comes to the conclusion that it is, based on the interpretation that ἐντελέχεια in question is the act of the potentiality for change (as opposed to the potentiality for being). Oded Balaban, “The Modern Misunderstanding of Aristotle’s Theory of Motion,” *Journal for General Philosophy of Science / Zeitschrift für allgemeine Wissenschaftstheorie* 26, no. 1 (1995): 4, comes to a conclusion that faults Aristotle’s definition as self-contradictory. Lang, *The Order of Nature*, 55–60 and Waterlow, *Nature, Change, and Agency*, 109–18, after long aporetic segments, offer more accurate interpretations of the definition as neither state nor process.

61. Aristotle, *Physics*, III.1, 200b28–32; St. Thomas, *In Phys.*, lib. III, lect. 1, n. 5: “[P]raemittit quaedam ad investigandum definitionem motus.” (Leon.2.102) St. Thomas refers to Aristotle’s method for defining by division, presented in *Posterior Analytics*, II.13 and *Metaphysics*, VII.12.

62. Wallace claims this is a demonstration of a certain sort, see his “St. Thomas’s Conception of Natural Philosophy,” in Leo Elders, ed., *La philosophie de la nature de saint Thomas d’Aquin: actes du Symposium sur la pensée de saint Thomas, tenu à Rolduc, les 7 et 8 nov. 1981*, Studi tomistici ; 18 (Città del Vaticano: Libreria Editrice Vaticana, 1982), 18. See below, §4.2.

the subject of its own action, then it would follow that “all movers would be moved, or, having motion, they will not be moved.”⁶³ Now, Aristotle considers the first option to be false, and the second option is an absurdity. Thus, if the motion precisely as caused is only in the moved and not the mover, the logical space will exist for unmoved movers.⁶⁴

With the definition of motion established, Aristotle has prepared the way to inquire about the subject of the mover’s act, which, in turn, leads us to tackle further questions about movers and their effects. Aristotle implicitly raises two perplexing questions: first, what is the subject of motion, and, second, how are the acts of mover and moved related?⁶⁵ Aristotle’s answer is that motion is in the mobile and that the act of the mover and the moved are numerically the same, and thus in the mobile. This answer is paradoxical. Evidently, the act of mobile and mover is one and the same and in the mobile as subject. Yet how can the act of one thing be in another thing? Indeed, it seems impossible for the being of passion and action to be one, as Aristotle maintains, for action and passion seem opposed.⁶⁶ The solutions to these paradoxes or dilemmas have important consequences for my project.

4.1 *The definition of motion*

Motion is the act of what exists in potency as such. Since this is a definition, it cannot be demonstrated strictly speaking. Aristotle instead manifests its truth by appealing to our common experience and indicating what is necessary in things: the distinction between act and potency.⁶⁷ Motion is somehow between act and potency: it cannot be the potency which exists in a mobile before its motion, nor can it be the actuality which the mobile achieves

63. Aristotle, *Physics* III.3, 202a30–31.

64. Coughlin in *Physics*, fn. 15, 62. Waterlow, *Nature, Change, and Agency*, 179, notes this connection as well..

65. Aristotle, *Physics*, III.2, 202a3–12.

66. Aristotle, *Physics*, III.3, 202a31–36.

67. Both Philoponus, *On Aristotle’s Physics 3*, 12 and Simplicius, *On Aristotle’s Physics 3*, The ancient commentators on Aristotle (Ithaca, N.Y: Cornell University Press, 2002), 15 call this an “axiom.”

after the motion. It would remain, then, to try to fit act and potency together in the right way so as to define motion as such an “in between” sort of being.⁶⁸

If motion exists and is therefore an act of some kind, since act is relative to potency, of what potency is motion the act? There seem to be five possibilities.⁶⁹ Either (1) motion’s act is the act by which the subject as such exists, (2) the act of the potency of the mobile before the motion (the term from which), (3) the act of the potency of the mobile after the motion (the term to which), (4) the act of the potency of the mobile at some intermediate act (between the term from which and to which), or (5) the act of what the mobile is in potency towards, taken privatively. (A sixth option, that the act is of the potency of the mobile before the motion, taken privately, is incoherent: this would mean that the act of water warming up is the act of that potency which the cold water had to be cold, yet taken privatively. This would entail that all motion progress “backwards” to the *terminus a quo*.)

The only option which adequately captures the reality of motion in speech is the act of that potency which the mobile has at the terminus, with privation (a “not yet”).⁷⁰ The first option above is excluded by Aristotle himself: “to be bronze and to be some mobile in potency are not the same, since, if these were the same simply and according to account, the actuality of bronze as bronze would be motion.”⁷¹ The second option is also excluded because that is an act which exists only before the motion begins; similarly, the third option is an act which exists only at the motion’s end. The fourth option, that motion is the act of the potency of some intermediate stage, merely describes the act of an intermediate stage of the motion—e.g., the actuality which water possesses as it is tepid, on its way to boiling.⁷²

68. St. Thomas, *In Phys.*, lib. III, lect. 2, n. 3: “Considerandum est igitur quod aliquid est in actu tantum, aliquid vero in potentia tantum, aliquid vero medio modo se habens inter potentiam et actum.” (Leon.2.105)

69. See Coughlin, “Appendix 6: The Definition of Motion,” in *Physics*, 249–50. See also Philoponus, *On Aristotle’s Physics 3*, 22, 24.

70. Waterlow, *Nature, Change, and Agency*, 115 and 117: “Thus the change-actuality differs from the product-actuality in that the former holds of its subject in virtue of an irreducibly negative condition.”

71. Aristotle, *Physics*, III.1, 201a31–34.

72. Nor can the potentiality be the potentiality for change itself, without an infinite regress, contra Heina-man, “Is Aristotle’s Definition of Change Circular?,” 25.

What remains is the fifth option. The potency identified is the potency of the *terminus ad quem*, yet only insofar as it exists in act before the mobile rests in that terminus. The act thus designated is the one requisite for the *definiens*, some act that is ordered to the *terminus ad quem*.⁷³ This allows the definition to capture what is intuitively known about motion, viz., that there is an order of the prior parts of a motion to the *terminus ad quem*.

By achieving this definition of motion, Aristotle completes his answer to Parmenides: not only have the conditions of the possibility of motion been revealed (Book I), and the causes in terms of which we are to discuss it (Book II), but we have also given motion itself a *logos*.⁷⁴ This is crucial for the possibility of a science of mobile beings, insofar as “motion” incorporates, in general, the properties investigated in natural philosophy. By correctly applying the names “act” and “potency” to the principles of change, and then using these determinations about the principles to make our vague grasp of the *per se* and the *per accidens* more distinct within the notion of nature, and (finally) by completing our understanding of nature as a principle through the definition of motion, Aristotle has, in a logical order of dependence, clarified the subject, principles, and property of the science at hand. This order follows the natural path in our knowledge and utilizes predicable wholes instead of quantities or number-measures to signify the object of study.⁷⁵ Words are adequate to the reality of motion because they can capture the potentiality that is the necessary condition of real change and which is a disposition within substances and accidents but is not an actual measurable quantity as such. Thus, potentiality escapes the grasp of methods based on spatio-temporal imageability—number measures of length and time along with their graph-

73. St. Thomas, *In Phys.*, lib. III, lect. 2, n. 3 (Leon.2.105).

74. Bague, “Aristotle’s Definition of Motion and its Ontological Implications,” 3–4. Bague calls it the “ontological rehabilitation of motion.” See also above, §2, 54 and §3, 92. However, by giving motion a *logos*, we should understand a formal notion that is very general and, indeed, analogical. (Its generality does not prevent Aristotle from accomplishing theoretical work with it, e.g., as in Book VI of the *Physics*.) The specific details of the formal, agent, and teleological elements of various species of motion require further efforts to uncover and could not be deduced from this definition (although, if they are true species of motion, they should be connected to it).

75. As Bague notes, Aristotle relies upon the priority that “saying” has over “seeing.” See *Ibid.*, 15–16.

ical representations, x, y, z , and t —because these methods treat of motion only insofar as it is fully actual, i.e., composed of actual moments in time or locations in space.⁷⁶

4.2 *The subject of motion, passion, and action*

While the act of motion itself is in the mobile as in a subject, the act of the *mover* as such is also in the mobile. The reality of action is nonetheless really distinct from the reality of passion, even though action and passion are the same in number with the act of motion and differ only in *ratio* or account. This perplexing second statement is what we are led to based upon the first statement. Consider the first statement again:

And it can be said that here [Aristotle] posits another definition of motion, which compares to the previous one as matter to the form and a conclusion to the principle. And this is the definition: motion is the act of the mobile insofar as it is mobile. For this definition is concluded to from the previous one. That is, because motion is the act of what is existing in potency as such, however, what is existing in potency as such is mobile—not, however, the mover, because the mover as such is a being in act—it follows that motion is the act of the mobile as such.⁷⁷

This demonstration is of the type which proves the material definition of a thing from its formal definition.⁷⁸ The force of the demonstration is founded on the distinction between potency and act: because motion is the act of a potency, and the mover (considered precisely as such in reference to the motion caused) is in act and only accidentally in motion, motion must belong to the moved as its subject. Thus, Aristotle approaches this conclusion from a consideration of the reality belonging to the mover as such.

76. The term “spatio-temporal imageability” is one I borrow from Richard Hassing. Consider Richard F. Hassing, “Thomas Aquinas on Physics VII.1 and the Aristotelian Science of the Physical Continuum,” in *Nature and Scientific Method*, ed. Daniel O. Dahlstrom, vol. 22, Studies in Philosophy and the History of Philosophy (Washington, DC: Catholic University of America Press, 1991), 142–46. I return to this theme in Chapter 6.

77. St. Thomas, *In Phys.*, lib. III, lect. 4, n. 1 (Leon.2.109).

78. Wallace, “St. Thomas’s Conception of Natural Philosophy,” 18.

Aristotle's argument relies on two things, the second of which is implicit: movers are such as to also be in motion and yet this is accidental to being a mover.⁷⁹ That movers are also in motion is clear from the fact that movers at some time are only potentially movers and then they are actually movers; further, when the mover ceases moving we say that it is resting—but being at rest is opposed to being in motion. That movers are accidentally in motion *qua* movers is true, first, if they are movers by contact, and hence suffer or undergo a being moved as a condition of their being movers. It also follows from the observation that movers “always bear some species,”⁸⁰ that is, being in complete act, and not in act imperfectly as motion exists, allows movers to be movers in the first place.

Consider this parallel set of action-passion relationships.⁸¹ Given the condition—*if* they interact through contact—and given the distinction in the parallel relations (the mover acts on the moved, which suffers, and, given their mutual contact, the moved reacts against the mover, which suffers), it follows that the mover is moved accidentally precisely insofar as it is a mover and is in act. That is, it suffers motion only due to the contact and reaction. However, if the motion in consideration must have an essential subject, it cannot be the mover, for it is in act, and so motion must be in the moved. As pointed out just now, the “mover will always bear some species” and hence always be in act as a mover, and not in potency. Placing motion in the subject, then, supports common experience of action and passion relationships where we see that an agent cause makes something like itself—viz., what it is actually already—and the moved suffers or receives this insofar as it is in potency to that form (capable of being moved). Since the agent acts through its form, and hence is in act, it cannot be the subject of the motion it causes. What it causes as an agent is a form

79. The first point is made at 202a3–7; St. Thomas brings out the implicit second point, *In Phys.*, lib. III, lect. 4, n. 6 (Leon.2.110).

80. Aristotle, *Physics*, III.2, 202a9.

81. The exception that St. Thomas notes on Aristotle's behalf will be of concern later; *In Phys.*, lib. III, lect. 4, n. 5: “Corpora autem caelestia, quia non communicant cum corporibus inferioribus in materia, sic agunt in ea quod non patiuntur ab eis, et tangunt et non tanguntur.” (Leon.2.110) See also Philoponus, *On Aristotle's Physics 3*, 33.

like itself. The second aspect does not require numerical identity, while the first aspect does: “What the mover by acting causes and what the moved receives by suffering is the same.”⁸²

Here we have Aristotle’s doctrine that the act of the agent is in the patient and their act is numerically one. That is, both agent and patient have an act—for both can be in potency, and hence both, at the appropriate time, are in act together.⁸³ This act is numerically one. This sits well with our experience. It is the mobile itself which is moving with the motion caused in it and not the agent. Here, one of Aristotle’s examples is apt. If a teacher were in an empty room giving his lecture, there would be no action of teaching. Once students enter the room, provided that they were disposed, the action and passion of teaching and learning would begin. Yet, there was no change in the teacher, who was all along proceeding with his “lecture.” That is, absent any change in the teacher’s own action, it became teaching only by being received by the students. The act of motion, then, is one in number but two in account: “just as the interval from one to two and from two to one is the same.”⁸⁴

However, this raises a “logical difficulty.”⁸⁵ If Aristotle is correct, not only is the caused motion in the mobile as its subject, but so also is the very action of the agent cause. This seems to mean that the action caused is not in the agent as in a subject but in the patient. Are action and passion not really distinct beings? If they are not, then they differ only in account. This latter seems to be Aristotle’s answer: just as the interval from one to two and then from two to one again is the same interval, differing only in account, so also action and passion differ only in account; the motion which is actively caused and passively undergone

82. St. Thomas, *In Phys.*, lib. III, lect. 4, n. 10 (Leon.2.110).

83. Aristotle, *Physics*, III.3, 202a13–21. St. Thomas, *In Phys.*, lib. III, lect. 4, n. 9 (Leon.2.110).

84. Aristotle, *Physics*, III.3, 202a18–20; Philoponus, *On Aristotle’s Physics 3*, 51, 54, expands in similar fashion on the case of teaching and learning; see also Simplicius, *On Aristotle’s Physics 3*, 64. Consider also St. Thomas, *In Phys.*, lib. III, lect. 4, n. 11 (Leon.2.110).

85. Aristotle, *Physics*, III.3, 202a21–22. St. Thomas also points out that it is a logical or “dialectical” difficulty because there are probable reasons on both sides, see *In Phys.*, lib. III, lect. 5, n. 2 (Leon.2.112). *ibid.*, 57, 58, following Eudemus, notes that the problem also arises because we could be deceived by language into assigning the reality of action to the agent as an inhering accident, in the same way that “seeing” and “hearing” are in the one who sees or hears.

is the same act of motion. This seems to imply that action and passion are not distinct categories, for things which are the same with the same are the same with each other and both action is the motion caused and passion is the motion caused.

4.3 *Distinguishing action and passion*

Action and passion are distinct realities and not merely distinct in reason or name.⁸⁶ Properly understanding the reasoning behind St. Thomas' view will aid the argument not only in this section but also in upcoming ones which deal with the predicamental reality of place and time. Without properly grasping the real basis in things for our speech about action, passion, place, and time, the key properties of mobile being connected to the *primum mobile*, viz., place and time, will be reduced to merely mental relationships. Conversely, by properly understanding the connection between mobile substances and their accidents (such as intrinsic quantity, action, passion, place, and time), the natural philosopher initiates a much more adequate understanding of nature (see below, §4.4 and §5), and, eventually, the cosmos as an ordered whole of substances bearing relations to each other of various kinds, including agency and patiency.

St. Thomas maintains the real distinction between action and passion as accidents belonging to agent and patient substances. He does this despite defining action and passion as motion considered in different respects, i.e., with different rational relations.⁸⁷ A possible

⁸⁶. I would like to acknowledge beneficial discussions and private communications with David Grothoff on this issue.

⁸⁷. As to the names and reality of action, passion, agent, and patient, note that "agent" and "patient" can name the distinct substances (or distinct parts of substances) involved in transitive action, i.e., causal interaction. (It bears noting that this entire discussion will focus on transitive action; immanent action is only discovered later in natural philosophy and its priority to transitive action is a more metaphysical topic.) Yet "agent" and "patient" can also name the *relations* between two substances, e.g., "father" and "son" or "mover" and "moved." However, these relations require a foundation in their subject and for agents and patient relations this foundation is action and passion, see fn. 100. This is not a circular order because (at least one of) the substances as such are prior, and the action and reception of the causal powers involved (efficient and material) are powers or parts of the substance first, then possess action or passion, upon which follows the agent-patient relationship in the order of being. Relations can therefore be real beings and not merely mental, even though St. Thomas points out that their existence is weakest among the categories;

unfitting consequence here is that unless some real foundation were present in the cause of motion by which we can say that the action belongs to the cause, causal action exists only as a rational relation and physics studies only mental beings when it studies causes of motion. At this point in the investigative arc of natural philosophy, the real distinction between

De Pot., q. 7, a. 9, c.: “Sicut dicit Commentator in XI *Metaph.*, quia ratio est debilioris esse inter omnia praedicamenta, ideo putaverunt quidam eam esse ex secundis intellectibus. Prima enim intellecta sunt res extra animam, in quae primo intellectus intelligenda fertur. Secunda autem intellecta dicuntur intentiones consequentes modum intelligendi: hoc enim secundo intellectus intelligit in quantum reflectitur supra se ipsum, intelligens se intelligere et modum quo intelligit. Secundum ergo hanc positionem sequeretur quod ratio non sit in rebus extra animam, sed in solo intellectu, sicut intentio generis et speciei, et secundarum substantiarum.” St. Thomas goes on to argue in this passage that relations must have ontological status, otherwise the good which obtains in the order of the parts of the universe to each other, a type of relation based in quantity or active and passive powers, would not exist in reality.

As to the definition of action and passion, see St. Thomas, *ST*, Ia, q. 28, a. 3, ad 1: “[L]icet actio sit idem motui, similiter et passio, non tamen sequitur quod actio et passio sint idem, quia in actione importatur respectus ut a quo est motus in mobili, in passione vero ut qui est ab alio.” (Leon.4.324) See also, q. 45, a. 2, ad 2: “[A]ctio et passio convenient in substantia motus, et differant solum secundum habitudines diversas, ut dicitur in III *Physic.*” (Leon.4.466) The difficulty is not confined to the medievals. Themistius, *On Aristotle Physics 1-3*, 88, finds Aristotle’s solution difficult and argues for action not being “cut off” from the agent: “But it is also absurd for the activity of what produces an effect not to be in what produces the effect. . . . Thus if they are *neither* distinct *nor* one, perhaps they are *both* one *and* distinct. At the outset too it was stated that they are one in their underlying subject but distinct in their definition. And this exposes them to no absurdity since when the activity of what produces change is one with respect to the underlying subject in both of them and comes about in what is being changed, it will not also be completely cut off, just as we also see from plain fact.” Consider also Philoponus, *On Aristotle’s Physics 3*, 44 and Simplicius, *On Aristotle’s Physics 3*, 66–68. Waterlow, *Nature, Change, and Agency*, 160–202, works through this passage extensively.

St. Thomas states in various passages (even ones from the same work) that, on the one hand, the reality of action is in the thing moved, while, on the other hand, also stating that the reality of action is in the thing doing the moving. This apparent contradiction has caused difficulties amongst Thomistic interpreters. St. Thomas, *ScG*, II.9: “Actio quae non est substantia agentis, inest ei sicut accidens subiecto: unde et actio unum inter novem praedicamenta accidentis computatur.” (Leon.13.284) Yet in *De Pot.*, q. 10, a. 1, St. Thomas states that action is a perfection of the thing affected: “Est autem duplex operatio: quaedam quidem transiens ab operante in aliquid extrinsecum, sicut calefactio ab igne in lignum; et haec quidem operatio non est perfectio operantis, sed operati: non enim aliquid acquiritur igni ex hoc quod est calefaciens, sed calefactio acquiritur calor. Alia vero est operatio non transiens in aliquid extrinsecum, sed manens in ipso operante, sicut intelligere, sentire, velle, et huiusmodi. Hae autem operationes sunt perfectiones operantis: intellectus enim non est perfectus nisi per hoc quod est intelligens actu; et similiter nec sensus, nisi per hoc quod actu sentit.” By contrast, in the same work, q. 8, a. 2, St. Thomas states that action is in the agent: “Unde dicendum est, quod nihil prohibet aliquid esse inhaerens, quod tamen non significatur ut inhaerens, sicut etiam actio non significatur ut in agente, sed ut ab agente, et tamen constat actionem esse in agente.” See also Wippel, *The Metaphysical Thought of Thomas Aquinas*, 227, fn. 105. Marianne Therese Miller, “The Problem of Action in the Commentary of St. Thomas Aquinas on the *Physics* of Aristotle, Part II,” *The Modern Schoolman: A Quarterly Journal of Philosophy* 23 (1946): 200–226 provides a pertinent analysis of this problem, including the disagreement between Cardinal Cajetan and Sylvester of Ferrara over the precise notion of action and passion, *ibid.*, 209–218. Miller’s treatment does not include that of John of St. Thomas, *Curs. Phil.* II, q. 14, aa. 2–4, which a more complete study of this topic among Thomists must include.

action and passion must be seen such that the natural philosopher can adequately speak of the reality properly belonging to causes as well as seeing the necessity of arguing that every motion has a cause.⁸⁸

We can defend the real distinction between action and passion in three levels from the texts of St. Thomas.⁸⁹ First, St. Thomas assumes the distinction to be established in the text of Aristotle to the degree that he merely cites it as a proof text. In his treatise on the Holy Trinity, St. Thomas raises the objection that, since things the same with the same must be the same with each other, the Trinitarian relations (which is to say, the Trinitarian Persons which are each the divine essence) cannot be really distinct. In his reply, St. Thomas appeals to Aristotle's *Physics*. A distinction in *ratio* can in fact give rise to a real distinction and he uses action and passion as his examples.⁹⁰

Second, St. Thomas himself asks whether action and passion are distinct categories.⁹¹ In

88. R. Glen Coughlin, "The Existence and Nature of Time," *Peripatetikos* 8 (2012): 138: "At least some relations must be real if we are not to say that studying the order of the cosmos, for example, or considering the relative sizes of quantities in mathematics or in physics is really a study of some merely mental reality." Joseph Owens, "Aristotle on Categories," *The Review of Metaphysics* 14, no. 1 (1960): 88, draws on the original legal context of categorization to make this point against Bertrand Russell's three-category ontology of subjects, attributes, and relations (which makes an action such as "Brutus killed Caesar" a relation between the two men): "To reduce killing to a relation, even for the purposes of logic, seems another instance of such a category mistake. It would hardly make legal sense to hang a man merely for being related to his victim. He is hanged for what he did to him, for his *action* and not his *relation* to him, even though the relation of 'murderer' follows upon the action of murdering. It may well be that the mathematical logician is interested only in the relation that follows upon the killing, but that hardly justifies him in designating the nature of the killing as a relation. It is a nature that should be categorized, logically or metaphysically, as action." From Waterlow, *Nature, Change, and Agency*, 191–93, we can draw the observation that Hume's difficulty with transitive agency, viz., that there is no objective third thing between the event-change as passion and the event-change as action besides the subjective mental relation of conjunction (and consequently no objective reality to transitive action as such), is obviated by a solution showing the intrinsic, dynamic reality between agent and patient based upon categories of action and passion.

89. Consider also Wippel, *The Metaphysical Thought of Thomas Aquinas*, 226–28.

90. *ST*, Ia, q. 28, a. 3, obj. 1 and ad 1.

91. St. Thomas, *In Phys.*, lib. III, lect. 5, n. 14: "Sed restat circa hoc duplex dubitatio. Prima quidem quia, si actio et passio sint unus motus, et non differunt nisi secundum rationem, ut dictum est, videtur quod non debeant esse duo praedicamenta, cum praedicamenta sint genera rerum. Item, si motus vel est actio vel passio, non inveniatur motus in substantia, qualitate, quantitate et ubi, ut supra dictum est; sed solum continebitur in actione et passione." (Leon.2.114) Our current difficulty is the first; the second will be mentioned below. It should be noted that the first difficulty does not correspond to any of the five difficulties Aristotle raises in *Physics* III.4 concerning the thesis that action and passion are the same as motion; rather, Aristotle's difficulties are resolved by showing that motion is the same in *re* and differ in *ratio*, while St.

the course of his answer he provides one of his two derivations of the ten categories of being.⁹² In this division, St. Thomas notes that there is an opposition between the notions of cause and effect.⁹³ Now, this opposition must be based on some contrariety, for the things which are opposed are essentially not each other. Because of this opposition, action and passion must be really distinct, on pain of contradicting the principle of contradiction.

Third, a parallel passage in St. Thomas' commentary on the *Metaphysics* reaches the same conclusion. St. Thomas argues that action and passion must be really distinct because their *rationes* are contrary to each other and hence they cannot be the same reality. Action is constituted by a relation of proceeding to another, passion by the relation of having come from another.⁹⁴ (In what follows, I will indicate these reciprocal notions.)

In order to do so, a first difficulty to be overcome is the objection from the axiom about sameness. That is, there seem to be no exceptions to the axiom that things that are the same with the same are the same with each other. However, this axiom must be understood in light of its higher axiom, namely the axiom about contradiction. Every contrariety (virtue and vice, sickness and health, hot and cold) relies upon some contradiction (affirmation and negation); that is, the opposition of contradiction is prior to that of contrariety.⁹⁵ This means that, just as contradictory predicates cannot be the same nor belong to the same subject *simul et eodem modo*, so also contrary *rationes* cannot be found in the same thing *simul et eodem modo*; hence, what "the same" means in the axiom about sameness must be

Thomas's first difficulty asks the naturally subsequent question of whether a difference in *ratio* is sufficient to make things distinct in reality.

92. St. Thomas, *In Phys.*, lib. III, lect. 5, n. 15 (Leon.2.114). St. Thomas' other derivation of the ten categories is found in his commentary on the *Metaphysics* lib. V, lect. 9; consider also Wippel, *The Metaphysical Thought of Thomas Aquinas*, 208–228 and John F. Wippel, "Thomas Aquinas's Derivation of the Aristotelian Categories (Predicaments)," *Journal of the History of Philosophy* 25 (1987): 13–34.

93. St. Thomas, *In Phys.*, lib. III, lect. 5, n. 15 (Leon.2.114). This is even noted by Aristotle, who states that "the act of this in that and the act of that from this are different in account."

94. St. Thomas, *In Meta.*, lib. V, lect. 9, n. 892. In the *Metaphysics*, IX.1, 1046a19?28, Aristotle notes that active and passive powers in different subjects, which supports basis for the extrinsic denomination argued for by St. Thomas.

95. See St. Thomas, *In I Sent.*, d. 5, q. 1, a. 1, ad 1; *De Pot.*, q. 1, a. 3, c.; *In Meta.*, lib. X, lect. 6, n. 2042.

understood to mean “the same in *re* and in *ratio*.”⁹⁶

Consequently, action and passion must be really distinct by demand of the principle of contradiction; their contrary *rationes*, based on real extrinsic causality, require really distinct categories of being.

Thus, it is clear that, granted that motion be one, nonetheless the predicates which are taken according to motion are two, because predicamental denominations come to be from diverse exterior things. For the agent is one thing, from which, as from something exterior, the predicament of passion is taken by way of denomination; the patient is another thing, from which the action is denominated.⁹⁷

This extrinsic denomination of action and passion sourced in really distinct termini (the patient and agent, respectively) guarantee the real distinction of these categories.⁹⁸ Action and passion are motion with relation to really distinct termini. Motion considered only in itself abstracts from action and passion.⁹⁹ Action and passion differ in *ratio* from motion by opposed, constitutive relations: action is constituted by a relation of proceeding to another (that by which motion exists), passion by the relation of having come from another.

Yet what if this relation is just a species of the category of relation? Then action and passion would not be distinct categories but species of predicamental relation. This is not the case. Action and passion are motions considered together with certain relations *secundum dici* (sometimes called transcendental relations), not relations *secundum esse* (predicamental or categorical relations). To be precise, the relations which define or constitute action and passion are *secundum dici*, rational relations; I will call them “transcendentally rational.”¹⁰⁰

96. This insight I owe to David Grothoff.

97. St. Thomas, *In Phys.*, lib. III, lect. 5, n. 16 (Leon.2.115).

98. Note that this assumes the real distinction between agent and patient as substances, to be distinguished from “agent” and “patient” insofar as these can also name relations which are founded upon action and passion. See fns. 100 and 87.

99. *Ibid.*, n. 13.

100. John of St. Thomas comes to a very similar solution; see *Curs. Phil.*, I, q. 19, a. 1 and II, q. 14, a. 2. Relation is a vast topic in St. Thomas’ metaphysics and theology. Here I review some basics for clarity; consider *I Sent.*, d. 30, q. 1, aa. 2–3; d. 30, q. 1, a. 1; *ST*, Ia, q. 13, a. 7, q. 28, aa. 1–2; *De Pot.*, q. 1, aa. 2,

That is, it is possible for there to be relations which are rational but attributable to things based upon a remote foundation in them. This is the logical space needed for understanding

5; q. 7, aa. 8–11; *In Phys.*, lib. III, lect. 1, n. 6. (Leon.2.103), and lib. V, lect. 3, n. 8 (Leon.2.237); consider also Coughlin, “The Existence and Nature of Time,” 137–47. I have also benefited from texts of St. Thomas collected by Duane H. Berquist in his unpublished lecture notes on this subject.

It is commonly noted that real relations are opposed to rational relations (or relations of reason); furthermore, relations *secundum esse* (also called predicamental or categorical relations) are also opposed to relations *secundum dici* (also called transcendental relations). However, the two distinctions are not the same. St. Thomas notes this in *De Pot.*, q. 7, a. 10, ad 11: “[D]istinctio ista relativorum secundum esse et secundum dici, nihil facit ad hoc quod sit relatio realis. Quaedam enim sunt relativa secundum esse quae non sunt realia, sicut dextrum et sinistrum in columna; et quaedam sunt relativa secundum dici, quae tamen important relationes reales, sicut patet de scientia et sensu.” While the terminology of “transcendental relation” is not found in St. Thomas, the meaning is nonetheless there; Wippel, *The Metaphysical Thought of Thomas Aquinas*, 320, fn. 96: “While I would grant that the terminology ‘transcendental relation’ is missing from Thomas’s texts . . . it is clear that Thomas defends the view that a principle of being such as matter is related in objective or extramental fashion, i.e., really rather than merely logically.” Now, these two pairs of distinctions can be crossed to provide four options for all possible created relative being. I list these four in the main text and discuss the two pairs of distinctions here.

(i) Categorical relations: Aristotle’s treatment of relation in the *Categories* begins without distinguishing between relations *secundum esse* and *secundum dici*, and then Aristotle redefines relation to include only relations *secundum esse*. The first attempt at defining relation (6a36–37) yields “We call relatives all such things as are said to be just what they are, of or than other things, or in some way in relation to something else,” while the second, more precise attempt (8a31–32) gives us “those things are relatives for which being is the same as being somehow related to something.” This latter definition is arrived at to avoid a multiplication of relations that would include even substances as relations (8a29–30: “Now if the definition given above was adequate, it is either exceedingly difficult or impossible to reach the solution that no substance is spoken of as a relative.”). A relation *secundum esse* means that the very *esse* of the relations in question are towards another, where *esse* means nature or quiddity and not act of existence; St. Thomas, *I Sent.*, d. 33, q. 1, a. 1, ad 1: “Dico igitur, quod cum dicitur: «Ad aliquid sunt, quorum esse est ad aliud se habere», intelligitur de esse quod est quidditas rei, quae definitione significatur; quia ipsa natura relationis per quam constituitur in tali genere, est ad aliud referri: et non intelligitur de esse quod est actus essentiae; hoc enim esse habet relatio, ex his quae causant ipsum in subjecto secundum quod esse non refertur ad aliud, sed ad subjectum, sicut et quodlibet accidens.”

(ii) Transcendental relations: A relation *secundum dici* is one that exists only in speech, as Aristotle’s examples of a head and “the headed” or a rudder and “the ruddered”; such terms do not name a reality that is of its nature related to something else. St. Thomas states, *De Pot.*, q. 7, a. 10, ad 11, that “dicuntur enim relativa secundum esse, quando nomina sunt imposita ad significandas ipsas relationes; relativa vero secundum dici, quando nomina sunt imposita ad significandas qualitates vel aliquid huiusmodi principaliter, ad quae tamen consequuntur relationes.” In the case at hand, the motion of a mobile is related to the termini of agent and patient *secundum dici*; the terms “action” and “passion” are the “aliquid huiusmodi principaliter” signified which are foundations for consequent real relations like father and son, murder and murdered; St. Thomas, *In Meta.*, lib. XII, lect. 4, n. 2456: “Et ponit specialiter de ad aliquid, quia ea quae sunt ad aliquid, remotiora videntur esse a substantia quam alia genera, ex eo quod sunt debilioris esse. Unde et substantiae inhaerent mediantibus aliis generibus, sicut aequale et inaequale, duplum et dimidium, mediante quantitate. Movens autem et motum, pater et filius, dominus et servus, mediante actione et passione.” See also *ST*, Ia, q. 28, a. 1, c.; q. 41, a. 1, ad 2; *De Pot.*, q. 3, a. 3, c.; q. 7, a. 10, c.

(iii) Real relations: Now, by contrast to predicamental and transcendental relations, real and rational relations are distinguished based upon the presence or absence of the conditions for real relatives, *De Pot.*, q. 7, a. 11, c.: “Ad hoc autem quod aliqua habeant ordinem, oportet quod utrumque sit ens, et utrumque distinctum (quia eiusdem ad seipsum non est ordo) et utrumque ordinabile ad aliud.” Thus, father and son

the relations which constitute action and passion. Given the two pairs of distinctions (categorical vs. transcendental relations and real vs. rational relations) there are four possibilities: relatives can be (A) real and *secundum esse* (as double and half, or father and son; “categorically real”); (B) real and *secundum dici* (as knowledge to what is known; “transcendentally real”); (C) rational and *secundum esse* (as left and right in a column, or genus and species; “categorically rational”); (D) rational and *secundum dici*, or “transcendentally rational.” The relations which define action and passion are transcendently rational relations.

To manifest this we can proceed by elimination.¹⁰¹ (A) The relation constituting action and passion cannot be categorically real relations (like father to son), because real relations must be in different subjects and action and passion are in the same subject, viz., in the mobile. (B) The constitutive relations cannot be transcendently real relations (like that of knowledge to the thing known) for the same reason.

(C) Nor can these constitutive relations be categorically rational relations. These rational relations are either non-attributable to things outside the mind (as in the case of genus and species) or attributable.¹⁰² Now, action and passion are not non-attributable to things

are really related because both are beings, they are really distinct, and there is an order between them based on a real foundation, in this case, action and passion; *I Sent.*, d. 4, q. 1, a. 1 ad 4: “[G]eneratio realiter non est aliquid medium inter Patrem et Filium, cum generatio secundum rem passive accepta, sit ipsa filiatio, quae est proprietas Filii, et est in Filio; et cum in Patre accipitur active, est ipsa paternitas quae est in Patre, et est ipse Pater: tamen significat proprietatem per modum actus, et ista significatio fundatur aliquo modo supra rem in acceptione unius ab altero.”

(iv) Rational relations: Rational relations arise when one of these conditions is lacking; see *De Pot.*, q. 7, a. 11, c., where St. Thomas gives four examples of the possible cases. (1) The relation is rational or only “of reason” if one or both of the *relata* do not exist outside the mind, as the relation between genus and species or yesterday and tomorrow. (2) If the *relata* are not really distinct outside the mind, then their relation is rational, as when we say Socrates is the same as himself. (3) The *relata* could lack order to each other if one of them is already a relation, as when the mind relates “fatherhood” to Aristotle. (4) The *relata* could lack order to each other because a foundation for the relation is found only in one of them: knowledge is really related to the known, but not vice versa. Also, bilateral symmetry (having left and right) in a non-biological thing like a rock or column are cases of this: see *In Phys.*, lib. V, lect. 3, n. 8 (Leon.2.237).

101. Compare Miller, “The Problem of Action in the Commentary of St. Thomas Aquinas on the *Physics* of Aristotle, Part II,” 223.

102. Certain rational relations are attributable to things only *qua* understood (i.e., because mind brings something to things), as the relation between genus and species. Other rational relations are attributable to the things themselves (because things bring something to the mind when understanding them), *De Pot.*, q. 7, a. 11, c.: “Secundum quod huiusmodi relationes consequuntur modum intelligendi, videlicet quod intellectus

outside the mind and so they cannot be constituted by this relation. This is because action and passion, even if they were not really distinct, are really in the thing in motion. They do not exist due to a reality granted them by the mind. Of attributable rational, categorical relations, there are two cases given by St. Thomas.¹⁰³ The first case is when one or both *relata* do not exist outside the mind (as yesterday and tomorrow). As just stated, this cannot be the case with action and passion. The second case is when the *relata* are not distinct outside the mind (as when Socrates is the same as Socrates). Action and passion cannot be a case like sameness and Socrates because they are opposed in notion (as argued above) while Socrates and himself are not.

(D) The remaining possibility is that the relation which constitutes action and passion is a transcendently rational relation. This relation found only “in speech” without falling into a category is what St. Thomas means by stating action and passion are denominated extrinsically—they are constituted by a transcendental relation of *the agent* as terminus to the *motion* as terminus in the patient. To manifest this, note first that agent and patient name subjects whereas action and passion name accidents. Second, recall that action is motion proceeding into the patient from the agent, whereas passion is motion proceeding from the agent into the patient.¹⁰⁴ Third, recall also that some rational relationships (those which exist because of mind) nonetheless implicate a remote foundation in things (today is *really* before tomorrow, but only in the mind does this relation exist fully). Finally, some

intelligit aliquid in ordine ad aliud; licet illum ordinem intellectus non adinveniat, *sed magis ex quadam necessitate consequatur modum intelligendi*. Et huiusmodi relationes intellectus non attribuit ei quod est in intellectu, sed ei quod est in re.” My emphasis. Such relations arise when the mind is forced, as it were, based upon something real in the things it considers. That is, the truth of the relation has a remote foundation in things, instead of a proximate one that real relations have; St. Thomas explains this in a case of sameness with oneself as follows, *ibid.*, ad 3: “[A]liquis est idem sibi realiter, et non solum secundum rationem, licet relatio sit secundum rationem tantum, propter hoc quod relationis causa est realis, scilicet unitas substantiae quam intellectus sub relatione intelligit.” Likewise, today is really before tomorrow even though tomorrow does not exist; Coughlin, “The Existence and Nature of Time,” 143: “Despite the fact that tomorrow does not exist today, we can hardly avoid thinking of today as before tomorrow. And the statement is no doubt true even if it involves a mere relation of reason.”

103. St. Thomas, *De Pot.*, q. 7, a. 11, c.

104. See above, fns. 87 and 94.

transcendental relations are indeed between things in different categories.¹⁰⁵

Thus, when considering the notion of “action” and “passion” we assume that agent and patient are really distinct, but these subjects must also be included in the notion of action and passion. Consequently, the “proceedings” in the definitions of action and passion must be transcendental relations because a subject is being related to a motion (an incomplete accident). Furthermore, when the mind in its consideration of the motion in the mobile sees that action and passion have an opposition in their *rationes* implying things that differ in reality (the agent and the patient), it can denominate the agent and patient with these new accidents and must conclude that they fall into different categories because of this opposition. Agent and patient as really distinct are the remote foundation for seeing the real distinction between action and passion, even though these differ only *in ratio*. Yet this act of consideration means that a rational relationship (albeit one with a remote foundation in things) is present. So, action and passion are constituted by a transcendently rational relation.¹⁰⁶

Consequently, it is of crucial importance to note that the real distinction between action and passion and their complete notions rely upon an assumed real distinction between agent and patient (as subjects), as well as a rational relationship constitutive of their *rationes*. We

105. Knowledge and the known as correlative terms are intended to signify a thing which implies another in some other category (knowledge as a habit implies known things in *any* of the categories) and hence “the knowable” cannot be a predicamental relative. St. Thomas, *Super I Sent.*, d. 30, q. 1, a. 2, c.: “Aliquando autem nomen imponitur ad significandum illud supra quod fundatur habitudo, sicut hoc nomen «scientia», qualitatem quam consequitur respectus quidam ad scibile. Unde ista talia non sunt relativa secundum esse; sed solum secundum dici. Unde ista principaliter dant intelligere rem alterius praedicamenti, et ex consequenti important relationem.”

106. Compare John of St. Thomas, *Cursus Phil.*, II, q. 14, a. 2; also, q. 19, a. 1, I:624b33–625a4: “[I]sta praedicamenta dependere ab aliquo extrinseco existente, non ut a termino, sicut relatio secundum esse, sed ut a principio et forma a qua originatur, vel circa quam versatur denominatio; et iste respectus est secundum dici, vel transcendentalis, quia licet pendeat ab existentia illius extrinseci, ut actu existenter denominet, tamen quia essentialiter et per se a tali extrinseco dependet, sicut ubi a loco, actio ab effectu, etc., ideo dicitur illa relatio transcendentalis et secundum dici. Relatio autem secundum esse non consistit in hoc solum quod pendeat ab existentia termini ut actu existat, quod aliis est commune, sed quod sit ad illum solum ut ad purum terminum.” Whether St. Thomas would have agreed entirely with this position is an interesting but additional question; see above concerning Miller’s contributions, fn. 87.

can identify these two assumptions in what St. Thomas states in his reply to the second difficulty he had added to his consideration of *Physics*, III.3, viz., that if motion is the same as action and passion then motion belongs only to those two genera and not in any others. He notes that “the *ratio* of motion is completed not only by that which obtains of motion in things, but also by that which the mind [*ratio*] apprehends.”¹⁰⁷ That is, motion in things is an imperfect *act*—as noted above, we only *see* what is actual of a motion in progress. Yet to completely understand and define motion as an *imperfect* act, the mind must apprehend—see the *logos* of—motion as an order between two terms with the requisite relation between prior and posterior.

This does not mean that the reality of motion obtains only in the mind, but that only the mind can apprehend that to which motion is ordered, even though the apprehension of this order between the motion and its terminus (which does not yet exist) is only a relation of reason.¹⁰⁸ Thus, just as it is true that Socrates *truly is* the same as himself, yet, nonetheless, understanding this relationship depends upon the use of a relation of reason, so also for the relationship between a motion and its terminus.

Analogously, action and passion are linked to motion only by the mind, albeit with a foundation in reality.

Therefore, as to that which belongs to motion in things, motion is placed by reduction in that genus which provides a terminus to motion [*in illo genera quod terminat motum*], just as the imperfect is led back to the perfect But as to that which the mind apprehends about motion, namely being a medium between two termini, so there is already implied the notion of cause and effect: *for something is reduced from potency to act only by some agent cause. And in*

107. St. Thomas, *In Phys.*, lib. III, lect. 5, n. 17 (Leon.2.115).

108. See the footnote above on the four types of relation, p. 100. Coughlin, “The Existence and Nature of Time,” 145, commenting on this passage in St. Thomas, notes: “The relation of the momentum to the term of motion is necessary in order to understand it as a division of motion, and not simply as any sort of imperfect act. Consequently, reason completes the notion of motion by understanding a relation between the momentum and the term of motion, even though that relation is not itself a real relation. Nevertheless, such a relation must be grounded on some real aspect of motion as it is outside the mind, or else its predication of the real being outside the mind is unintelligible.” Coughlin argues that place is the ground that the real order in motion demands; see also 145–451.

this way motion pertains to the predicate of action and passion, for these two predicaments are taken according to the notion of cause and effect.¹⁰⁹

That is, motion is present in the categories of action and passion only by an act of the mind seeing the implied relationship that motion has to agent and patient as the really distinct and constitutive termini of of action and passion.¹¹⁰ St. Thomas gives the reason why cause and effect are implicated in the notion of motion, namely that motion cannot occur without an agent cause. A motion cannot cause itself and therefore must depend upon something really distinct from its own subject, the mobile—whether that subject is another substance (my hand moving a stick) or another part of that substance (my muscles moving my fingers). This assumption requires proof, but given that it is true, action and passion must be distinct realities belonging to the really distinct agent and patient. Thus, action and passion are complete in their definitions as motions considered with transcendently rational relations: Motion considered together with the *secundum dici* relation between the agent *as terminus* to the motion in the patient is action; motion considered together with the *secundum dici* relation of the patient *as terminus* to the motion from the agent is passion.

4.4 *The motivation to investigate efficient causality*

Consequently, the natural philosopher is able to realize, after defining motion and arguing that motion, action, and passion must be found in the mobile, that action and passion are distinct realities provided that the agent *as terminus* and patient *as terminus* (both

109. St. Thomas, *In Phys.*, lib. III, lect. 5, n. 17 (Leon.2.115). My emphasis. St. Thomas is not conflating the order between the termini of the motion and the order between agent and patient, but drawing an analogy; see *De Pot.*, q. 3, a. 3, c.

110. Coughlin, “The Existence and Nature of Time,” 149–50: “The relation of the mobile to its term, then, is something reason understands in the momentum, but it is not a real relation in the momentum. This rational relation implies further the categories of action and passion, for the ordering to the further act is only possible through an already existent act which is present to the potential, i.e., through an agent.” Because Hume cannot account for the reality of the agent and patient, he is forced to conclude that the real causal connection between action and passion is subjective; his position correctly sees that a motion or event is joined to categories such as action and passion only by the mind, but then fails to see the real foundation of this rational relation in things, leading to a denial of their reality; Hume, *A Treatise of Human Nature*, especially Book I, Part 3, Section 6.

elements in the *rationes* of action and passion) are really and necessarily distinct. If they are, then action and passion must be really distinct and this grounds the intelligibility of causal relations insofar as such causal relations as maker and made, mover and moved, father and son, etc., are founded upon action and passion.¹¹¹ This includes the ways that a mover can be moved (i.e., by another mover as the *per se* cause of its ability to move, or accidentally by the reaction of the moved thing). This structure of substances in causal interaction where a priority of causality exists among them preserves space for the discovery of a hierarchy among substances. The key instance here would be the difference between the living and the non-living, from which difference in kind and consequent heterogeneity of activity and passivity (the living cat leaps off the non-living mat) mathematical physics abstains from considering.¹¹² This shows the importance of the topic of relation, action, passion, and motion for this project.

Furthermore, this real opposition and distinction between action and passion, insofar as it requires that agent and patient be distinct, opens up a need to definitively argue that nothing can move itself as such. Indeed, when St. Thomas comments on one of Aristotle's arguments for the motor-causality principle, he refers us to what has been discussed here in Book III.¹¹³ Thus, the natural philosopher's consideration of the relationship between motion, action, and passion are necessary for motivating questions about causality.

111. See above, fn. 100. Also, St. Thomas, *I Sent.*, d. 26, q. 2, a. 2, ad 4; *III Sent.*, d. 8, q. 1, a. 5, c.; *ST*, Ia, q. 28, a. 4, c. For the text in Aristotle's *Metaphysics*, see V.15, 1021a15ff, and St. Thomas, *In Meta.*, lib. V, lect. 17.

112. For instance, the causal neutrality of the Newtonian laws of motion (and consequently their compatibility with either holism or reductionism) is shown by Richard F. Hassing, "Animals versus the Laws of Inertia," *The Review of Metaphysics* 46, no. 1 (1992): 29–61, see in particular 41–52; see also Hassing, "History of Physics and the Thought of Jacob Klein," 232–33.

113. St. Thomas, *In Phys.*, lib. VIII, lect. 10, nn. 3–4 (Leon.2.401–402). Two arguments are raised here, viz., that mover and moved cannot be the same because they have opposing *rationes*, and that the mover is in act while the moved is in potency; these correspond to key points required in the discussion of *Physics*, III.2–3. For noting this connection I thank David Grothoff. Richard Sorabji, *The Philosophy of the Commentators, 200-600 AD: Physics* (Ithaca, N.Y.: Cornell University Press, 2005), 148–50, notes likewise that *Physics* III sets the stage for considerations of the Prime Mover as well as impetus.

§5 THE NATURAL PATH OF INVESTIGATION IN PHYSICS LEADS FROM THE PRINCIPLES, CAUSES, SUBJECT, AND DEFINITION OF MOTION TO CONSIDER THE PRIMARY CONCOMITANTS AND CONSEQUENTS OF MOTION. (*Physics*, BOOKS III–VI)

Motion implies an understanding of activity and passivity which calls for further investigation, for if a mobile, insofar as it is passive, receives its act as mobile from a really distinct agent, which agent is itself in motion, we are led to ask about the ensuing causal chain. Yet Aristotle does not move immediately to investigate the relationship between mover and moved. This is put off until Books VII–VIII.¹¹⁴ Indeed, when introducing the subject of motion, Aristotle had already proposed an order of investigation. This order is based upon what was laid down in his *prooemium*, viz., that what is common must be investigated before what is proper.¹¹⁵ That is, Aristotle postpones the investigation into efficient causes until he has explicated the concomitants to motion because these concomitants of motion are more general to the subject matter of natural philosophy. Furthermore, this is reasonable and necessary because they are more proximate to motion's relationship with the mobile as subject. This order of inquiry unfolds more of the *logos* belonging to mobile beings, which is to say, what reality belongs to them. This mode of physical inquiry, carried out in words and not in images of quantity or numbers, typifies Aristotelian-Thomistic physics.¹¹⁶

The concomitants of motion are realities which are posterior to motion in the order of understanding in natural science.¹¹⁷ The particular aspects in question are place, void, time, and corporeality. These concomitants of motion allow us to make *a posteriori* arguments for the character of the *primum mobile*. The burden of the line of reasoning in the remaining sections of this chapter, then, is to identify a connection between these predicates of mobile

114. St. Thomas, *In Phys.*, lib. III, lect. 1, n. 1 (Leon.2.56).

115. Aristotle, *Physics*, III.1, 200b12–25; St. Thomas, *In Phys.*, lib. III, lect. 1, n. 3 (Leon.2.56).

116. See above, fn. 75, as well as below, Ch. 6, §25, fn. 228.

117. Following St. Thomas, *ibid.*, I call them concomitants. See also Philoponus, *On Aristotle's Physics 3*, 12, whose term is translated as “incidental,” but his Greek term stems from παρακολουγεῖν, to follow, and can mean a logical property, an inseparable connection, or attribute, and thus should not be taken as “incidental” in a weak sense.

beings and, for each of them except the void, some principle of their reality.

§6 THE EXISTENCE OF PLACE REQUIRES AN ULTIMATE PRINCIPLE OF IMMOBILITY FOR BEING PLACED. (*Physics*, BOOK IV.1–5)

. . . I'll follow you then; wherever
You place the shores, I ask, "What of the spear?
Where does it fly?"

LUCRETIUS
On the Nature of Things, I.978–80

If the conditioned is given, then the whole sum of conditions, and hence the absolutely unconditioned, is also given, through which alone the conditioned was possible. . . . Thesis: The world has a beginning in time, and in space it is also enclosed in boundaries. Antithesis: The world has no beginning and no bounds in space, but is infinite with regard to both time and space.

IMMANUEL KANT
Critique of Pure Reason, B436, 454–55

If the last sphere be not in a place, this is only because nothing is able to be outside it, not because of a lack of the aptitude [to be in place].

ST. THOMAS AQUINAS
Super Boetium de Trinitate, q. 4, a. 3, c.

In this section I will consider the key element of the definition of place, viz., that it must be immobile. If place must be immobile and places which we observe are moving containers or places only in a qualified sense, then their immobility must be founded upon some immobile principle. Thus, some first immobile principle of place must exist. After considering this resolution, certain difficulties will be advanced from accounts of place or space proposed

after Aristotle. Indeed, the question of place and its relationship to the universe as a whole is most difficult.¹¹⁸

6.1 A short note on the infinite

While this project cannot treat expressly of Aristotle's consideration of the infinite in *Physics* III.4–8, it is useful to note that it is logically prior to his consideration of place.¹¹⁹ Were rectilinear motions possibly infinite, Aristotle's notion of place would be useless as their measure. Consequently, if there is no infinite body, then place will be a finite being—whatever place turns out to be. Furthermore, since place, on Aristotle's full account, is the first immobile container of the placed body and this immobility is determined with reference to some first, immobile position, then the finitude of body shores up Aristotle's inquiry concerning place.¹²⁰

6.2 The definition of place

Aristotle begins his treatment of place by establishing that it exists. In a passage analogous to the fundamental realization that “nothing comes from nothing,” we are told that “all assume beings to be somewhere, for non-being is nowhere.”¹²¹ While it is unclear what place is, that it exists is clear from mutual replacement of bodies as well as the “power” which

118. Edward Grant, *Planets, Stars, and Orbs: The Medieval Cosmos, 1200-1687* (Cambridge ; New York: Cambridge University Press, 1994), 124, quotes Franciscus Toletus: “Dubium hoc praecipuum est in hac materia propter summam ipsius difficultatem.” For this topic, consider *ibid.*, 122–35, and Edward Grant, “The Medieval Doctrine of Place: Some Fundamental Problems and Solutions,” in *Studi sul XIV secolo in memoria di Anneliese Maier*, ed. Alfonso Maierù and Agostino Paravicini Bagliani (Roma: Ed. di Storia e Letteratura, 1981), 57–79.

119. Donal F. Scholz, “Aristotle's Definition of Place” (Ph.D. Diss., Université Laval, 1962), 68.

120. The consideration of infinity also serves to more fully restrict mathematical abstractions and imagination from serving as the measure of physical truth. The infinite can seem to be actual due to mistaken imagination; Aristotle, *Physics* III.8, 208a14–19. See also St. Thomas, *In Boet. de Trin.*, q. 6, a. 2, c.: judgments in natural philosophy must resolve to the level of sensible objects, not to the imagination, as is proper to mathematics. The presence in our imagination of a space beyond the limits of the universe is not sufficient for establishing its existence, even though it is impossible to avoid imagining this exterior space. The impossibility of infinite bodies conjoined with a reminder of the proper mode of judgment in natural philosophy motivates questions about the nature of place in the finite universe.

121. Aristotle, *Physics*, IV.1, 208b30–31.

place possesses as a natural principle.¹²² These pieces of evidence are proper to a discussion belonging to natural philosophy. As Aristotle observes, “[P]lace would not be sought if there were not motion according to place.”¹²³ The reality of motion, in this case local motion, is better known to us and is the light under which we see the existence of place.¹²⁴

Now, even mathematical objects have relative position of their parts, and so, one could argue, physical place is really nothing other than relative position.¹²⁵ However, if motion is an act which really belongs to a subject, then the location which measures local motion must be real. Likewise, if place has a certain “power” or natural character as an end of motion, it must exist in some way to provide such teleological order. Finally, if movers really act on the mobiles which they move locally, then local motion is not entirely a relation, for then it would be just as true to say the mover moved the rest of the universe; here the “fundamental experience of action and power” which was developed in Book III can be brought to bear.¹²⁶

Aristotle dialectically prepares for his definition by considering how “in” is said in various ways and whether something can be “in itself”; he begins his proper treatment of the definition of place with certain axioms—what we naturally know about place.¹²⁷ Aristotle assumes that

122. Aristotle, *Physics*, IV.1, 208b7–11; St. Thomas, *In Phys.*, lib. IV, lect. 1, nn. 6–7 (Leon.2.147). See also Macierowski and Hassing, “Philoponus on Aristotle’s Definition of Nature,” 80–81; as ancient and medieval physical theories after Aristotle adopted a view closer to that of absolute Newtonian space, the way became open for an ateleological natural “order,” and consequently one entirely mathematical; on this “emancipation” of space as a concept from Aristotelianism, see Max Jammer, *Concepts of Space: The History of Theories of Space in Physics*, 3rd ed. (Mineola, NY: Dover Publications, 1993), 53–94. Consider also Mohan Matthen and R. J. Hankinson, “Aristotle’s Universe: Its Form and Matter,” *Synthese* 96, no. 3 (September 1993): 417–435. Modern thinkers, suggests Emma R. Jones, “The Nature of Place and the Place of Nature in Plato’s *Timaeus* and Aristotle’s *Physics*,” *Epoché* 16, no. 2 (2012): 264–65, require a phenomenological rehabilitation of the “life-world” of natural place such that nature as a principle of motion, and motion to natural places, makes more sense over and against mathematical, Newtonian falsified imagination.

123. Aristotle, *Physics*, IV.4, 211a12–13.

124. Coughlin, *Physics*, 96, n. 25.

125. Aristotle considers and rejects this when discussing the power of natural place, that place is not relative to us; see 208b7–25, and especially 208b22–25.

126. Coughlin, “Appendix 7: Place,” in *Physics*, 258. He supplements my first argument just given by citing Aristotle’s argument that there is no change in the category of relation or position (*situs*); hence if place were a mere predicamental relation it would eliminate the reality of local motion. See also Benjamin Morison, *On Location: Aristotle’s Concept of Place* (Oxford University Press, 2002), 169–71.

127. Aristotle, *Physics*, IV.3, 210a14–24 (and see V.5, 213b30–213a1), IV.4, 210b32–211a7. See also Grant, “The Medieval Doctrine of Place: Some Fundamental Problems and Solutions,” 57.

place is a container (and not part of the contained), that place is a commensurate container (neither less than nor greater than the contained), that place is separable from the contained, and that place has natural types. The first is clear from our experience of being “in” a place.¹²⁸ Following upon this notion of containment, the second axiom is made clear by a distinction between common and proper place: it is clearly different for the room which contains the glass of water and the glass to provide a place for the water. The third is made clear from our experience of mutual replacement. The fourth axiom draws from experiences which the modern scientific imagination finds questionable, but which are nonetheless defensible; we must pass over such a defense here.¹²⁹

After these *praecognoscenda*, Aristotle presents four options for the genus of place: form, matter, space, or the extremes of the containing body.¹³⁰ He then proceeds to eliminate each option with the exception of the extremes. Further, it cannot be the extremes of the contained body (by the third axiom; otherwise no body could move locally except by deformation). The remaining option is the containing body. To this, Aristotle adds the specific difference that place is immobile. This feature is what we must consider carefully.

6.3 *Immobility in the definition of place*

The key text is from Aristotle’s completion of the definition of place:

[J]ust as a jar is a transferable place, so is place an immovable jar. Whence, when what is within moves and changes in a moving thing, as a ship in a river,

128. Albert Einstein, *Relativity: The Special and General Theory, A Popular Exposition*, trans. Robert R. Lawson (New York: Wings Books, 1961), 156–68, also recognizes this implicitly when he discusses the “psychological origin of the idea of space.”

129. Concerning natural place, see Coughlin, “Appendix 7: Place,” in *Physics*, 259–60. The usual objections are based on the principle of inertia; see William A. Wallace, “Newtonian Antinomies Against the Prima Via,” *The Thomist* 19 (1956): 176–86, and James A. Weisheipl, “Natural and Compulsory Movement,” *The New Scholasticism* 29, no. 1 (1955): 50–81. There are various examples of natural place that still seem relevant: e.g., the specific gravities of fluids or the local center of gravity of a system of massive bodies.

130. Coughlin, “Appendix 7: Place,” in *Physics*, 254, implicitly argues that these are the only options based upon the axioms Aristotle allows, in particular that place and the placed are equal. That is, if the equality axiom is true, then place is either material and internal (matter), material and external (space), formal and internal (form), or formal but external (the extremes of the body).

it uses the container more as a jar than as a place. One intends place, however, to be immobile. Whence, the whole river is more the place, because the whole is immobile. Whence, place is the first immobile limit of the containing [body].¹³¹

The key is that the true notion of place cannot admit mobility. The discussion of the jar and the ship in a river are meant to lead us to add “immobile” to the definition which Aristotle proposed a few lines earlier, viz., that place is “the limit of the containing body.” This need for immobility follows from what Aristotle lists as a common notion about place, that place is separable from the placed. Once we determine what place is more specifically, then it becomes a question as to *how* the immobility of place is explained. That is, if place is the surface of the containing *body*, and if it also seems to be the case that all bodies providing such containment are in motion, then how is such a surface immobile?

The immobility of place is not merely a conceptual requirement that can be waived off.¹³² Rather, that place must be immobile is a requirement of its existence. Indeed, if place moved in place, then place would be “in itself” in a very odd way. Furthermore, place as an immobile terminus for motion must exist if local motion is to exist. If place as such moved in place (or were moveable in principle), then no termini would be possible, due to the infinite regress that would arise. Thus, we are not speaking of an epistemic measure but an ontological measure.¹³³ Were place mobile, it could not measure the bodies moving in place such as to

131. *Physics*, IV.4, 212a15–21.

132. For historical overviews of this note of “immobility” causing interpretive difficulties, see Richard Sorabji, *Matter, Space and Motion: Theories in Antiquity and Their Sequel* (Ithaca, NY: Cornell University Press, 1992), 186–201. The notion that place or space must be immobile, whatever its precise definition, is something common to physicists in general—even relative frames of reference are constituted by immobile coordinate systems. Isaac Newton, *The Principia*, trans. Andrew Motte (Amherst, N.Y.: Prometheus Books, 1995), 79, maintains that order of the parts of true place is immutable. Aristotle’s consideration, however, has been thought doomed: Pierre Duhem, *Medieval Cosmology: Theories of Infinity, Place, Time, Void, and the Plurality of Worlds*, ed. and trans. Roger Ariew (Chicago: University of Chicago Press, 1985), 139, notes that: “Peripatetic theory of place rested upon two essential propositions: According to the first, the place of a body must contain the body. According to the second, the place of a body must be a motionless thing, for it is the fixed term to which all local movement is referred. Moreover, these two propositions are condemned to be unreconciled in the framework of Peripatetic physics.”

133. See John of St. Thomas, *Curs. Phil.*, II:337b19–40, 339a14–340a17. Above, p. 127, I noted the connection between knowing the existence of local motion and knowing the real existence of place; this is an order in our knowledge (that we are led to know the existence of place because we see local motions). Here the order is

provide a real terminus to moving body so that it might gain a new being, viz., a new place. Were place mobile, one of the principles of motion discovered in Book I (the form) would itself have been subject to change and hence would no longer be a principle.¹³⁴

6.4 The principle of the immobility of place

How are we to defend this immobile referent? A difficulty is that this immobile referent that “immobilizes” place—the banks of the river in Aristotle’s example—is a common and not a proper place.¹³⁵ Aristotle’s definition would, then, not be commensurate with what he

the reverse, the order in being: local motion could not fully exist without place as a terminus. Place provides the remote foundation in things by which the mind truthfully knows motion under a rational relation (the mobile in motion in relation to its terminus must be a rational relation because the terminus does not yet exist). However, the place that *is now* the *terminus ad quem* exists concurrently with the motion, and consequently we can refer this rational relationship truthfully to things. See Coughlin, “The Existence and Nature of Time,” 146.

I maintain that even though St. Thomas calls place and time “extrinsic measures” of the mobile—see *In Phys.*, lib. III, lect. 1, n. 3 (Leon.2.102) and lib. IV, lect. 1, n. 1 (Leon.2.146)—this is not meant as a measure in the sense of a method for determining a quantitative result. An extrinsic measure is a being that provides a principle of measure that does not constitute the quantity of only that being; *II Sent.*, d. 2, q. 1, a. 2, ad 1: “[M]ensura est duplex. Quaedam intrinseca, quae est in mensurato sicut accidens in subjecto; et haec multiplicatur ad multiplicationem mensurati; sicut plures lineae sunt quae mesurant longitudinem plurium corporum aequalium. Est etiam quaedam mensura extrinseca; et hanc non est necesse multiplicari ad multiplicationem mensuratorum, sed est in uno sicut in subjecto ad quod multa mesurantur, sicut multi panni mesurantur ad longitudinem unius ulnae: et hoc modo multi motus mesurantur ad numerum unius primi motus, qui numerus est tempus; et multa permanentia ad unitatem unius permanentis, quod est aevum.” Consider also *In Phys.*, lib. III, lect. 5, n. 15 (Leon.2.114) and *De Pot.*, q. 7, a. 9, c. A somewhat comparable notion is proposed by Sokolowski in “Measurement,” in *Pictures, Quotations, and Distinctions: Fourteen Essays in Phenomenology* (Notre Dame: University of Notre Dame Press, 1992), 139–54. However, Sokolowski’s contrast between extrinsic and intrinsic measurement finds a closer parallel to De Koninck’s discussion of the constitution of a mixed science—how mathematics can be applied to physics. See below, §24.

Now measure “habet rationem principii, quia per mensuram res mensuratae cognoscuntur, res autem cognoscuntur per sua propria principia. Et ex hoc patet, quod unum est principium noti *vel cognoscibilis* circa quodlibet, et est in omnibus principium cognoscendi.” (*In Meta.*, lib. V, lect. 8, n. 872, my emphasis.) Measure as a principle of *knowability* can therefore be something real in the thing. By knowing this ontological measure (whether intrinsic or extrinsic, e.g., place), we would know something of the ontologically measured (where the body is). Morison, *On Location*, 172–73, points out something similar, that Aristotle’s analysis of place is not aimed at providing answers to “where questions” in the sense of measurements but what it is we are looking for when we ask such questions. Just as modern politics, in Francis Slade’s distinction, focuses on regime arguments and not philosophical arguments about constitutions, so also Aristotelian physics does not focus on measurement methods but an analysis of the essence of what the measurements seek.

134. This position, that place is an independent, real basis for the reality of motion’s order to its terminus along with the order which the agent brings to the patient mobile (see above, fn. 109), could be subject to modification under a modern view of space; see below, p. 137.

135. Grant, “The Medieval Doctrine of Place: Some Fundamental Problems and Solutions,” 59–60.

wanted to define. Coughlin notes two problems: “[H]ow is the river immobile, given that it is always flowing?” and “[I]s not the river only a common place for the boat? How is Aristotle’s text of any help, if the place must equal the placed?”¹³⁶ Indeed, Aristotle’s example of the river “deliberately [chooses] an example where the motion of the container is a given.”¹³⁷ Perhaps Aristotle’s example of the river can become a model for a universe which seems to have no one part at permanent rest with respect to which the proper place of any body could be called immobile.

Concerning the first problem, Coughlin, following St. Thomas, begins with the principle that the unity of the immobility of the containing body “is from the form or order, while the diversity is from the material.”¹³⁸ The surface of the water against the boat, the order of the parts of the river to its banks, and its bank in relation to the earth are formally unified; it is the water that shifts through this relative ordering. Coughlin uses this formal unity to draw his conclusion, based on the idea that the “order” in question “is an order of position.”¹³⁹

Because position follows immediately upon dimensions, and place is an accident of a body, i.e., a dimensional thing, the surface of a body can be in a position. So the common place, which is the river, can be immobile formally, or in position. But even the surface of water which is in immediate contact with the ship can have a determinate and immobile position relative to the whole river, despite the fact that the water continues to flow past it. The motion of the water, the surface of which is the immediate place of the ship, is no more destructive of the immobility of that surface, considered as having a determinate, immobile

136. Coughlin, “Appendix 7: Place,” in *Physics*, 257.

137. Ibid.

138. Ibid., 257. St. Thomas’ discussion of this problem, and his resolution of the immobility of place to the outermost celestial sphere, can be found *In Phys.*, lib. IV, lect. 7, nn. 13–15 (Leon.2.168–69).

139. Coughlin, “Appendix 7: Place,” 257. By “position” or *situs* here is meant the order of parts in a whole—not the category of *situs*, for the category implies the notion of place, whereas *situs* as order of parts within a whole is a difference in the category of quantity. See St. Thomas, *In Phys.*, lib. IV, lect. 7, n. 4 (Leon.2.167), and compare *ibid.*, lib. III, lect. 5, n. 15 (Leon.2.114). Since place is also in the category of quantity, immobility can be properly added to place, insofar as it implies *situs* as a species-making difference in quantity as a genus and not a categorical reality.

position relative to the whole river, than the motion of the water is destructive of the immobility of the river as a whole.¹⁴⁰

That is, place is immobile because place is constituted in part by a relation of position which possesses immobility. Place has position because “to be place” is to be a type of surface (a containing one), which is part of a body, and position follows upon body. This position of the containing surface has immobility in virtue of fixed reference points (in this example, the banks of the river). Place, then, as the dimensional container of the placed, can have immobility in virtue of the position its dimensions imply. Here we see that the notion of containment is important, for we cannot eliminate place in favor of mere position without making irrelevant the axioms that place contains the placed and does so commensurately.¹⁴¹

Aristotle’s image of a ship in a river might be a good local illustration, but how does this analogy map onto the bodies anywhere in the cosmos? Coughlin discusses Aristotle’s implicit solution to this second problem, which locates the referent in the outer sphere.¹⁴² The fixity of any proper place is established by resolving the immobility of the position of the containing surfaces to the immobility belonging to the outermost sphere: “The complete notion of place in all containing things is from the first thing containing and locating, namely the heaven.”¹⁴³ The “complete notion” of place, including the required element of immobility, therefore belongs to all immediately locating bodies *per aliud*, namely in virtue of the unmoving poles of the universe.

If the sphere is to be the source of the immobility of position, it must itself, in some way, be absolutely immobile translationally—which it would be if the cosmos is finite.¹⁴⁴ It

140. Coughlin, “Appendix 7: Place,” 257. The fact that the water erodes the river banks adds only another level to the problem (that the soil of the banks is also mobile) and hence, the same solution would apply: the banks are immobile in reference to an immobile first in the position of the banks relative to the earth as a whole. See also St. Thomas, *In Phys.*, lib. IV, lect. 6, n. 14 (Leon.2.164–65).

141. Coughlin, *ibid.*, n. 13, 261.

142. *Ibid.*, 257–58; St. Thomas, *In Phys.*, lib. IV, lect. 7, nn. 13–15 (Leon.2.)168–69; Scholz, “Aristotle’s Definition of Place,” 260–61.

143. St. Thomas, *In Phys.*, lib. IV, lect. 6, n. 14 (Leon.2.165).

144. Another problem to be averted here is explaining how the sphere could change in place, by rotation, if

follows that the axis of the rotating sphere is the source of the immobility of position and, consequently, of place.¹⁴⁵ In the “complete notion” of place, the property of “immobility” possessed by the first containing surface exists because those surfaces possess a constant relation of position to points in the universe which are immobile. Just as the surfaces of the moving water containing the resting boat have a constant relation of position to the banks of the river, which do not move, so also do surfaces of moving and containing bodies in the cosmos have a constant relation of position to the poles of the universe (which do not move, and consequently the *situs* of the sphere does not move). In this way, Aristotelian place is grounded on a natural order or cosmic frame of reference. Insofar as we conceive of the *situs* or position of the surfaces of the locating body in relation to the whole universe, where *situs* is a difference of parts within a whole, we must conceive of the cosmos as an ordered whole.

However, does this conception of cosmic position make place merely a relation of positioned bodies? Furthermore, without assuming the existence of the outer sphere and (hence) the finitude of the universe, is there a necessity for a first, immobile referent through which the relative positions of proper places are immobile? The solution to the second question requires us to answer the first question. A first immobile principle of place would be that with reference to which (through a formal order of position) all primary containing surfaces are

it is not in place. The reply is that the essence of rotational motion is only that a body moves around an axis; containment by other bodies is accidental; Aristotle, *Physics*, IV.5, 212b7–23. John of St. Thomas, *Curs. Phil.*, q. 16, a. 1, II:340, argues that the change of the outermost sphere is not one of order or *situs*. Place is immobile by immobility of order of *situs*, not by all types of immobility. The heavens do not move as to order of *situs*, and this suffices such that, II:340b36–38: “quatenus omnes superficies sub eadem coordinatione et termino ad primum locans succedunt.” This is a complex problem in the history of cosmology. See Grant, “The Medieval Doctrine of Place: Some Fundamental Problems and Solutions,” 63–65, 66, 68, for the Thomistic origin of the theory of formal place, its development, and objections against formal place from Scotus and Ockham. Grant also discusses, in *Planets, Stars, and Orbs*, 122–35, the history of the problem of whether the outermost sphere has a place, a history leading to theories of intrinsic place, which when taken together with questions of extracosmic void space, motivated the theories of absolute space in Newton; see 135 and 169–85. See also Duhem, *Medieval Cosmology*, 155–57, where he discusses St. Thomas’ position on formal place. On 173–78 Duhem discusses the problem of the place of the outermost sphere, noting how, on 181, this led to one of the propositions condemned in 1277 by Etienne Tempier: “*Quod Deus non possit movere Caelum motu recto. Et ratio est quia tunc relinqueret vacuum.*”

145. Coughlin, “Appendix 7: Place,” pp. 257–58.

immobile. However, such a principle must exist based on three converging conditions: first, local motion is real and hence must have termini which are in some way immobile; second, local motion is change of place and not a change in a relation; and third, the conditions or grounds of immobile proper places cannot continue to infinity.

That local motion exists has already been assumed and it has been argued that the places in and through which bodies undergo local motion must be immobile.¹⁴⁶ Concerning the second condition, place is a reality which is not a mere relation. In addition to the arguments presented above, we can draw an argument from the passage where Aristotle excludes motion from the category of relation:

Neither [is there motion] in relation. For it can be true that, one of the terms changing, the other changes not at all; whence, motion among relations is accidental.¹⁴⁷

That is, relation is a being which is towards another, and hence can “change” without its subject changing. This excludes a *per se* change because the potency of the mobile itself is not required. Real motion—the type defined in Book III—exists in the mobile as in a subject as the imperfect act to which the subject is in potency. Since this is lacking in the relational “shift,” true motion is not involved.¹⁴⁸ Coughlin draws out how this refutes the position that change of place is merely relative:

If, in fact, place is nothing but a relation, then change of place amounts to a change in relation presupposing no other change. But a relation is what it is in virtue of some other attribute of the thing which has a relation.¹⁴⁹

This entails that place itself cannot be purely relative, “for relations only change in virtue of the foundation of the relations changing, but it is assumed” in the counterfactual case of

146. See above, p. 130.

147. Aristotle, *Physics*, V.2, 225a11-13. St. Thomas notes that this argument also excludes position and *habitus*, *In Phys.*, lib. V, lect. 3, n. 3 (Leon.2.236). Coughlin’s exposition of place’s immobility follows St. Thomas here, “Appendix 7: Place,” 258.

148. St. Thomas, *In Phys.*, lib. V, lect. 3, n. 7 (Leon.2.237).

149. Coughlin, *Physics*, 117, n. 12.

relative place, “that there is no such thing in the case of place.”¹⁵⁰ Consequently, if place were merely the relation of position, there would be no basis in things for explaining why existing local motions are *per se* changes.

If place is truly predicated of a thing moving locally, and this predication of change of place depends upon the existence of a proper place, and this proper place must be immobile, then we can construct an infinite regress argument to say that there must be a first principle of place; this is the third condition.¹⁵¹ If it is a moving body that provides the first immobile containing surface to the body in that place, then a source of that immobility must exist. For if the immobile referent is merely immobile in one respect but moving in another respect, then this referent is only changing place due to another immobile referent, and so on. Were there no first immobile referent, there would not be a first immobile containing surface of any body and, consequently, the observed effect (that a body is changing place and place cannot change place) would be uncaused. The immobile proper place, if it is moving, can only be immobile *per aliud*, and the *per aliud* is impossible without the *per se*. Therefore, some first immobile principle of place exists.

This point can be made in another way. This order of immobility is an ontological requirement.¹⁵² In order to be immobile, the changeless formal position or *situs* of the proximate containing surface depends upon a subject which is immobile—this can occur even if the subject of those surfaces is shifting, as the water in the river. If this is the case, viz., that the subject of the immobile containing surface is itself moving, then the immobility of that surface must have reference to some other immobile subject. Now, an order of subjects, which is a material order of causality, cannot proceed to infinity.¹⁵³ Consequently, some first subject

150. Ibid.

151. Morison, *On Location*, 137–38, 146–50 interprets this principle of place as the “maximal surrounder” of the placed body, viz., the universe as a whole. In Aristotle’s definition of place, “the surrounding body” according to Morison is the universe itself.

152. See above, p. 130.

153. Aristotle, *Metaphysics*, II.2, 994a11–20.

must exist that sustains the immobility of the immediate containing surface. What exactly this first principle or subject is cannot be determined from this argument alone. We could surmise that this principle must be something of body insofar as it is an immobile principle of position, which follows upon dimensionality. The nature of this first, situationally immobile, quantitative thing is another inquiry.

6.5 A modern difficulty with this account of place

The complete account of what place is, then, cannot be gleaned from the resources of the *Physics* taken alone. Indeed, Aristotle's account of place, in the commentary tradition, was elaborated by many further embellishments and specifications. For instance, one stems from a difficulty arising from St. Thomas' interpretation of Aristotle's example of the boat on the river; this interpretation developed into the medieval theory of formal place.¹⁵⁴ Another concerns the category of "where." Since formal place helps to define place as a quantity—how is "to be in place" or to have a "where" an independent category?¹⁵⁵

154. See St. Thomas, *In Phys.*, lib. IV, lect. 6, nn. 14–15 (Leon.2.164–65). Grant, "The Medieval Doctrine of Place: Some Fundamental Problems and Solutions," 63–72, discusses the Thomistic origin of the notion of formal place. Duhem, *Medieval Cosmology*, 155ff, also notes that Robert Grosseteste's *summa* of Aristotle's *Physics* is the origin of the terminology of the distinction between formal and material place. Morison, *On Location*, 171, notes the similarity of his interpretation of Aristotle's doctrine to the medieval account of formal place, but differs in a key respect. See also Sorabji, *Matter, Space and Motion*, 190. Formal place requires that place be something other than the surfaces of the surrounding bodies themselves, because surfaces are absolute accidents of the surrounding bodies, and thus the surfaces depart when those bodies move. Since place cannot move, the *surfaces* themselves are not place. Besides arguments already cited from St. Thomas above, John Poinsot emphasizes this, *Curs. Phil.*, q. 16, a. 1, II:338b35–339a9: "[L]ocus non est sola superficies, ut inhaerens corpori locanti, sic enim non est magis immobilis, quam superficies locati, et movetur moto ipso corpore, cui inhaeret. Nec est ipsa superficies, ut praecise continens aliud; sic enim etiam invenitur in vase, quod continet liquorem, et movetur cum illo; locus autem, ut dixit Philosophus, est vas immobile. Quare locus debet esse superficies continens, secundum ordinem situs, et distantiae, et positionis in universo; hoc enim praecise nomine loci significamus, et distinguimus diversa loca secundum diversas positiones, in quibus ordinantur." This line of reasoning demonstrates why Morison's interpretation of Aristotelian place falls short, for he holds that the surfaces themselves are place: Morison, *On Location*, 171–72.

155. St. Thomas, *In Meta.*, lib. V, lect. 17, n. 1005: "Alia vero genera magis consequuntur relationem, quam possint relationem causare. Nam quando consistit in aliquali relatione ad tempus. Ubi vero, ad locum. Positio autem ordinem partium importat. Habitus autem relationem habentis ad habitum." Also, *In Phys.*, lib. III, lect. 5, n. 15: "Exteriores autem mensurae sunt tempus et locus: secundum igitur quod aliquid denominatur a tempore, est praedicamentum quando; secundum autem quod denominatur a loco, est praedicamentum

Now, place as an ontological measure of motion provides one of the real foundations in things that allows us to say that motion is really ordered to a terminus.¹⁵⁶ This leads to a distinctively modern difficulty about the first moved mover in connection to place: “It seems more difficult to explain the immobility of place . . . if the universe is expanding . . .

Perhaps all we can say is that place (and time) do not exist in as perfect a manner as Aristotle and Newton assumed, so that the immobility of place (and the simultaneity of time) is somewhat relative. That is, place might be immobile relative to some things but not to everything. Still, if place is not perfectly immobile, then it seems it must be somewhat mobile, and place will change place, an evident absurdity. It might be better to say, then, that the expansion takes its origin from something the physicists call a “singularity,” from which the big bang began to boom, and that this origin provides a sort of immobile referent for position. If this is reasonable, then we could have the immobility of the surfaces which materially constitute place in much the same way as Aristotle had it by reference to the outer sphere and, more ultimately, to the axis of rotation of the universe.¹⁵⁷

This further determination of the precise nature of the immobile principle of place, however, must be left for Chapter 5.

ubi et situs, quod addit supra ubi ordinem partium in loco.” (Leon.2.114) See also John of St. Thomas, *Curs. Phil.*, II:342a3–22. Perhaps since *to be in a place* implies a relation between the place itself (a quantity) and the body in that place (a substance), “where” is constituted by a relation that is a transcendental and not a predicamental relation, for relations between accidents and a substance cannot be predicamental. This means that the where of a body is denominated extrinsically from its place as a quantity. This feature of transcendental relations or relations *secundum dici* was noted in §4. Further, the predicamental relation between place and the placed is not founded on the mere quantities and positions involved; rather, it is founded on the action and passion required for physical bodies to be placed. Place as a real physical quantity contains bodies by touching or some other mode of physical containing involving action and passion for the sake of bodies achieving or maintaining their natural places or “where’s.” See St. Thomas, *In Phys.*, lib. IV, lect. 6, n. 17, and *ibid.*, lect. 8, n. 7 (Leon.2.165, 171–72). That the natural relation of place and placed is founded on action and passion must be qualified in the case of the heavens, for the aether of celestial bodies touches without being touched; see *De Generatione.*, I.6, 323a26–32 and Christopher A. Decaen, “Aristotle’s Aether and Contemporary Science,” *The Thomist: A Speculative Quarterly Review* 68, no. 3 (2004): 389, fn. 40 and 392–93, fn. 50. This relation is also real insofar as the place and the placed are simultaneously real, distinct subjects with an order to each other (*viz.*, that founded on action and passion).

156. See p. 130; also, Coughlin, “The Existence and Nature of Time,” 149–51. The other real foundation in things is the fact that the agent cause of any motion possesses the terminus of the motion in its power.

157. Coughlin, “Appendix 7: Place,” p. 259.

§7 THE EXISTENCE OF TIME AS A MEASURE OF ABSOLUTE SIMULTANEITY DEPENDS UPON THE UNITY OF A COSMIC MEASURE OF TIME; IF ABSOLUTE SIMULTANEITY CAN BE DEFENDED INDEPENDENTLY, THEN A SINGLE COSMIC MEASURE OF TIME MUST EXIST. (*Physics*, BOOK IV.10–14)

It is worth looking into how time is related to the soul, and why there seems to be time in all things, both in the earth and in the sea and in the heaven.

ARISTOTLE
Physics, 223a15–17

This section has a two-part argument to one conclusion. First, if time is an extrinsic measure of a motion, this can only be through the “being together” of the cause of that motion measuring that motion. If that measure is in motion through another cause, then we have a causal series which must resolve to a first motion and hence a first mobile. Furthermore, if there is only one time for all motions, then there must be a first motion which measures all time. Thus, using a causal series we resolve how time is measured and through the unity of time we conclude that this measurement of all motions is resolved to the same first measure and not many.

I will proceed by briefly recounting how Aristotle arrives at his definition of time. Then, I will draw certain points from this definition which raise the question about how time is measured in all things. Finally, we will examine the argument for a first cosmic measure of time.

7.1 *The definition of time*

In typical fashion, Aristotle begins his treatment of time by asking whether it exists.¹⁵⁸ The existence of time is difficult to grasp; indeed, so difficult that Aristotle returns to this topic at the end of his treatment of time, for *Physics* IV.14 considers whether time exists only if the numbering mind exists. If time does exist in some sense, then, on the one hand, time is not

158. Aristotle, *Physics* IV.10, 217b32–33: “Some might suspect from the following, then, that [time] either does not exist at all, or exists scarcely and faintly.”

motion and yet, on the other hand, time is not apart from motion.¹⁵⁹ We should notice here that Aristotle, to connect time and motion, appeals to our experience of time for his proof of the fact.¹⁶⁰ This mode of procedure some find difficult because it seems to imply that we argue for the existence of a thing based upon what is phenomenal or psychological.¹⁶¹

Yet this position—that we sense time upon sensing motion—preserves us from the natural illusion of “making a substance out of uniform motion.”¹⁶² It is unnecessary that Aristotle’s position be maintaining an inferential connection between the sensation of motion and that of time. The two are sensed together without inference, just as by perceiving color we perceive surface, or by perceiving local motion we perceive place. This points to the fact that Aristotle’s argument for time being something of motion assumes no Cartesian divide between our sensation and the world, just as the sensation of motion assumes no such divide. Further, this means that the Aristotelian theory of time maintains, against Newton, that time is not an absolute being existing apart from motion. Yet it maintains with Newton that there is one cosmic time for all motions. With Einstein, the Aristotelian maintains that time is not separate from motion, but finds its subject in the mobile’s motion. Yet Einstein’s account of time seems to demand that time is not one in all motions. These differences thus cleanly oppose the three theories about time.¹⁶³ Just as Aristotle’s emphasis on containment and being “in” are essential for preserving the physical understanding of place in contrast to a mathematical conception, so also his emphasis on our sensation of time preserves the nat-

159. Aristotle, *Physics* IV.10–11, gives two arguments for the former (218b10–13, 218b13–b18) and one for the latter (218b21–219a10). St. Thomas notes this order of Aristotle’s preliminaries, spanning the tenth and eleventh chapters, *In Phys.*, lib. IV, lect. 16, n. 1 and n. 4 (Leon.2.199, 200).

160. Aristotle, *Physics*, IV.11, 219a2–10.

161. David Bostock, “Aristotle’s Account of Time,” *Phronesis* 25, no. 2 (1980): 148, claims that Aristotle’s argument is inadequate because time can pass without our noticing, as when we are asleep, when “there is no obvious reason to think that during all that time there has been movement.” Its basis is false, Bostock claims, because we also notice time when perceive nothing moving and all is at rest. His first point is puzzling because this is what Aristotle takes as the very evidence that motion and time cannot be without each other. The second point Aristotle later answers by saying that rest is measured accidentally by motion, *Physics*, IV.12, 221b7ff.

162. Coughlin, “Appendix 9: Time,” 266, and see 266–67.

163. See Coughlin, “Appendix 9: Time,” 271–72.

ural philosopher from mathematizing time.¹⁶⁴ Without retaining the connection to motion as sensed, the physicist's notion of time becomes a mere mathematical order.

Given that time is something of motion, Aristotle determines its definition by adding two specifying elements: "before and after" and "number." Time is, then, "the number of motion according to the before and after."¹⁶⁵ The "before and after" intended here is that belonging to motion itself, which follows upon the continuity and order of magnitude.¹⁶⁶ Since time is something "of motion," being parasitic or dependent upon it, time derives its character from what characterizes motion. The mind can apprehend discrete "now's" which

164. A student of De Koninck's, Robert Labrie, "Commentaire du traite du temps d'Aristote" (Ph.D., Université Laval, 1952), 252–55, argues against the mathematical interpretation of Aristotelian time presented by Joseph Moreau, "Le Temps selon Aristote (à suivre)," *Revue Philosophique de Louvain* 46, no. 9 (1948): 69, 80–81. Moreau's mistake derives from conceiving of motion as a succession of moments, and failing to distinguish between time itself and its Cartesian, mathematical representation.

165. Aristotle, *Physics*, IV.11, 219b2.

166. *Ibid.*, 219a10–19. The usual objection against this element is that it is circular, assuming the precise notion of before and after in time; Denis Corish, "Aristotle's Attempted Derivation of Temporal Order from That of Movement and Space," *Phronesis: A Journal of Ancient Philosophy* 21, no. 3 (1976): 241–251. Corish's difficulty is most keenly felt in 247–49, where he depends upon describing the "precedes–succeeds" relation in terms of a symbolic representation such as a number line; under such a conception, he concludes that spatial asymmetry provides no hints to determine why body should have ontological priority in the "precedes–succeeds" relation before motion, and that before time.

The text of St. Thomas, which Corish himself quotes, clarifies the problem if we properly understand the definition of motion; St. Thomas, *In Phys.*, lib. IV, lect. 17, nn. 6–7 as well as n. 10: "Si quis autem obiiciat contra praedictam definitionem, quod prius et posterius tempore determinantur, et sic definitio est circularis, dicendum est quod prius et posterius ponuntur in definitione temporis, secundum quod causantur in motu ex magnitudine, et non secundum quod mensurantur ex tempore. Et ideo supra Aristoteles ostendit quod prius et posterius prius sunt in magnitudine quam in motu, et in motu quam in tempore, ut haec obiectio excludatur." (Leon.2.203) This only helps to demonstrate the ontological priority of magnitude when one realizes that motion cannot exist without an order to its terminus (whether actual or contained within the power of the agent), and consequently the potential local terminus of any motion provides the principle according to which possible "before's" and "after's" are found in space.

Furthermore, the existence of natural place as well as the existence of directedness in living things (which have by nature a "forward" and "backward" position) provide a basis in bodily motions for before and after (directedness is thus transferred to artificial things—as the fore and aft of naval vessels). Such a concrete consideration would be lost to a mathematical account of time. See also Paul F. Conen, "Aristotle's Definition of Time," *New Scholasticism* 26, no. 4 (1952): 444, who invokes Simplicus. Bostock, "Aristotle's Account of Time," 151 is stymied by such suggestions, arguing that making the "before and after" that of motion makes it unclear how this indicates a *temporal* extent, rather than, e.g., a spatial extent. It seems Aristotle himself anticipates this at 219a20ff, saying that "the before and after in motion, as to subject, are motion; nevertheless, to be this [the before and after,] is different and not motion." The precise aspect of the before and after in motion which constitutes time is enumeration, thus differentiating time from motion (and raising further issues concerning how time exists apart from a numbering soul).

determine a motion according to before and after. By comparing these we number the parts of a motion.¹⁶⁷

7.2 Two central difficulties about time

This definition has at least two crucial difficulties. The first concerns how time is measured if it is always something belonging to motion. If there are many motions, how can we explain that they are all measured by one time?¹⁶⁸ The second difficulty is that time, in itself, is a numbered number. That is, time in its subject, the mobile, is not the number by which something is numbered (the concept of “five”) but the numbered number (“five cows”).¹⁶⁹ If time is formally a number, does it only exist in the soul? The definition leaves little room for time’s independent being—indeed time seems little more than an aspect of motion, viz., its enumerability. Here we can see the paucity of being which time possesses, a mere “moving

167. Aristotle, *Physics*, IV.11, 219a25–b9. This apprehension of discrete “now’s” is necessary to answer difficulties such as Bostock’s, who points out that if time is continuous, as motion and magnitude are, it is difficult to see how time is also a number, a discrete quantity; Bostock, “Aristotle’s Account of Time,” 152ff. Conen, “Aristotle’s Definition of Time,” 445–48, again follows Simplicius, who maintains that the discrete “now” is unlike the discrete unit in that the latter does not mark out a continuous magnitude. “Number” is used in an analogous sense, for the continuity of motion is numerable, not number itself.

168. Aristotle, *Physics*, IV.12, 221a1–10, where Aristotle argues that time is the measure of the very being of motion. This question is the second question which Aristotle raises in IV.14, according to St. Thomas, viz., how time is unified if time is a measure. St. Thomas, *In Phys.*, lib. IV, lect. 23, n. 6 (Leon.2.223), calls it the “[quaestio] de unitate temporis, sive de comparatione temporis ad motum.” Labrie, “Commentaire du traite du temps d’Aristote,” 179, argues that these two problems do not belong to the natural philosopher to solve, but rather to the metaphysician, for a particular science assumes the existence and unity of its subject. I deny the inference here because time is not the subject of physics but a property of mobile being studied by the natural philosopher. Furthermore, unlike the Eleatic problem in Book I which denied the existence of motion, the difficulties here do not deny the existence or unity of time, but raise difficulties concerning its existence and unity based upon the definition already established; viz., if time is a number, does it exist apart from soul, and if time is something of motion, how is there one time for all things? As such, it belongs to the natural philosopher to clarify the topic and prevent false inferences from being drawn based upon the definition. This apparent conflict between time as a measure of motion and the cosmological unity of time is akin to the apparent conflict between place being the first containing surface of a body in place and place also being immobile—both are solved in similar ways, contra Gernot Böhme, *Zeit und Zahl: Studien zur Zeittheorie bei Platon, Aristoteles, Leibniz und Kant* (Frankfurt am Main: Vittorio Klostermann, 1973), 163 (cited in Johannes Fritsche, “The Unity of Time in Aristotle,” *Graduate Faculty Philosophy Journal* 17, nos. 1-2 (1994): 104–105), who maintains “that Aristotle’s assumption of time’s cosmological unity goes back to the Parmenidean presupposition of being’s unity, but is in fact no longer compatible with his account of time. Once time’s existence is grounded in motion, time’s cosmological unity must be given up.”

169. Aristotle, *Physics*, IV.14, 223b3ff; compare 219b15–28, where Aristotle points out that the now is the point-like subject of motion as numerable, and 220b5–13.

shadow.” The reality of time in motion is, like the reality of number in things, a difficult reality to grasp distinctly.¹⁷⁰

This second difficulty can be addressed briefly. The tenuous existence of time is akin to the tenuous existence of place. Is place nothing more than a relation of position? Now, place is really in things and it is not merely a relation of position, because the new reality gained in a change of place cannot be accounted for through the category of relation. Similarly, time has a real foundation in things because there is a real order between the prior and posterior parts of a motion, which in turn are possible because of real potencies in the mobiles themselves as ordered to real termini. Thus, the order between before and after in time and in motion is led back to real relations obtaining between bodies. The fact that these bodies have a real possibility for motion entails that they have in them the possibility for a historical order of their arrangement. This is time as numerable, an aspect of the being of motion that really exists only as an instant. Time’s full existence as number only comes about through the soul, just as the full understanding of a motion (whose termini do not exist) requires a contribution by the mind. Time depends upon the mind not only for its being a measure (as place also does—for measure in the fullest sense implies use of the measure to know), but also for its being as a complete quantity. Apart from soul, time has only an imperfect existence. Nonetheless, time has a real existence, which is completed by the mind in some way, just as time’s subject (motion) is fully understood as to its beginning and end only by the mind.¹⁷¹

170. This is the first question which Aristotle raises in *Physics*, IV.14; see St. Thomas, *In Phys.*, lib. IV, lect. 23, n. 1: “Postquam philosophus determinavit de tempore, hic removet quasdam dubitationes circa tempus. Et primo circa existentiam temporis; secundo circa temporis unitatem.” (Leon.2.222)

171. Concerning the imperfect existence of time, see St. Thomas, *In Phys.*, lib. IV, lect. 23, n. 5 (Leon.2.223). Coughlin, “The Existence and Nature of Time,” 158–60, notes the completion which the mind “adds” to time when commenting on the following text of St. Thomas, *In Meta.*, lib. V, lect. 15, where St. Thomas is trying to reconcile the fact that in the *Metaphysics*’s treatment of quantity, place and time are not included as quantities, while they are in the *Categories*; n. 986: “Sciendum est autem, quod philosophus in *Praedicamentis* posuit tempus quantitatem per se, cum hic [viz., the *Metaphysics*] ponat ipsum quantitatem per accidens; quia ibi distinxit species quantitatis secundum diversas rationes mensurae. Aliam enim rationem mensurae habet tempus, quod est mensura extrinseca, et magnitudo, quae est mensura intrinseca. Et ideo ponitur ibi ut alia species quantitatis. Hic autem considerat species quantitatis quantum ad ipsum esse quantitatis. Et

What about the first difficulty? If Aristotle's position requires that time be a measure only when in the presence of soul, is time a unified numerable for all motions—is there only one time for the soul to measure? Aristotle defends the affirmative answer by resolving the enumerability of all motions to the first motion of the first mobile. Does this work as a solution? That is, the now of time is found to be the same across many subjects that are in motion; it differs in being just as motion differs in being, namely, as it progresses or passes and becomes other than itself. How, then, can time be *one* across many subjects when their motions are not one? If time is one, and yet still requires motion to be its subject, how is this possible given the obvious fact that there are many motions?¹⁷²

ideo illa, quae non habent esse quantitatis nisi ex alio, non ponit hic species quantitatis, sed quantitates per accidens, ut motum et tempus. Motus autem non habet aliam rationem mensurae quam tempus et magnitudo. Et ideo nec hic nec ibi ponitur quantitatis species. Locus autem ponitur ibi species quantitatis, non hic, quia habet aliam rationem mensurae, sed non aliud esse quantitatis.” Coughlin notes, *ibid.*, 159–60: “The text from St. Thomas, then, seems to say that time and place are not distinct quantities in themselves, that is, in their natural modes of being, but are so only insofar as we measure something, namely motion, by them. But such measurement, whether it have a natural basis are not, is only intelligible on the assumption that there is a mind doing the measuring. Still, place has an abiding existence, and so what is place as a thing outside the mind, namely, the surface of containing body or, on a more Newtonian or Einsteinian view, the independent dimensions of space, does have part outside of part, as required for quantity, while time and motion do not. Thus, while the mind provides the notion of measurement for both time and place, it provides for time also that permanence necessary for quantity.”

Thus, one must properly identify the contributions which the mind makes to our object of study and the realities which follow upon the object itself. St. Thomas, when speaking of “measuring,” is not only speaking of an epistemic act but an ontological foundation, albeit one that requires the mind to have the complete notion of being a measure. Thus, St. Thomas states in *In Phys.*, lib. IV, lect. 17, n. 4 (Leon.2.202), that all other motions are “caused and measured” by the first motion, implicated a notion of measure that is not purely epistemic. Such a distinction is also found in Peter John Olivi; see Fritsche, “The Unity of Time in Aristotle,” 105–106, 108. Likewise, “when” as a distinct category must be constituted as to its notion by a transcendental relation. St. Thomas, *In Meta.*, lib. V, lect. 17, n. 1005, maintains that “quando consistit in aliquali relatione ad tempus,” viz., that between time as a quantity and the substance or accident in time, for “aliquid dicitur esse quando vel ubi per denominationem a tempore vel a loco,” as St. Thomas notes *In Phys.*, lib. III, lect. 5, n. 15 (Leon.2.114). This categorial theme cannot be pursued at length.

172. See Aristotle, *Physics*, IV.11, 219b10–11, and 223a30–b13. Aristotle's solution is frequently argued against. See also Coughlin, *Physics*, 100, fn. 77. Aristotle asserts elsewhere that time is one numerically for all motions: *ibid.*, IV.12, 220b5–7. Augustin Mansion, “La théorie aristotélicienne du temps chez les péripatéticiens médiévaux: Averroès, Albert le Grand, Thomas d'Aquin,” *Revue néo-scholastique de philosophie* 36, no. 41 (1934): 277–79, maintains that Aristotle's original doctrine suffers from the unresolved logical incoherence between the multiplicity of subjects of motion and the unity of time, while the medieval commentators misinterpreted the text in *Physics* IV.14, 223b13–22, as referring to the Stagirite's solution. Labrie, “Commentaire du traite du temps d'Aristote,” 200–206 defends the unity of the text, and 206–20, offers his commentary on Aristotle's solution. Fritsche, “The Unity of Time in Aristotle” is a recent attempt to recapitulate Aristotle's solution. This is contrary to the view of Wieland, who maintains that Aristotle's *Physics*

7.3 *The cosmic measure of time*

The solution can be obtained through an argument in two parts. First, if time is the measure of motion, this can only be through the “being together” of the cause of that motion itself with the caused and measured motion. If that measure is in motion through another cause, then we have a causal series which must resolve to a first motion and hence a first mobile. If, independently, one can show that time is one, then there must be one such motion. However, we can make this claim in the second part of the argument through the nature of dimensionality. Using a causal series we resolve how time is measured, while through the unity of time we conclude that this measurement of all motions is resolved to the same first measure and not many.

First part of the argument, from causality

Time is the measure of a motion and this “measurement” can only be accomplished by a causal measuring motion that is “at once” or *simul*—“together with”—that motion.¹⁷³ A measure must be homogeneous with the thing measured—whether directly or indirectly. Thus, a

is not metaphysical but a conceptual analysis of the everyday language used to describe the natural world; Wolfgang Wieland, “Aristotle’s Physics and the Problem of Inquiry Into Principles,” in *Articles on Aristotle*, ed. Jonathan Barnes, Malcolm Schofield, and Richard Sorabji (Duckworth, 1975), 140 and Wieland, *Die aristotelische Physik*, 132–33, 280. Concepts such as time are quasi-Kantian “concepts of reflection” according to Wieland, concepts which are not directed at objects but at the conditions by which we can have concepts of certain objects. Consequently, Wieland’s interpretation of Aristotelian time as a concept of reflection is inconsistent with the conclusion that the first sphere’s motion is the unifier of time; this is, instead (*ibid.*, 328, cited by Fritsche, “Unity of Time,” 103), a “backlash of cosmology onto physics.” Fritsche (111–12) notes how the causality of the heavens can unify time for all terrestrial motions, and (112–15) attempts to clarify these cosmological assumptions in Aristotle’s solution, noting that Aristotle’s theory of time is a modification of Plato’s theory of time for purposes of sustaining cosmological causality.

173. My argument here draws its structure from R. Glen Coughlin, *Musings on Time*, Thomas Aquinas College, November 2012, accessed December 29, 2014. This lecture also contains the substance of helpful comments Coughlin made at the 2012 meeting of the American Catholic Philosophical Association on my presentation of draft versions of the materials in Chs. 3–4. Following Coughlin, I emphasize that the term “together” or “togetherness” must be used, to avoid the appearance of circularity when discussing moments that are together, i.e., simultaneous. This is also noted by Tony Roark, *Aristotle on Time: A Study of the Physics* (Cambridge: Cambridge University Press, 2011), 180–81, against Ursula Coope, *Time for Aristotle* (Oxford University Press, USA, 2005), 4, 116, that ἄμα should be translated “together.”

length is measured by a length (directly homogeneous), and temperature is measured by the volume of a mercury column (indirectly homogeneous).¹⁷⁴ As it is only in the mind that the complete notion of measure is found, beforehand, before taking the measure to things, we have only the “natural measure” or ontological measure which provides the principle or ground for the knowability of that being as measured. This is what Aristotle means when speaking of the numbered number in contradistinction to the number by which we number.

If time is a number of motion, then it is a counting of a motion—and hence must be counted by a homogenous thing, i.e. a motion. Thus we routinely use a motion to measure a time (the motion of the hands of a clock), and we even name times to measure the length of a motion—‘It will take five minutes to walk there,’ or ‘New York is four hours away.’¹⁷⁵ If the measure by which one measures is a motion (outside the soul), then the before’s and after’s of the measuring motion coincide with those of the measured motion (or, equivalently, the measured time). This is similar to the case of the ruler measuring a length—the ends of the lengths must be *simul* or together in place.¹⁷⁶

How does this occur in a motion? The *termini* of the motions (the measured motion and the measuring motion) are not in the same mobile, so how could they be together? We can’t “check” that both motions are together using another, separate *motion*, e.g., were we to confirm, using a stopwatch, that the runner crossed the finish line together with the end of the timepiece’s motion. This would just reduplicate the problem. Furthermore, we could think that this “togetherness” is provided by the *imagination*, but this would just be measurement in the mind, whereas Aristotle clearly means that time (at least in the sense of the numbered number and not the number by which we number) is in things.¹⁷⁷ Likewise

174. The indirect homogeneity reduces to direct homogeneity. In the case of the mercury column, this would be the causal link between the capacity for expansion caused by the heat of the measured body and the effected expansion in the measuring body, viz. the change of volume of the mercury column.

175. Compare Aristotle, *Physics*, IV.12, 220b15ff.

176. Coughlin, “Appendix 9: Time,” 270.

177. These last two arguments noted by Coughlin, *Musings on Time*. The latter argument directly, as well as the one following to some degree, counters the position defended at length by Roark, *Aristotle on Time*, 181–

we cannot “check” using *sensation* that the motions are together, for we would then have the same difficulty with the “togetherness” of our act of sensation and the motion(s) in question. Besides, these latter two options rely too heavily on the presence of the mind. Time as a numbered number is not a feature of the mind (*pace* Kant), and yet it is not absolute or separate from motion (*pace* Newton). While we require sensation to determine empirically when events are simultaneous, as Einstein indicates, this is not the same as the being of simultaneity in things.¹⁷⁸

The being of simultaneity outside the soul must therefore be founded upon something that is beyond what the mind contributes to time.¹⁷⁹ The solution to this *aporia* can be found

84, who resolves the togetherness of motions to phantasms and perceptions. The passage Roark relies on, from *De Anima* III.2, 426b20–30, argues that simultaneity is measured by perception from the conclusion that the common sense faculty is that by which the soul judges and compares perceptions together and consequently in an undivided time. This view of simultaneity flows from Roark’s “hylomorphic” interpretation of time, where motion is the matter of time and its perception is its form; *ibid.*, 183: “Put in the simplest terms possible, the hylomorphic interpretation analyzes simultaneity in terms of joint perceptibility. Since kinetic cuts are the matter of nows while perception provides their form, the inclusion of both kinetic cuts and perception in the definiens guarantees that strict simultaneity is defined here as a genuinely temporal relation.” To the problem of how time exists apart from the numbering soul, St. Thomas proposes an answer similar to Roark’s in *I Sent.*, d. 19, q. 2, a. 1, c: “Et haec duo, scilicet prius et posterius, secundum quod numerantur per animam, habent rationem mensurae per modum numeri, quae tempus est. Unde dicit Philosophus, IV *Physicorum*, quod tempus est numerus motus secundum prius et posterius. Et est numerus numeratus, et non numerus simpliciter. Sicut enim dicimus quod duo canes est numerus numeratus, et duo est numerus simpliciter; ita etiam numerus prioris et posterioris in motu est numerus numeratus, qui est tempus. Ex quo patet quod illud quod est de tempore quasi materiale, fundatur in motu, scilicet prius et posterius; quod autem est formale, completur in operatione animae numerantis: propter quod dicit Philosophus, IV *Physic.* quod si non esset anima, non esset tempus.” This comes in the context of a discussion of God’s eternity. However, St. Thomas’ solution in the *Physics* commentary is to distinguish between time as numbered and time as numbering: *In Phys.*, lib. IV, lect. 23, n. 5 (Leon.2.223). To reconcile the two, Labrie, “Commentaire du traite du temps d’Aristote,” 190–95, a student of De Koninck’s, proposes that in the *Physics*, St. Thomas considers time materially (as to its subject) in order to clarify how it has existence in nature, while in the *Sentences* commentary he considers time formally so as to contrast it with eternity as clearly as possible. Without this material aspect, time would only be a being of reason and would no longer fall under physics.

178. Coughlin, “Appendix 9: Time,” 271, provides this observation, that Einstein’s notion of simultaneity as simultaneity of perception (or measurement) cannot be sufficient, for “if this is all there is to it, are we not claiming that our perceptions determine the physical world?” For Einstein’s defense that simultaneity is a meaningless and deceptive notion apart from such measurement, see Einstein, *Relativity*, 26. As De Koninck is keen to point out in his consideration of Eddington’s philosophy of science, the mathematical physicist’s formal object of study is constructed by measurement, and hence as long as this limit is recognized, an observation like Coughlin’s can exist alongside the contention of the mathematical physicist such as Einstein—albeit the philosophical appetite would like to see that and why they are not as incompatible as they seem; consider “The Philosophy of Sir Arthur Eddington,” De Koninck, *Writings*, Vol. 1, 118–30.

179. Coughlin, “Appendix 9: Time,” 271.

in causality. Two reasons causality is promising as a solution are that it is actually in the things apart from the mind's cognitive response and its source, the agent, is present together with the motion. These two provide the mental independence and togetherness requisite for the solution.

We can see this by the following argument. As argued in §4, the act of the mover and the act of the mobile are numerically one act. If we are considering movers which are also moved (I move the cup by putting my hand in motion), the motion of the cup and the hand are *simul*, and hence the before and after in the act caused by my hand *as mover* is numerically the same as the before and after in the cup *as moved*. Because the cup's motion is caused, the before and after in its motion *as moved* is also caused and not possessed *per se*. Since the *per aliud* must reduce to the *per se*, the before and after which "counts out" the motion must originate with the causality involved. Now, if the mover is itself moved, then the mover's own motion is, in turn, counted by what is moving it. What this means is that the togetherness of motions is maintained through the presence of a causal link.¹⁸⁰ Thus, for all motions to be simultaneous, there must be a single source of causality that unifies them as such. In this way, the notion of simultaneity could be resolved to the responsibility of a first mover of all cosmic motions, were such an argument provided.

Second part of the argument, from dimensionality

However, could we prove "the unity of the now" *without* proving in advance that all motions are causally connected to one first cause?¹⁸¹ Some quantities have parts which do not have relative position, viz., number and time.¹⁸² The parts of number do not have relative position

180. Coughlin suggests that we can confirm this conclusion by an inductive elimination, viz., that no other category apart from action and passion can explain how motions can be together. Coughlin, *Musings on Time*; also, personal conversation. He fleshes out this suggestion in R. Glen Coughlin, "The Ground and Properties of Time," *The Aquinas Review* 19 (2013): 68–69.

181. Again, Coughlin proposes such an argument: Coughlin, *Musings on Time*; also, personal conversation. See also Coughlin, "The Ground and Properties of Time," 72, 75.

182. See Aristotle, *Categories*, ch. 6.

because spatial relatedness is by definition not found in discrete quantity. Time does not have parts which have relative position because certain parts of time (past and future) do not exist at once with the present.¹⁸³ If the parts do not endure, they cannot have relative position (they nonetheless have a real order, which the mind knows through the rational relations between past, present, and future). Quantities whose parts have relative position, then, must have parts that do endure, otherwise there can be no real relation between the parts.

Yet if no quantities with non-enduring parts are quantities whose parts have relative position, then, conversely, no quantities whose parts have relative position are quantities with non-enduring parts. Obversely, all quantities whose parts have relative position are quantities with enduring parts. Therefore, if things have an actual spatial relation, then they must share a now. However, bodies do have an actual spatial relation. Thus, if there is one space, then there is one time. But there is one space. So there is one time.¹⁸⁴

183. Ibid., 5a25ff.

184. Now, it does not follow from this that any intra-cosmic causal agent could affect or receive information from simultaneously existing parts of space at any arbitrary distance. That is, the “signal” principle of relativity theory is not the same principle as the simultaneity of the parts of space. Yet, this position does have the consequence that there is unobservable simultaneity insofar as relativity theory defines simultaneity in conjunction with the speed of light as a universal constant. Indeed, Einstein himself seems to assume this unobservable simultaneity in his thought experiment with the lightning strikes: see Einstein, *Relativity*, 26 (also, see Coughlin, “Appendix 9: Time,” 271, who makes the following argument, which is also made by Richard Swinburne, “Verificationism and Theories of Space-Time,” in *Space, Time and Causality*, ed. Richard Swinburne, Royal Institute of Philosophy Conferences 157 (Dordrecht: D. Reidel, 1983), 70–72). In Einstein’s thought experiment, an observer sits “between” the two events and must await the results of his observation. Thus, before he is informed as to the simultaneity or non-simultaneity of the distant events, he assumes that the causal transmission of the information signal (light beam) is acting through all the intervening parts of space. The very notion of “between” implies that the light beams are “out there somewhere” in the interim. If one stipulates the reality of this transversal and the action of light on absorbing and reflecting bodies, one consequently assumes an unobserved simultaneity, namely, the simultaneity of the parts of space acted upon during a sequence of causal action and passion. The objection that this necessity is merely one in our thinking, viz., because we cannot *imagine* otherwise, does not militate against this position, for the claim here is not about something in the imagination but depends upon an argument regarding the nature of space and the action of light, whatever this might mean precisely. Space cannot be there to bear light as a signal of simultaneity unless its parts are simultaneous in some more fundamental sense.

Conclusion to the argument

Since, by the first part of the argument, time *in re* is measured through the motion of the cause of all motions, and, if there is one time, then there is one such motion. However, by the second part of the argument, there is only one time. We can conclude that there is some one cause whose motion measures all time.¹⁸⁵ Aristotle's suggested conclusion concerning the first measure of time is as follows:

Whence also, time seems to be the motion of the sphere; because the other motions are measured by this motion, and time by this motion.¹⁸⁶

However, this conclusion to the existence of the outermost sphere relies upon experience which is primitive and not primary. In order to revise this conclusion by replacing the primitive while retaining what is primary and perennial, we would have to say how time still obtains a causal unification for real simultaneity. The agent responsible has not yet been identified in our inquiry. Furthermore, the experience by which we can perceive or observe this motion may not be one belonging to common experience.¹⁸⁷ Indeed, Aristotle's "celestial

185. Coughlin notes, in *Musings on Time* and "The Ground and Properties of Time," 77, that these two parts motivate us to wonder about the connection between dimension and causality in the universe.

186. Aristotle, *Physics*, Book IV, ch. 14, 223b21–23. Other scholars have noted problems which arise in this passage when relating Aristotle's natural philosophical and cosmological works. Fritsche, "The Unity of Time in Aristotle," 101–102, refers us to Wolfgang Wieland's interpretation of the *Physics* as an analysis of forms of speech only and not realities, of which time is one example. Thus, the concrete conclusion Aristotle floats in the passage just quoted is an intrusion of cosmology into Aristotelian "verbal" physics; see *ibid.*, 103, where Fritsche refers us to Wieland, *Die aristotelische Physik*, 328: "Indeed, we have here an instance of the retroactive effect of cosmology upon physics. One can see from this that the absoluteness and unity of time—incidentally, likewise one of those unquestioned, accepted assumptions of modern physics only criticized in our century—is to Aristotle at least not a physical but rather a cosmological postulate." ("In der Tat haben wir hier eines der Beispiele für die Rückwirkung der Kosmologie auf die Physik. Man kann daraus ersehen, dass die Absolutheit und Einheit der Zeit—übrigens ebenfalls eine jener von der neuzeitlichen Physik unbefragt übernommenen und erst in unserem Jahrhundert kritisierten Voraussetzungen—bei Aristoteles jedenfalls nicht ein physikalisches, sondern ein kosmologisches Postulat ist.") While I agree with Wieland that the turn to cosmological details is necessary to complete the account of time, it does not follow that arguments in natural philosophy do not touch reality in some significant way.

187. De Koninck, "Random Reflections on Science and Calculation," 101–102. Labrie, "Commentaire du traité du temps d'Aristote," 221–22, follows his teacher's thought. For instance, if the first motion were the expansion of space, then only very specialized observations, made only in the last century, suffice to "perceive" its existence. On "perceiving" the existence of the first mobile in any given motion, see St. Thomas, *In Phys.*, lib. IV, lect. 17, nn. 3–4 (Leon.2.202), as well as Duhem, *Medieval Cosmology*, 313–15.

reductionism” of time to the first heavenly sphere is an empirically testable hypothesis of sorts, whose falsification began with Kepler and ended with Newton.¹⁸⁸ Yet the perennial claim of natural philosophy is not made at a level of concretion which requires specialized experimental evidence, but at the level of common and primary experience. The modern replacement to the *primum mobile* will be discussed in Chapter 5.

§8 THE IMPOSSIBILITY OF THE VOID INDICATES THAT SOME COSMIC PLENUM MUST EXIST; FURTHERMORE, SINCE EVERY BEING WHICH IS IN MOTION MUST BE A BODY, IF THERE IS A FIRST MOVED MOVER, THEN THE NATURE OF THE FIRST MOVED MOVER MUST SHARE IN CORPOREALITY IN SOME WAY. (*Physics*, BOOK IV.6–9 AND BOOK VI)

Nor is there any emptiness; for the empty is nothing; and so that which is nothing cannot be.

MELISSUS, DK 7

If being is divided, it moves; and if it moved, it could not be.

MELISSUS, DK 10

In this section, I mention two theses that are important to Aristotelian natural philosophy but which this dissertation cannot defend at length. First, the void does not exist.¹⁸⁹ Second, every being which is in motion must be a body.¹⁹⁰ The importance of these two theses will become more evident in the following two chapters. The core argument of Chapter 3 depends upon the divisibility of the mobile to argue that it cannot be the source of its own motion. Aristotle’s understanding that void is impossible motivates his search for the interstellar medium, also discussed in Chapters 3–4. Finally, the general truths about the non-existence

188. Piero E. Ariotti, “The Conception of Time in Late Antiquity,” *International Philosophical Quarterly* 12, no. 4 (1972): 528.

189. Coughlin, “Appendix 8: Void,” in *Physics*, 263–65, and Decaen, “The Existence of Aether” discuss the principal arguments at greater length.

190. See Marcus R. Berquist, “The Proof of the First Mover in Physics VII, 1,” *The Aquinas Review* 17 (2010): 48–51. §8.2, below, is a greatly condensed version of the core argument in my “Mobiles, Bodies, and the Science of Quantified Motion: *Corpus* in Aquinas’s Exposition of *Physics* VI.4 and in Early Modern Mathematical Physics” (Ph.L. Thesis, The Catholic University of America, 2011).

of void and the corporeality of mobile being can still guide more specific scientific inquiries, even after Aristotle's have been removed.

8.1 *The non-existence of the void*

Aristotle offers arguments against the existence of the void in *Physics* IV.6–9. The heaven-filling aetherial medium is only argued for later in the *De Caelo*. Even many of Aristotle's arguments in the *Physics* against the existence of the void are presented as probable or dialectical.¹⁹¹ Here, we must assume that what Aristotle means by “the void” in this context is place without body or that in which there is no tangible substance.¹⁹² The central, demonstrative argument against the void's existence is found in *Physics*, IV.8, 216a26–b12.

The argument depends upon something akin to the indiscernibility of identicals. In this case, the identicals are the body entering the void-space without displacing the void (as void cannot move, since it is not a body, it cannot be displaced). Given the priority in being which the body's dimensions have to its other accidents (most importantly, sensible qualities, via which it interacts and bears relations to other parts of its environment), quantity is the only remaining feature by which the void could be distinguished from the body coincident with it. This is what Aristotle takes to be impossible: “that two bodies cannot be together [*esse simul*] is not due to matter or sensible qualities but only to dimensions, in which there can be no diversity (if they are equal) except according to position [*situs*].”¹⁹³ This requires that the impossibility of interpenetration of bodies follows immediately upon dimensionality and not upon a qualitative accident or force.¹⁹⁴ This follows if prime matter is a principle of

191. St. Thomas, *In Phys.*, lib. IV, lect. 12, nn. 10, 13–14 (Leon.2.178–79).

192. Aristotle, *Physics* IV.7, 213b30–214a4.

193. St. Thomas, *In Phys.*, lib. IV, lect. 13, n. 1 (Leon.2.190). Decaen, “The Existence of Aether,” 118–34, discusses the whole argument at length. Aristotle adds a further *reductio* argument to the effect that identical but distinguishable void spaces may as well be infinite, *Physics* IV.8, 216a26–b12.

194. St. Thomas defends this in *SBdT*, q. 4, a. 3, c. In this context, “body” means a continuum of three dimensions whose enduring parts have relative position; hence, its parts must be simultaneous in time; a body is thus “every way divisible,” as Aristotle notes in the *De Caelo*, I.1, 268a6. See also *In De Caelo*, lib. I, lect. 2, n. 3 (Leon.3.6); *De Ente*, cap. 1 (Leon.43.371:110–15): “Corpus enim, secundum quod est in genere

dimensionality by being the principle of individuation.¹⁹⁵ If void is impossible, because the resulting penetration of void by body is impossible, then it follows as a corollary that where there seems to be void there must be body of some sort—a plenum. What this plenum is would require an additional positive argument.

8.2 *The corporeality of mobiles*

Aristotle provides the proof that every *per se* mobile is divisible (and hence, a body) in *Physics* VI.4.¹⁹⁶ The discussion depends upon Aristotle’s physical treatment of the nature of the continuum early on in *Physics* VI, where he argues that the continuum cannot be composed of indivisibles.

Aristotle’s demonstration relies on the essentials pertaining to the definition of motion. Every change is from something and to something. This is a specification of the “structure” implicit in motion due to the order to the last act and the order to the current potency. Given this structure, five options are logically possible for the mobile. The mobile can either be wholly in the *terminus ad quem*, wholly in the *terminus a quo*, wholly in both terms, in neither term, or partly in one and partly in the other term.¹⁹⁷ Which option allows for the full *ratio* of motion to be present such that the mobile is actually moving? St. Thomas presents the fifth option as the minor term of the demonstration implicit in *Physics* VI.4: “Every thing that changes, while it changes, as to something of itself is in one, and as to something of itself is in another.”¹⁹⁸ This can be rephrased as every thing that is changing is partly in one and partly in another. The predicate is *per se* (without a middle term) due

substantiae, dicitur ex eo quod habet talem naturam, ut in eo possint designari tres dimensiones; ipsae enim tres dimensiones designatae sunt corpus, quod est in genere quantitatis.” The modern use of “dimension” is not intended, viz., any measurable aspect of a subject (thus, even the weight or speed of a body would be one of its dimensions; see Descartes, *Philosophical Writings of Descartes*, 62–63).

195. Ibid., a. 2. See also Wippel, *The Metaphysical Thought of Thomas Aquinas*, 351–78, as well as Coughlin, “The Ground and Properties of Time,” 25–35.

196. Aristotle, *Physics*, VI.4, 234b10–20. The contrapositive thesis, that no indivisible is moveable *per se*, is defended in *Physics* VI.10, 240b8–241a25.

197. See St. Thomas, *In Phys.*, lib. VI, lect. 5, n. 14 (Leon.2.285–86).

198. Ibid.

to the very nature of motion, making the nature of motion the cause of the conclusion. The implied major term is every thing that is partly in one and partly in another is divisible. This premise is *per se* because the divisible is what has part outside of part.¹⁹⁹

Since the mobile is other than the extrinsic termini that bound its motion, something can accrue to the mobile in which motion inheres independently of the determinate nature of the termini to which the nature of motion refers. Now, motion as an imperfect act requires that the mobile be in a way *here* and in a way *there*. “Here” and “there” do not necessarily imply anything determinate about the nature of the termini as places (i.e., limits of containing bodies), but merely import a recognition that this change is according to some quantity. Continuous magnitude is that whose parts have relative position or *situs*—a here and a there. Therefore, in order to be capable of motion the same numerical subject must be able to possess both a here and a there, otherwise it cannot be in motion. This is to be divisible: to be partly in one and partly in another, having part outside of part. Since “body” is what is divisible in every way, and because any continuum cannot be composed of parts consisting only of a penultimate dimension (lines by points, planes by lines, and solids by planes), it follows that a naturally mobile being apt to move in any natural dimension must be a body.

Consequently, this argument uses the potentiality of the mobile and the “structure” which motion implies to manifest that the mobile requires divisibility as a condition of its motion, and as a consequence bodily being. For every *per se* mobile aspect of the observable universe, we must infer the presence not only of a subject of motion of some type but also something that is bodily *in some way*, that is, something with part outside of part.²⁰⁰

199. This argument, just as Aristotle’s refutation of the void, is not without its difficulties. For instance, does the argument beg the question when it assumes that there is a “next place” for the mobile? For a reply, see Berquist, “The Proof of the First Mover in Physics VII, 1,” 50.

200. This is not to say that *any* change or otherness over time requires that that very otherness be “dimensional” in the sense defined above. Thus, alterations imply a mobile subject with dimensions, but such a qualitative alteration is not itself a dimension. A difficulty from modern physics is whether or not light itself is such a *per se* mobile and thus a “body” in the Aristotelian sense, since light takes time to travel. I expand on a suggestion made by David Grothoff, “The Motion and Incorporeity of Light in Aristotle and Beyond (unpublished paper)” (The Society for Aristotelian Studies, June 2011), 21–24. We should distin-

CONCLUSIONS AND OBSERVATIONS FROM CHAPTER 2

Nature as a *per se* principle and cause of motion and rest is knowable from common, primary experience. By asking about the ultimate priority of *per se* or *per accidens* causality, the natural philosopher realizes that—apart from the more familiar realms of human luck and biological chance—some argument on a cosmological scale is needed to determinately settle the ultimate priority of *per se* efficient causality. Further, the definition of motion and the comparison of motion with action and passion and the subject of motion provide further clues concerning the need to resolve the causality of the cosmos to a sufficient source. The definition of place and its key element, immobility, allows the natural philosopher to discover the existence of some first principle of place. Similarly, the definition of time and its key feature, that it is the number and measure of motion, allows the natural philosopher to discover the existence of some first principle of temporal measurement of the universal “now.” The impossibility of the void and the necessity that every moving thing be a body provides further impetus for the identification of the first principle of place, time, and the cosmic plenum. Note that, even given all these properties, we still need to make an argument which establishes that these properties (cosmic source of *per se* causality, cosmic principle of place, cosmic measure of time, cosmic plenum) belong to one existing thing as their cause and subject. In passing through the above sections several themes were also developed. We noticed how Aristotle follows the natural path from things we know based on common experience to more determinate accounts of natural principles and definitions. The need for completeness in the

guish between light’s properties insofar as it illuminates and insofar as it is generated and corrupted when it interacts with other objects; thus, the question of light’s substantiality is distinct from how it can exhibit continuous features (superposition) as well as discrete characteristics (energy quanta). Light, on this view, would be the qualitative affectation of a medium and it can potentially exhibit discrete or continuous effects. This distinction between light as a continuous characteristic of a subject-medium and light originating from a generating source or corrupting has a dim relation to the medieval distinction between *lux* (the source) and *lumen* (light in the medium); see St. Thomas, *Sent. De Anima*, lib. II, cap. 14, (Leon.45/1.128–29): “Unde dicimus, quod sicut corpora elementaria habent qualitates activas, per quas agunt, ita *lux* est qualitas activa corporis caelestis, per quam agit, et est in tertia specie qualitatis sicut et calor. . . . Ipsa igitur participatio vel effectus lucis in diaphano, vocatur *lumen*.” My emphases.

science of physics—resolving properties and features of its subject to their first principles—was also noted concerning *per se* causality and the concomitants of motion. Finally, we have also noticed the importance of the categories of being to Aristotle’s presentation in the *Physics*.

CHAPTER 3 The First Mobile in *Physics*, Book VII

INTRODUCTORY NOTE TO CHAPTER 3

The goal of this chapter is to argue for the existence of the first moved mover or *primum mobile*. This discovery not only advances the overall goal of the project but offers closure to various points raised in the previous two chapters. First, it provides a substantial example of general natural philosophy discovering something first in itself (even if our conception of it is vague), namely, an instrument of the ultimate active principle correlative to the passivity of mobile being and its ultimate material principle, primary matter. This shows how the points made about methodology (§1) and general principles of change (§2) are furthered within the investigative arc of general natural philosophy. Second, it offers resolution to the initial points about universal, *per se*, agent causality in the cosmos (§§3–4), the first principle of place (§6), and the measure of cosmic time (§7) by identifying the subject (§8) that possesses these predicates.

§9 will examine context of the argument for the first moved mover in Aristotle's *Physics* Book VII.1–2. After this overview, §10 will present the argument for the first moved mover. The attempts Aristotelian and medieval cosmology made to know the *primum mobile* more determinately occupy the consideration of §11. Taking the discussion in Chapter 3 as a whole, §12 presents the positive and sound conclusions which the inquiry reaches based upon the argument from *Physics*, Book VII. It also takes stock of the various problems or difficulties

which remain after the arguments in this chapter.

§9 THE ARGUMENT FOR A FIRST MOBILE PROVIDES THE NECESSARY INTEGRITY FOR THE GENERAL INQUIRY INTO MOBILE BEING AS SUCH. (*Physics*, BOOK VII)

It is not possible to bring God near within reach of our eyes, nor to grasp him with our hands, by which route the broadest road of persuasion runs into the human mind.

EMPEDOCLES, DK 133

Aristotle argues for the existence of a First Unmoved Mover in *Physics*, Books VII and VIII.

The arguments also establish the existence of the first moved mover, i.e., a first mobile. St.

Thomas comments at the outset of *Physics*, Book VIII:

After the philosopher, in the preceding book, showed that it is necessary to posit the existence of a first mobile, a first motion, and a first mover, he intends in this book to inquire of what sort are [*qualis sit*] the first mover, first motion, and first mobile.¹

To St. Thomas' mind, then, the arguments in *Physics*, Book VII are sufficient to show the existence of these fundamental agents in the cosmos but they are not sufficient to provide details about their nature or properties ("*qualis sit?*").

9.1 *The context of the argument*

The place of this argument in the investigative arc of the *Physics* provides the necessary integrity for the general inquiry into mobile being as such. That is, without a resolution to the first efficient cause of mobile being as a subject, the general science of nature would be incomplete. St. Thomas observes:

After the Philosopher, in the preceding books, determined about motion according to itself, about its concomitants, and about its parts, here he begins to consider motion through a comparison to movers and mobiles. It is divided into

1. St. Thomas, *In Phys.*, lib. VIII, lect. 1, n. 1 (Leon.2.362).

two parts. In the first part, he shows that there is a first motion and a first mover. In the second part (beginning in Book VIII), he asks in what way the the first motion and the first mover exist.²

St. Thomas summarizes the preceding four books in the first sentence: the definition of motion (in Book III), the consequents or concomitants of motion (Books III–IV, viz., the infinite, place, void, and time), and the parts of motion (whether qualitative or quantitative, Books V and VI, respectively).³ While Books I–II considered the universal principles of natural science, Books III–VIII consider mobile being in general, the proper subject matter of general natural philosophy.⁴ Within the latter division, Books III–VI are divided against Books VII–VIII, for the former consider motion in itself while the latter consider motion in relation to movers and mobiles.⁵

The argument of *Physics*, Book VII ascends to its conclusion in virtue of the nature of mobile being as quantified or extended. As we shall see, the conception of the middle term in these arguments is no more determinate than the physical continuum as such. This minimalist approach is striking. From only the character of physical dimension, Aristotle claims we can infer the existence of an extra-cosmic principle: “Even in such a relatively straightforward and easy fact—that the mobile is divisible—there are very remarkable and wonderful consequences implicit.”⁶ The argument, if successful, certainly would derive a great deal from scarce resources, yet it leaves the natural philosopher unclear about the specific characteristics of the ultimate movers, moved or unmoved. More determinate inquiries—in general natural philosophy and even further in the specific parts of natural philosophy—are required.

2. Ibid., lib. VII, lect. 1, n. 1.

3. See *ibid.*, lib. V, lect. 1, n. 1.

4. Ibid., lib. I, lect. 2, n. 1.

5. Ibid., lib. III, lect. 1, n. 1.

6. Berquist, “The Proof of the First Mover in *Physics* VII, 1,” 48. This article is a transcript of Mr. Berquist’s last public lecture.

9.2 *The completeness of doctrine about motion*

Given its place in the order of the *Physics*, the argument for an ultimate efficient cause provides a necessary integrity to general natural philosophy at several levels. First, it satisfies the logical requirements of a science that the properties of the subject—in this instance, motion—be resolved to their first causes—in this case, the efficient cause. Second, it begins to form a more complete picture of cosmic causality, which the student of natural philosophy first begins to suspect when asking whether *per se* causality is prior to chance throughout the whole cosmos. We sustain the “cosmological thesis” by determining, even if in general terms, the character of the cosmos. Third, the argument also adds to the adequacy of the natural philosopher’s knowledge of cause and effect by proving their necessary distinction and conjunction.⁷

Finally, this argument allows the natural philosopher to begin to piece together a more determinate picture with regard to the principles of place and time (discussed in §§6–7). If the first moved mover is in some other way immobile with respect to all other mobiles, then it serves as a principle of the immobility of place. Since the first moved mover is so fundamental—its motion is prior to all others—its motion is the first measure of time. When taken in conjunction with the arguments against the void and the requirement that any thing in motion be a body (discussed in §8), the argument in this chapter provides the basic determinations concerning the substance, motion, causality, and relationship to place and time of the most fundamental mobile in the cosmos.

7. This was assumed in the discussion of motion, action, and passion in §4.4. By proving that the mover and moved are distinct realities, the defense of the real distinction between action and passion is assured.

§10 THE FIRST MOVED MOVER EXISTS; THIS CAN BE SHOWN AS A COROLLARY TO THE ARGUMENT FOR A FIRST MOVER FROM THE NATURE OF THE PHYSICAL CONTINUUM AND CORPOREAL AGENCY. (*Physics*, BOOK VII.1–2)

It is safe to say that the proof depends upon every scientific principle previously possessed in the ordered study of nature, and to reproduce the proof requires nothing less than a reconstruction of the whole of Aristotle's *Physics*.

V. E. SMITH

“The Prime Mover: Physical and Metaphysical Considerations”

In the following section I will present the argument based in *Physics*, VII.1 for the first moved mover. First (§10.1), certain qualifications must be made about the extent to which I will consider Aristotle's text in light of contemporary debates among Thomists and the historical development of physics. Second (§§10.2–3), I will present the argument itself. Lastly (§10.4), certain difficulties will be noted and resolved to the degree possible.

10.1 *Two qualifications about this presentation of the argument*

First, the investigation of the first premise of the argument in *Physics*, VII.1—in St. Thomas' Latin, *omne quod movetur ab alio movetur*—while demonstrated through the universal or indeterminate *ratio* of mobile being, is difficult to apply in certain cases of motion. In particular, if the present progressive aspect of the second passive verb *movetur* is used to construe the English translation—everything in motion is being moved by another—then the motion of falling bodies, other elemental motions, the motion of projectiles, and celestial motion stand as difficult counterexamples. If the premise is truly a universal natural principle, then any motion must be accounted for; however, not all the difficult cases will be solved in this treatment.

Second, I will not directly address the famous question about the character of Aristotle's philosophical monotheism; this would take us too far afield. Besides, the debate need not be

solved to arrive at our desired conclusion. Whether or not Aristotle's arguments in the *Physics* terminate in the existence of God, they do in fact require that the ultimate mover (itself unmoved) be related without medium to a first moved thing, a *primum mobile*.⁸ De Koninck

8. Of particular interest to Thomists, the debate over the conclusion of the arguments in *Physics* VII and VIII are also linked with debates over the distinction of physics from metaphysics and how one initiates the study of the latter. This debate is historically and philosophically motivated by several related issues. Upon the call for a renewed Thomism by Pope Leo XIII in *Aeterni Patris*, the schools which developed were influenced by several contingent factors: attempts to escape Cartesian, Suarezian, and Wolffian understandings of metaphysics, the problems of defending St. Thomas' philosophy and especially his metaphysics in light of modern natural science, and the question of St. Thomas' unique contributions to philosophy and (as some maintained) Christian philosophy as a distinct study. This debate also draws from all aspects of philosophy as it requires answers about a nexus of issues: how to define the subject of natural philosophy and metaphysics (e.g., is *esse* included in the mode of the latter?), the cogency and character of arguments for the existence of God, the modes of abstraction and *separatio* that distinguish the various sciences, and what the human mind connaturally knows by its various intellectual operations (particularly the first two). James Counahan, "The Quest for Metaphysics," *The Thomist* 33 (1969): 521–26, succinctly summarizes the genesis of the debate.

Perhaps the debate's full range can be captured in a key question: Is the nature of the human mind such that it requires a natural philosophical proof of the existence of positively immaterial being (e.g., God) in order to claim metaphysics as a distinct science, having a distinct subject, and begin to study it? Aristotle's answer, in part, is found in one sentence in *Metaphysics*, VI.1, 1026a27–28: "We answer that, if there is no substance other than those which are formed by nature, natural science will be the first science." Thus, the *Physics* ends where it does (267b17–26) insofar as it proves that the first mover, wholly immobile, is eternal and moves an eternal motion, has infinite power, and "is indivisible and partless and a thing having no magnitude [μέγεθος]." Lacking magnitude, which is the proper attribute of mobile being, this being's principles—at least of our knowing it, if it has no principles of its being—or attributes are no part of the genus studied by natural philosophy. Thus, by the logic of *Posterior Analytics*, I.7 and I.10, it must fall to a different science to study it; see Coughlin, *Physics*, 197, fn. 85, and his "Introduction," xxii. The related debate over Aristotle's God began with his earliest disciples and the ancient commentators, and continues to the present. Efforts of contemporary philosophers include one by Charles De Koninck's son, who provides a thorough consideration of the question: Thomas De Koninck, "Aristotle on God as Thought Thinking Itself," *The Review of Metaphysics* 47, no. 3 (1994): 471–515.

How does St. Thomas answer the key question? That is precisely the debate (and among the members of the two camps, there are of course differences glossed over in this note). As for the texts of St. Thomas, apart from the questions of interpretation, the central source about which this debate revolves is the understanding of the division and method of the sciences, *SBdT*, qq. 5–6. In particular, q. 5, a. 3, c., and the understanding of "*separatio*" are at stake, e.g.: "Substantia autem, quae est materia intelligibilis quantitatis, potest esse sine quantitate; unde considerare substantiam sine quantitate magis pertinet ad genus *separationis* quam abstractionis." Orbiting about this key text are the relevant passages in his commentaries on Aristotle's *Physics* (in particular Books VII and VIII) and *Metaphysics* (in particular the *prooemium*, Book II, VI, and XII), the fourth chapter of *De Ente et Essentia*, the opusculum *De substantiis separatis*, and *Summa Theologiae*, viz., Ia, q. 2 and q. 87.

Some Thomists, including the disciples of Gilson and existentialist Thomists, answer the key question in the negative. Generally, these interpreters deemphasize or deny the relevance of St. Thomas' Aristotelian commentaries when it comes to reconstructing the philosophy of St. Thomas himself: Wippel, *The Metaphysical Thought of Thomas Aquinas*, xix–xxii, proposes a moderated version of this approach and does not discount these commentaries entirely. Consequently, these interpreters provide a different understanding of St. Thomas' use of Aristotelian-style proofs from motion for the existence of God, favoring a metaphysical

himself, in his published work, only obliquely touches on the necessity of demonstrating the

interpretation of the starting point. For representative sources of this view, consider George P. Klubertanz, "The Teaching of Thomistic Metaphysics," *Gregorianum* 35, no. 195 (1954): 9–13; Jacques Maritain, *Distinguish to Unite, Or, The Degrees of Knowledge*, ed. Ralph M. McInerny, trans. Gerald B. Phelan, vol. 7, The Collected Works of Jacques Maritain (Notre Dame, IN: University of Notre Dame Press, 1995), 224–34; Etienne Gilson, *Being and Some Philosophers*, 2nd (Toronto: The Pontifical Institute of Mediaeval Studies, 1952), 166–67, 190–215; Henri Renard, "What is St. Thomas' Approach to Metaphysics?," *New Scholasticism* 30, no. 1 (1956): 78–81; Joseph Owens in various works, e.g., "The Conclusion of the Prima Via," *Modern Schoolman* 30, no. 1 (1952): 212–13, "A Note on the Approach to Thomistic Metaphysics," *New Scholasticism* 28, no. 4 (1954): 468–73, "Aquinas and the Proof from the Physics," *Mediaeval Studies* 28 (January 1966): 134, "The Starting Point of the Prima Via," *Franciscan Studies* 27, no. 1 (1967): 256–59; Lawrence Dewan, "Jacques Maritain, St. Thomas, and the Birth of Metaphysics," *Maritain Studies/Etudes Maritainiennes* 13 (1997); J. F. X. Knasas, "Thomistic Existentialism and the Proofs Ex Motu at Contra Gentiles I, C. 13," *The Thomist* 59, no. 4 (1995): 594–97; and finally John F. Wippel in *Metaphysical Themes in Thomas Aquinas* (Washington, DC: Catholic University of America Press, 1995), 55–67, 69–104, as well as *The Metaphysical Thought of Thomas Aquinas*, 23–62.

Other Thomists, including many of De Koninck's students, hew to the Aristotelian line of reasoning. They place greater emphasis on the relevance of St. Thomas' Aristotelian commentaries for interpreting St. Thomas himself. (For this reason, the debates over the nature of Thomistic philosophy itself as a natural or Christian philosophy intertwine with this question.) These interpreters typically point to the manner in which St. Thomas utilizes Aristotelian proofs in his own arguments for the existence of God, as well as the comments he makes (or does not make) when considering Aristotle's arguments for the First Mover in the *Physics* or *Metaphysics*. For representative sources of this view, consider: William Kane, "Abstraction and the Distinction of the Sciences," *The Thomist* 17 (1954): 43–68; Vincent E. Smith, "The Prime Mover in Philosophy of Nature and in Metaphysics," *Proceedings of the American Catholic Philosophical Association* 28 (1954): 78–94; Antonio Moreno, "The Nature of Metaphysics," 30 (1966): 109–35; Weisheipl, "The Relationship of Medieval Natural Philosophy to Modern Science: The Contribution of Thomas Aquinas to Its Understanding," 194–96; T. J. Kondoleon, "The Argument From Motion and the Argument for Angels: A Reply to John F. X. Knasas," *The Thomist* 62, no. 2 (1998): 269–290; Benedict M. Ashley, *The Way toward Wisdom: An Interdisciplinary and Intercultural Introduction to Metaphysics*, Thomistic Studies (Notre Dame, IN: University of Notre Dame Press, 2006), 92–124; Ralph M. McInerny, "The Prime Mover and the Order of Learning," *Proceedings of the American Catholic Philosophical Association* 30 (1956): 129–137, as well as several others: *St. Thomas Aquinas*, 2nd ed. (Notre Dame, IN: University of Notre Dame Press, 1982), 86–93; "A Note on Thomistic Existentialism," 165–72 in *Being and Predication: Thomistic Interpretations* (Washington, DC: Catholic University of America Press, 1986); and lastly, *Boethius and Aquinas* (Washington, DC: Catholic University of America Press, 2012), 130–58.

In any event, a crucial text in the arena of debate over the initiation of metaphysics is the Angelic Doctor's own note that the approach to God is gradual: *ScG*, I.13: "Sed quia Deus non est pars alicuius moventis seipsum, ulterius Aristoteles, in sua *Metaphysica*, investigat ex hoc motore qui est pars moventis seipsum, alium motorem separatum omnino, qui est Deus. Cum enim omne movens seipsum moveatur per appetitum, oportet quod motor qui est pars moventis seipsum, moveat propter appetitum alicuius appetibilis. Quod est eo superius in movendo: nam appetens est quodammodo movens motum; appetibile autem est movens omnino non motum. Oportet igitur esse *primum motorem separatum omnino immobilem*, qui Deus est." (Leon.13.33) The problem stemming from how the *Physics* ends is not new. Owens, "A Note on the Approach to Thomistic Metaphysics," 472, notes: "as Suarez points out [disp. 29, sect. 1, n. 17], an entirely new procedure is necessary to identify that prime movent with the Christian God. The process has to be commenced all over again, this time on the metaphysical level."

existence of God from natural philosophy.⁹

10.2 Minor premise: the motor causality principle

The argument which Aristotle makes in *Physics* VII.1 can be divided into two parts: a defense of its minor premise (241b34–242a49; *textus alter*: 241b24–242a15) and major premise (242a49–243a31; *textus alter*: 242a16–243a2). St. Thomas devotes his first two *lectiones* to each premise individually. The former premise proves that everything which is in motion is being moved by another, while the latter proves that this sequence cannot continue indefinitely. The corollary to the main conclusion is that a penultimate moved mover must exist.

I will consider the argument in this order.¹⁰

9. See De Koninck, “Abstraction from Matter,” I:60–61. It will be necessary to consider an aspect of this debate when discussing the “natural path” in Chapter 6.

10. *Physics* Book VII, chs. 1–3 is preserved in two variants. Ross, in Aristotle, *Aristotle’s Physics*, 11–19, discusses this at length. He notes that Simplicius attests to the existence of two versions of the book in his time. Simplicius also notes that the general character of the arguments, and the fact that “more exact” arguments for similar conclusions are discussed in Book VIII, caused many other commentators to pass over Book VII entirely or at least its central points (Eudemus and Themistius); Simplicius, *On Aristotle’s Physics* 7, trans. Charles Hagen, *Ancient Commentators on Aristotle* (Ithaca, NY: Cornell University Press, 1994), 11. Simplicius agrees that the demonstrations in Book VIII, for instance, of the motor causality principle, receive “more exact demonstration,” (“ἀκριβεστέρως . . . ἀποδείξεως”) but this does not detract from the value of Book VII. The value of the less exact or more indeterminate demonstration is precisely the point at issue in this chapter.

The Latin text which St. Thomas uses in his commentary seems to be closer to the text Ross categorizes as the *textus alter*, but this is a difficult question to settle definitively. In his “Préface” to *Sent. De Anima*, Gauthiers notes, 205*: “Dès qu’on touche à la tradition latine de la *Physique* d’Aristote, il faut s’exprimer avec beaucoup de prudence: les problèmes qu’elle pose sont loin d’avoir été résolus.” In the “Introduction” to St. Thomas Aquinas, *Commentary on Aristotle’s Physics*, trans. Richard J. Blackwell, Richard J. Spath, and W. Edmund Thirlkel (South Bend, IN: Dumb Ox Books, 1999), xviii–xix, Vernon J. Bourke briefly reviews the multiplicity of Latin translations of the *Physics* which were available at the time of St. Thomas’ composition. He concludes that “one cannot precisely identify the Latin manuscripts of the *Physics* which Thomas Aquinas used for his commentary.” He likewise surmises that the actual manuscripts St. Thomas used were probably *Kontamination*, cobbled from various translations. Although he makes no mention of the version upon which St. Thomas’s Latin translations were made, Jean-Pierre Torrell, *Saint Thomas Aquinas, Vol. 1. The Person and His Work*, Revised, trans. Robert Royal (Washington, DC: Catholic University of America Press, 2005), 232, n. 20, asserts that at least the Leonine Latin text Aristotle’s *Physics* “may not” have been that used by St. Thomas; however, his later catalogue, *ibid.*, 342, asserts that it “is not” that used by St. Thomas. Bourke, *ibid.*, xix, fn. 7, takes the stronger opinion, citing Auguste Mansion, “Sur le texte de la version latine médiévale de la Métaphysique et de la Physique d’Aristote dans les éditions des Commentaires de saint Thomas d’Aquin,” *Revue néo-scholastique de philosophie* 34, no. 33 (1932): 68–69, who argues that the Leonine editors, when attempting to correct the Latin version of St. Thomas’ text of Aristotle, made use of manuscripts containing different versions of the translation. Leo J. Elders, “St.

The first premise is Aristotle's famous motor causality principle.¹¹ This premise is supported in part by the "stopping thesis" and a *reductio* argument (241b33–242a15). Although the argument is phrased so as to contain a *reductio*, as a whole it shows the cause of the conclusion—it is demonstrative or *propter quid*—a point which St. Thomas maintains against Averroes.¹²

In this presentation I will follow Coughlin's translation of Aristotle's thesis, which renders the key Greek terms, κινούμενον and κινεῖσθαι, as "moving" and "is moved," respectively, where the former is taken in the middle voice, rendered with the ergative English word "move." St. Thomas' own wording of this thesis is "*nesesse est omne quod movetur, ab aliquo alio moveri.*" The concerns over the proper translation of this thesis has been well examined

Thomas Aquinas's Commentary on Aristotle's *Physics*," *The Review of Metaphysics* 66 (2013): 715, notes that St. Thomas used at least two Latin translations of Aristotle's text, the *Nova* made by Van Moerbeke between 1260 and 1270, as well as the *Vetus* by James of Venice, among several others. This was the traditional supposition, as noted by Mansion, namely that St. Thomas had to hand the *Vetus* and the *Nova*, although perhaps in cross-contaminated versions. This common opinion is recognized as probable, but as opinions unsatisfactorily clarified and sure, by Jozef Brams and Gudrun Vuillemin-Diem, "Physica Nova und Recensio Matritensis: Wilhelm von Moerbekes doppelte Revision der Physica Vetus," in *Aristotelisches Erbe im arabisch-lateinischen Mittelalter: Übersetzungen, Kommentare, Interpretationen*, ed. Albert Zimmermann and Gudrun Vuillemin-Diem (Berlin: Walter de Gruyter, 1986), 215–216. Still, Jozef Brams, "La Recensio Matritensis de la Physique," in *Guillaume de Moerbeke: recueil d'études à l'occasion du 700e anniversaire de sa mort (1286)*, ed. Jozef Brams and W. Vanhamel (Leuven University Press, 1989), 211, notes that the Latin version of Book VII are from "the second version" of the book. Unfortunately, due to Brams' death, the *Aristoteles Latinus* edition of Moerbeke's revision of the *Vetus* is delayed in preparation and could not be consulted.

This *textus alter* is used as the main text in Coughlin's translation (and Apostle's), and he provides Ross' main text as an appendix (titled "Book VII, Alternative Text"). In what follows, I will be citing Coughlin's translation of Ross' *textus alter*, so all Bekker numbers will be from this alternate. If Coughlin's "Alternative Text" is cited, it will be noted as such. This will be necessary in a key instance, for Ross' main text at 243a27–28 contains a clearer statement of the intended conclusion of this section (compare *textus alter*, 242b4). The texts are very similar in order and content, but details vary. For instance, Robert Wardy, *The Chain of Change: A Study of Aristotle's Physics VII* (Cambridge University Press, 1990), 96, 243–44, notes various divergences in the two versions of the first chapter. Among them: the main version's thesis would conclude that AB is moved by something, while the *textus alter* concludes that AB is moved by something *else*; also, the main version's infinite regress argument considers only local motion, while the *textus alter* assumes that all motions are reducible to local motion.

11. Aristotle, *Physics*, VII.1, 241b24–242a15. For the name, see Hassing, "Physical Continuum," 109, who borrows from Wallace, "Newtonian Antinomies Against the Prima Via," 154. Simplicius, *On Aristotle's Physics* 7, 12, notes that "all the subsequent theorems having to do with nature" depend upon this principle. Its truth was rejected by many medieval commentators, notes John of St. Thomas, *Curs. Phil.*, II.445–47.

12. See *In Phys.*, lib. VII, lect. 1, n. 6 (Leon.2.323); also, Hassing, "Physical Continuum," 109, 140.

elsewhere.¹³

13. The Greek of the *textus alter*, *Physica*, 241b24: “ἅπαν τὸ κινούμενον ἀνάγκη ὑπὸ τινος κινεῖσθαι.”

John Lyons, *Introduction to Theoretical Linguistics* (Cambridge: Cambridge University Press, 1968), 375, notes: “The English verb move is ‘ergative’: B moves v. A moves B. . . . In corresponding Latin sentences, we find *B movetur* (‘passive’) v. *A movet B* (active, transitive). But *B movetur* can be translated in two ways: (i) as ‘B moves’ (with B either ‘agentive’ or ‘non-agentive’); or (ii) as ‘B is moved’ (with an ‘agentive’, other than B, implied). . . . the second of these interpretations is passive, rather than ‘middle’. The first can be glossed as ‘there is movement, and B is affected (whether B is the cause, or agent, of the movement or not)’.” Given this grammatical possibility, a literal construal is, “Everything that moves, moves by another.”

For St. Thomas’ rendering, see *In Phys.*, lib. VII, lect. 1, n. 2 (Leon.2.322). In all the other major places where St. Thomas states this argument, the double passive form is used: consider *ScG*, I.13: “In hac autem probatione sunt duae propositiones probandae: scilicet, quod omne motum movetur ab alio; et quod in moventibus et motis non sit procedere in infinitum.” (Leon.13.30); *ST*, Ia, q. 2, a. 3, c.: “Omne autem quod movetur, ab alio movetur.” (Leon.4.31); also, *In I Sent.*, d. 8, q. 3, a. 1, s.c.2.: “Praeterea, sicut probat Philosophus [VIII *Physic.*], omne quod movetur, ab alio movetur. Si igitur illud a quo movetur mobile ipsum, etiam movetur, oportet quod ab aliquo motore moveatur. Sed impossibile est ire in infinitum. Ergo oportet devenire ad primum motorem, qui movet et nullo modo movetur; et hic est Deus. Ergo omnino est immutabilis.” Busa excises “VIII *Physic.*” Another context is *De Motu Cordis*: “Quia omne quod movetur, necesse est habere motore, dubitabile videtur quid moveat cor, et qualis sit eius motus.” (Leon.43.127:1–3)

Sachs, in *Aristotle’s Physics*, 173, uses a middle voice for “τὸ κινούμενον” in his translation, as does Apostle, *Aristotle’s Physics*, 127. The translator of the summary of Philoponus’ commentary, in Philoponus and Simplicius, *On Aristotle’s Physics 5-8, with On Aristotle’s “On the Void”*, trans. Paul Lettinck and J. O. Urmson, *Ancient Commentators on Aristotle* (Ithaca, NY: Cornell University Press, 1994), 113, offers “If something is in motion, it must be kept in motion by something else.” In Simplicius, *On Aristotle’s Physics* 7, 12, the thesis is likewise rendered in the middle voice. On the side of a middle voice translation, Michael Augros, “Ten Objections to the Prima Via,” *Peripatetikos: The Journal of the Society for Aristotelian Studies* 6 (2007): 69, notes two possibilities, which I call the ‘weak’ and ‘strong’ versions: either “everything that is in motion is moved by another,” (the weak version) or “everything that is in motion is being moved by another,” (the strong version, because the latter claims more, viz., constant conjunction of mover and moved). Others render this premise, translating from St. Thomas’ Latin, as, “Everything that is moved is moved by another,” or similar double-passive constructions in English, taking a strict interpretation of the passive verb forms: James A. Weisheipl, “The Principle *Omne quod movetur ab alio movetur* in Medieval Physics,” *Isis* 56, no. 1 (1965): 26, 29–30; James A. Weisheipl, “*Quidquid Movetur ab Alio Movetur*: A Reply,” *The New Scholasticism* 42, no. 3 (1968): 422–23; Ferdinand Van Steenberghen, *Le Problème De L’existence De Dieu Dans Les Écrits De S. Thomas d’Aquin* (Louvain-La-Neuve: Editions de l’Institut Supérieur de Philosophie, 1980), 114–15; Owens, “The Conclusion of the Prima Via,” 36, 39; Owens, “Aquinas and the Proof from the Physics,” 139; Owens, “The Starting Point of the Prima Via,” 253; Wippel, *The Metaphysical Thought of Thomas Aquinas*, 414–15.

Kevin D. Kolbeck, “The *Prima Via*: Natural Philosophy’s Approach to God” (PhD diss., University of Notre Dame, 1989), 80–92, directed by De Koninck’s student Ralph McInerny. Support for translating τὸ κινούμενον by St. Thomas’ equivalent *quod movetur* such that it retains an intransitive or middle sense in the grammatically active English form “moving” or “moves” can be summarized under three headings: grammatical analogues, what is required for an intelligible argument, and philosophical claims.

First, the grammatical analogues exist which support rendering the Latin construction in the passive voice to capture the middle voice sense, given that Latin lacks such a distinction. Against this, Weisheipl, *Nature and Motion in the Middle Ages*, 78, argues that the middle voice translation is “grammatically impossible and philosophically absurd.” Kolbeck, “The *Prima Via*,” 83, replies that, in the Greek phrase itself, the κινούμενον and κινεῖσθαι should be taken to be a middle voice and passive voice, respectively, as indicated by the use of ὑπὸ τινος. While Latin does not have a middle voice in form, Kolbeck notes that Latin deponents, while

The complete text of the argument for the motor causality principle is as follows:

passive in form, can be intransitive in meaning while taking direct objects: *ibid.*, 84: “*Haec mala fortiter patior.*” Based on this analogy, Kolbeck claims, *ibid.*, 84–85: “It would not be unreasonable, then, for Latin thinkers to use passive forms of verbs to signify the activities that Greek thinkers signified by middle/passive forms. A reasonable way for Latin to handle the middle participle would be to use a relative clause whose verb is passive in form, but active and intransitive in meaning: *quod movetur.*”

Second, there are instances in St. Thomas’ commentary on the *Physics* and elsewhere where a passive form of the verb *movere* is used but where translating it with a passive instead of a middle meaning would make the argument less intelligible or unsound. For instance, St. Thomas, in St. Thomas, *SBdT*, q. 5, a. 1, c., states that “*Omne autem necessarium, in quantum huiusmodi, est immobile; quia omne quod movetur, in quantum huiusmodi, est possibile esse et non esse vel simpliciter vel secundum quid, ut dicitur in IX Metaphysicae.*” (Leon.50.138) Now, it is at the very least superfluous to the argument that a thing *which is being moved* is not necessary because it is contingent; the very contingency of motion as such suffices, not its additional relationship to a mover.

Kolbeck, *ibid.*, 85–59, also offers several passages as examples. First, in *In Phys.*, lib. VI, lect. 2, n. 4: “[E]t dicit quod necesse est id quod movetur ab uno termino in alium, non simul moveri et motum esse, in quantum movetur et quando movetur; sicut si aliquis vadit Thebas, impossibile est haec duo simul esse, scilicet ire Thebas et ivisse Thebas.” (Leon.2.271) The contrast between “moveri” and “motum esse” is paralleled by “ire” and “ivisse” as examples. These must be rendered in an active form, intransitive sense to capture the thesis of the argument: one cannot both be going to Thebes and have gone to Thebes—one cannot be moving and have moved to one’s terminus. Second, at *ibid.*, n. 5, “venit” is used as equivalent to “moveri.” Third, in *ibid.*, lect. 5, n. 9: “*Quies autem est privatio motus: unde nihil quiescit nisi quod est aptum natum moveri, et quando et sicut natum est moveri.*” (Leon.2.284) Here, rest is the privation of “motus,” such that only what is naturally apt to move or be in motion (not “to be moved” or “be put in motion”) can truly be said to rest; on the intransitive captures this in English. Fourth, *ibid.*, n. 8, if “moveri” is passive, and means to be put in motion, Kolbeck argues, then the proof is needless since to be put in motion cannot occur more or less swiftly. Finally, in *ScG*, I.13: “*Patet autem sensu aliquid moveri, utputa solem.*” (Leon.13.30) As Kolbeck notes, it is not patent to sense that the sun is moved by another.

I note, in addition, that a little further on in the same work, St. Thomas states “*Oportet etiam ipsum esse divisibile, et habere partes: cum omne quod movetur sit divisibile, ut probatur in VI Physic.*” Were the “movetur” of this last clause taken in a passive sense, then the use of this prior theorem from Book VI would make the proof in Book VII beg the question. In like manner, in *In Phys.*, lib. I, lect. 2, n. 7: “*In scientia naturali supponitur quod naturalia moveantur vel omnia vel quaedam: quod dicit quia de quibusdam est dubium si moventur et qualiter moventur, puta de anima, de centro terrae, de polo caeli, et formis naturalibus, et aliis huiusmodi. Et quod naturalia moveantur, potest manifestum esse ex inductione; quia ad sensum apparet quod res naturales moventur. Est autem necessarium motum supponi in scientia naturali, sicut necessarium est supponi naturam, in cuius definitione ponitur motus; est enim natura principium motus, ut infra dicitur.*” (Leon.2.9) Here, commenting on Aristotle’s reply to the monists, it would be superfluous for St. Thomas to mean that it is evident to sense that all or certain natural things are being moved, for the Eleatics deny the even more general premise that things are in motion.

Third, at a philosophical level, rendering the thesis with an intransitive sense and defending it as stated would answer objectors who claim that the passive translation makes the thesis tautologous. For instance, Anthony Kenny, *The Five Ways: Saint Thomas Aquinas’ Proofs of God’s Existence*, 2nd ed. (Notre Dame, IN: University of Notre Dame Press, 1980), 8–9, 19, holds that St. Thomas was deceived by the “double sense of the Latin *movetur*,” and this caused him to omit explaining why motion as such requires a cause. Similarly, to a concern such as that of James A. Weisheipl, “The Spector of *Motor Coniunctus* in Medieval Physics,” in *Studi sul XIV secolo in memoria di Anneliese Maier*, ed. Alfonso Maierù and Agostino Paravicini Bagliani (Roma: Edizione di Storia e Letteratura, 1981), 81, that “the point of the axiom is precisely the *ab alio*,” the intransitive sense of the first “movetur”—although avoiding the present progressive, “strong” sense of

It is necessary that everything moving is moved by something. (1) If, then, it does not have the principle of motion in itself, it is apparent that it is moved by something different. For the mover will be other.

(2) If, however, [it does have the principle] in itself, let there be taken AB which is not moving by some part of it moving.

(a) First, then, assuming that AB is moving by itself because the whole is moving, and by nothing outside, is as if, DE moving EZ and itself moving, one should assume that EZ is moving by itself, through not seeing at once which is moved by which, whether DE by EZ or EZ by DE.

(b) Moreover, what is moving by itself will at no time pause from moving by means of some different moving thing coming to a stand. It is therefore necessary that, if something moving pauses by something different coming to a stand, the former is moved by something different.

(c) This being made apparent, it is necessary that everything moving is moved by something. For, since AB was taken as moving, it will be divisible. For everything moving was divisible. Let it be divided, therefore, at C. It is necessary, then, if CB rests, that AB also rests. For if it does not, let it be taken as moving. CB resting, therefore, CA would be moving. So AB is not moving in virtue of itself. But it was supposed to be moving in virtue of itself first. It is clear, therefore, that, CB resting, BA would also rest, and the thing which is moving will at some time pause. But if something moving comes to a stand and pauses due to something else resting, the former is moved by something different. It is apparent, then, that everything moving is moved by something. For everything moving is divisible, and, the part resting, the whole will also rest.¹⁴

The argument for the motor causality principle can be divided into two legs: (1) if the principle of motion is extrinsic or (2) if the principle of motion is intrinsic. A broader logical division of options shows that the above text omits a certain prior division as obvious: a mobile's motion is either uncaused or caused; if caused, it is caused either by itself (*a seipso*) or by something other (*ab aliquo alio*); if by another, then by one of its parts (*qua* other)

the second "movetur" to allay fears of Weisheipl's "specter"—in fact provides more focus on the argument concluding to the motion being caused *by some other thing*.

Therefore, the passive form of "moveri" can have a middle voice meaning such that English requires the intransitive sense of "to move." Indeed, other authors writing in Latin use passive forms for motion verbs where ontological passivity is not intended philosophically. For instance, Cohen, in his "A Guide to Newton's *Principia*" in Isaac Newton, *The Principia : Mathematical Principles of Natural Philosophy*, trans. I. Bernard Cohen and Anne Whitman (Berkeley: University of California Press, 1999), 37–41, notes that Newton's use of verbs like "movere" and "gyrare" require a reflexive sense in English, expressed in the active voice.

14. Aristotle, *Physics*, VII.1, 241b24–242a15. I have added the subdivisions of Coughlin's text for ease of reference.

intrinsically or by something external to itself.¹⁵ Aristotle’s argument targets the second layer of the “caused” option: something cannot be put in motion by itself as such, in a sense that must be specified (the “primarily and *per se*” the argument depends upon). Once this option is eliminated, all motion must be caused by something “other” than the thing in motion, whether this is by some intrinsic part *qua* other or an extrinsic agent.

The first leg of the proof is straightforward: if the principle of motion is not in the mobile, the mover *ipso facto* is other.¹⁶ The bulk of the proof, then, argues in general terms about whether bodies can move themselves primarily and *per se*. Thus, the generality of the proof is not limited to cases such as animals. That the proof concludes to “some other mover” that may be external or internal will become clear given the fact that the force of the argument excludes the whole as such from being a mover, not discriminating between an “other” that is external or a part of the whole *qua* other.

That this is the case can be supported from St. Thomas’ further division of the proof:

Given this, he proceeds to show the proposition in two ways: first, by excluding that case where it seems most of all that something is not moved by another;

15. Kenny’s objection, that the argument never proves that uncaused motion is impossible, will be taken up below; see Kenny, *The Five Ways: Saint Thomas Aquinas’ Proofs of God’s Existence*, 19. This division should be compared to the one Aristotle makes in *Physics*, VIII.4, 254b7–14. In this text, Aristotle includes *per accidens* causes and violence, which are notably absent from *Physics* VII.1, which is properly considering natural, *per se* motion. Hassing, “Physical Continuum,” 118–19 provides a slightly different division of the options available to the argument in *Physics* VII.1; his division is based upon what is more obvious to sense, viz., that all that is moved is moved either from a source extrinsic to the moved or from an intrinsic source; of the latter, the whole is moved by a part or the whole is moved as such. However, he notes (*ibid.*, 118, fn. 29) that, ultimately, the division between obvious extrinsic and intrinsic breaks down, for the elements are moved in a non-obvious, extrinsic way; see *Physics*, VIII.4, 254b33–255a6.

16. Note that the argument abstracts from whether this motion is natural or violent. The word “apparent” (*φανερὸν*) does not specify that it is *clear* that an extrinsic mover is involved, but merely that, given an extrinsic mover, the desired conclusion clearly follows. Hence, there are clear (sensibly non-doubtful) cases where the thesis is true, but it is also clear (logically tautologous) given the possibilities that extrinsic principles require the mover to be other; St. Thomas, *In Phys.*, lib. VII, lect. 1, n. 2: “Quod quidem in aliquibus est manifestum. Sunt enim quaedam quae non habent in seipsis principium sui motus, sed principium motus ipsorum est ab extrinseco, sicut in his quae per violentiam moventur. Si ergo aliquid sit quod non habeat in seipso principium sui motus, sed principium sui motus est ab extrinseco, manifestum est quod ab alio movetur. Si vero sit aliquod mobile quod habeat in seipso principium sui motus, circa hoc potest esse dubium an ab alio moveatur.” (Leon.2.322) I note that this interpretation of St. Thomas’ aligns more with the division of possible movers Aristotle makes in *Physics*, VIII.4.

second, by showing that nothing is able to be in motion *a seipso*.¹⁷

That is, given the obvious case of (1), the second leg, (2), is shown in two ways. First, the case of living things is the most obvious instance where one might claim that a mobile is moving without a mover. This, however, is due to a lack of discrimination, as explained in (2a).¹⁸

The more direct argument is found in (2c). However, this argument is conditioned on the stopping thesis, (2b), which merely requires that a mobile is not self-moved primarily and *per se* at the cessation of motion of “something different.” This “other” must be taken strictly: any otherness can be meant, whether the otherness between whole and part or between two distinct, but touching, wholes. We can see this as follows: what type of mobile does the second leg of the proof really start with? If the principle of motion is intrinsic to the mobile, then is this the case because the principle is a part or because of the mobile as a whole? If the former, then the conclusion would still follow, for the whole mobile would be moved by one of its parts insofar as that part is other than the whole. However, this option is what (2a) excludes; furthermore, the question could merely be reiterated about that part as a whole. To derail this infinite line of questioning, Aristotle takes the alternative case: what if the mobile is in motion as a whole and not by some part?

This is related to what it means for a mobile to be in motion essentially (*per se*) and primarily.¹⁹ St. Thomas offers the following explanation:

17. St. Thomas, *In Phys.*, lib. VII, lect. 1, n. 2 (Leon.2.322).

18. As this comment is more of a clarification and extrinsic to the direct argument, I will not discuss it. Hassing, “Physical Continuum,” 130–34, discusses how Averroes and Aquinas differ in their interpretation of this qualification. Hassing also notes, *ibid.*, 133, fn. 57, that, as St. Thomas considers the argument for the motor causality principle to prescind from considering determinate natures, St. Thomas’ assertion that “AB” represents a living body must be confined only to his comments on (2a) and not to the argument as a whole.

19. See Kolbeck, “The *Prima Via*,” 93–94. Hassing, “Physical Continuum,” 117–30, is a detailed examination of the meaning of these two qualifiers. Hassing draws on *Physics*, V.1, 224a25–28, 224a30–33, and VIII.5, 257b27–35. On the basis of the last text, Hassing concludes that “the explanation of what moves itself primarily is indeed in terms of quantitative parts. A whole animal, therefore, when it moves itself locally, does not do so primarily, because if certain parts are separated (a tail or an ear, say), it would still be able to

If, therefore, something such is supposed that is not moved by another, then take the mobile AB, to which motion in fact belongs according to itself and primarily, not, however, on account of one of its parts moving. For thus it would not move according to itself, but according to a part. It is necessary, however, if something moves itself not being in motion by another, that it be primarily and *per se* in motion, just as if something is hot not by another, it is necessary that it be primarily and *per se* hot.²⁰

Aristotle defines what it means for a mobile to be in motion primarily and *per se* in *Physics* V.1, contrasting it against what is moved by a part and accidentally.²¹ Now, triangle possesses interior angles equaling two right angles primarily *and per se*—isosceles triangles have this property *per se* but not primarily, since they are only a part of the genus triangle.²² Is this the sense in which Aristotle intends primarily and *per se*? If so, then in this case of “AB” the mobile as such possesses the property of being in motion *per se* and primarily and not in virtue of a determinate nature, i.e., not because it is some part (species) of “mobile being” as a genus.²³ However, the motion could also belong to the whole primarily as opposed to

move itself locally. What then is an example of AB, a thing that moves itself primarily? Can there be such a thing? The answer to the latter question, we shall argue, is yes and no: yes, in the order of nature; no, in the argument of *Phys.* VII.1. For the argument of *Phys.* VII.1 is about body taken simply as physical continuum without regard to determinate natures.” Hassing notes that Averroes identifies to be moved primarily with being moved *per se*, which leads to un-Aristotelian consequences concerning the motion of animals (viz., that animals as a whole are not moved *per se* but *per accidens*, *ibid.*, 121–23) and the elements (viz., that they are moved by their form as the first self-moving part; *ibid.*, 123, 126–27). This misunderstanding motivates Averroes’ doctrine of conjoined movers; consider Weisheipl, “The Spector of *Motor Coniunctus* in Medieval Physics,” 96–99. Averroes does not resolve the argument to what Aristotle establishes of mobile continua in Book VI, but rather takes it as a *reductio* argument, a *quia* demonstration. This agrees with his final position that there are *in fact per se* and primary moved bodies. The only reason that Averroes, then, can agree with the argument for the motor causality principle is that the argument proceeds in abstraction from determinate natures, and only considers physical continuum in the abstract; see Hassing, “Physical Continuum,” 123–26, 128–30. Below, I will have more to say concerning the nature of this continuum.

20. St. Thomas, *In Phys.*, lib. VII, lect. 1, n. 2 (Leon.2.322).

21. 224a26–29: “[T]here is, however, something which moves neither accidentally nor by some of the parts of it [moving], but by itself moving first. And this latter is what is mobile in virtue of itself.” St. Thomas, *In Phys.*, lib. V, lect. 1, n. 2, notes that “ut per hoc quod dicit *primo*, excludatur motus secundum partem; per id quod dicit *secundum se*, excludatur motus per accidens.” (Leon.2.228)

22. See St. Thomas, *Exp. Po. An.*, lib. I, lect. 11.

23. As Aristotle maintains, the contrary is in fact the case, viz., that something can be primarily and *per se* in motion only if determinate natures are taken into account; see *Physics* VIII.5 and Hassing, “Physical Continuum,” 128–31, 128–30. This accords with the account Aquinas gives of a property belonging to some body primarily and *per se*, such as heat belonging to fire, and is how St. Thomas understands the “primarily” in the definition of nature, in terms of a commensurate universal property as explained in *Exp. Po. An.*, lib.

its parts, as Aristotle articulates in *Physics* VIII.5. Indeed, St. Thomas intimates as much in his response to Galen's objection to the motor causality principle.²⁴

Therefore, the mobile AB being in motion primarily and *per se* means that merely by being "mobile body" in kind, by none of its parts, and by nothing external, it is in motion. Were this true of body as such, "then we would find this self-motion in every body and its parts, even under division to infinity."²⁵ The primary and *per se* self-mover is akin to the fire that is hot through no other cause. AB moves on account of the motion of no other, whether an extrinsic whole or intrinsic part; it is the independent source of its own motion, and consequently in motion *per se* and primarily, depending upon no "other" taken strictly.²⁶

After making his clarification concerning self-movers, Aristotle advances the stopping-thesis in (2b): no thing in motion primarily and *per se* is something that stops upon something other stopping. St. Thomas states that "*hoc accipit quasi per se notum.*"²⁷ That is, the predicate is immediately implied by (but not contained in the very *ratio* of) the subject, as an effect follows upon the activity of the cause. The very notion of a primarily and *per se* moved thing prevents "stopping upon the rest of something other" from belonging to it. Given a mobile in motion primarily and *per se*, it follows without a middle term (immediately, *quasi per se nota*) that it cannot be moved secondarily—i.e., by something other that itself as a

I, lect. 11; see *In Phys.*, lib. II, lect. 1, n. 5 (Leon.2.57). For instance, the explication of falling is not resolved to the specific nature of an animal as such but to that nature under the more generic conception of heavy body.

24. St. Thomas, *In Phys.*, lib. VII, lect. 1, n. 4: "Sed deceptus est Galenus ex aequivocatione eius quod est per se. Per se enim quandoque sumitur secundum quod opponitur ei tantum quod est per accidens; et sic quod movetur secundum partem, movetur per se, ut Galenus intellexit. Quandoque vero sumitur secundum quod opponitur simul ei quod est per accidens, et ei quod est secundum partem; et hoc dicitur non solum per se, sed etiam primo. Et sic accipit per se Aristoteles hic: quod patet quia, cum conclusisset non ergo movetur per se AB, subiungit: sed concessum est per se ipsum moveri primum." (Leon.2.323) See also Hassing, "Physical Continuum," 140–42.

25. *Ibid.*, 130.

26. See Berquist, "The Proof of the First Mover in *Physics* VII, 1," 53–54. Coughlin, in n. 4 to *Physics*, VII.1, 155, argues that the "other" is a part of AB. This is true within the second leg of the argument, but the force of the thesis seems as universal and indeterminate as Berquist in fact makes it out to be.

27. St. Thomas, *In Phys.*, lib. VII, lect. 1, n. 3 (Leon.2.322). The *per se* character of this thesis I take to be *per se* in the fourth mode of *per se* discussed by Aristotle in *Posterior Analytics*, I.4. See 73a34–37; St. Thomas, *Exp. Po. An.*, lib. I, lect. 10, n. 7.

whole, which is to say some other internal part or external whole—or *per accidens*.²⁸

St. Thomas then notes that from this *quasi per se nota* thesis that Aristotle “*ulterius concludit, quod si aliquod mobile quiescit ad quietem alterius, quod hoc movetur ab altero.*”²⁹ This follows given the independence of a primarily and *per se* moving thing.³⁰ Also, if the first premise is *quasi per se nota*, the further step follows by the excluded middle: if the mobile is not moved primarily and through itself, it must be moved through another or (equivalently) through a part.³¹

This stopping thesis finds its use in the “resting part” hypothetical in the main argument, (2c). The proof in (c) is a delightful piece of contrary-to-fact hypothetical reasoning. The crucial part of the argument is the proof that if the part BC of AB rests, then the whole rests. This is justified because if AB does not rest, then upon the supposition of its part BC resting, then only the remainder AC must be in motion. However, this is against the

28. Nikolaus Lobkowitz, “Quidquid Movetur ab Alio Movetur,” *New Scholasticism* 42, no. 3 (1968): 409, objects that one could “conceive of two self-moving bodies between which there is no direct causal relationship whatsoever and which nevertheless always begin and cease to move simultaneously.” Besides the fact that the objection relies upon an imaginary situation, it is not altogether clear that a primary and *per se* moving thing could stop moving; see Berquist, “The Proof of the First Mover in Physics VII, 1,” 52, 54. Indeed, “the whole point of a self-mover is that it does not depend on anything for its motion,” notes Weisheipl, “*Quidquid Movetur ab Alio Movetur: A Reply*,” 424–25, in reply to Lobkowitz. Sylvester of Ferrara notes that “If something is said to move itself primarily, upon the resting of one part of itself, the part remaining could be moved by the motion of the whole, yet then to move and be moved would not belong to the whole primarily.” See *Comm. sup. ScG*, I.13, 34. Consider also Kolbeck, “The *Prima Via*,” 101–102.

29. St. Thomas, *In Phys.*, lib. VII, lect. 1, n. 3 (Leon.2.322). The summary of Philoponus’ commentary also notes that this is a “conversion by antithesis.” Philoponus and Simplicius, *On Aristotle’s Physics 5-8, with On Aristotle’s “On the Void”*, 113; likewise Simplicius, *On Aristotle’s Physics 7*, 15, notes the contraposition.

30. This “further conclusion” can also be supported through an inductive examination of cases, see Hassing, “Physical Continuum,” 135–39.

31. St. Thomas seems to summarize these connections in his brief manner in *ScG*, I.13: “Si aliquid movet seipsum, oportet quod in se habeat principium motus sui: alias, manifeste ab alio moveretur. Oportet etiam quod sit primo motum: scilicet quod moveatur ratione sui ipsius, et non ratione suae partis, sicut movetur animal per motum pedis; sic enim totum non moveretur a se, sed sua pars, et una pars ab alia. Oportet etiam ipsum esse divisibile, et habere partes: cum omne quod movetur sit divisibile, ut probatur in VI *Physic.*” (Leon.13.30–31) Two other proofs from *Physics*, Book VI are in the background of this demonstration, St. Thomas mentions them both in his commentary: *In Phys.*, lib. VII, lect. 1, n. 6: “[M]otus enim totius dependet a motibus partium, et dividitur in eos, ut in sexto probatum est.” Also, *ibid.*: “In motu non invenitur primum, neque ex parte temporis, neque ex parte magnitudinis, neque etiam ex parte mobilis, propter horum divisibilitatem.” (Leon.2.323) For the former, see Aristotle, *Physics*, VI.4, 234b22–235a11; for the latter, VI.5, 236a7–236b18; p.128–29.

supposition that the whole AB is in motion primarily and *per se*. Thus, if a part rests, the whole must rest. This, however, fulfills the conditions of the “stopping thesis.” Thus, AB must be moved by some other. Because every thing in motion is divisible, and every divisible thing depends upon its parts, the argument is true of every thing in motion. So, everything in motion is moved by another.

The strongest objection is the one which questions whether or not the supposition that BC rests is an allowable supposition, for it seems to be an impossibility that a part of a mobile in motion *per se* and primarily rest.³² One possible response is that the supposition that BC rests is true of the general notion of body. However, as St. Thomas reports, Avicenna finds this response wanting for it would then be just as cogent to claim that the whole AB could rest and thus not be moved primarily and *per se*. Further, someone could claim that being in motion primarily and *per se* is the specific difference distinguishing AB from body in general, and thus the ability of one of its part to rest is an impossible supposition, just as the supposition that man is non-rational *qua* man.

The proper response is provided by Averroes, who notes that Aristotle’s supposition relies upon the context of a conditional argument. Thus, just as it is a true conditional statement that “If squares are triangles, then the interior angles of squares add up to two right angles,” so also is it a true conditional statement that “If a part of a mobile in motion primarily and *per se* is at rest, then the whole mobile is at rest.” The truth of the conditional obtains despite the impossibility of the simple statements in the antecedent and consequent.

Now, because of this, St. Thomas observes, Averroes thinks that the argument is not a *propter quid* but a *quia* demonstration, as it does not contain the cause. Averroes provides the correct solution to the difficulty, but misses the demonstrative force of the argument because a “first in motion” is impossible simply speaking. The impossibility of a first in motion

32. St. Thomas reports this objection from Avicenna, *In Phys.*, lib. VII, lect. 1, n. 5 (Leon.2.323). See also Simplicius, *On Aristotle’s Physics* 7, 14–15, who notes Galen has a similar objection.

provides a *quia* demonstration—were one to stop at that. This is because the demonstration is through the second figure.³³ (All primarily and *per se* mobiles are firsts in motion, but no body (as such) is a first in motion; therefore, no body as such is a mobile of the likes of AB.)

Yet the argument does not stop there. A first in motion cannot be found because the whole motion depends upon its parts, which are a continuum, and hence indefinitely divisible. This provides the cause: every mobile in motion is divisible into parts upon which the motion of the whole depends; however, since all such mobiles cannot be moved primarily and *per se*, they must be moved by another.

Thus, therefore, Aristotle shows the cause of why no mobile moves itself: because it is not possible for there to be a first mobile whose motion does not depend upon its parts, just as if one were to show that nothing divisible can be the first being, because to be a divisible thing of such a kind depends upon parts. Thus, just as this conditional is true: *if the part does not move, the whole does not move*—so also this conditional is true: *if the part is not, the whole is not*.³⁴

That is, an insufficiency arises on the part of mobile being due to its quantity. Extension is a necessary condition for being mobile, but this means that the mobile whole precisely insofar as it is in motion cannot be the first sufficient ground of its own motion by the very fact of being materially dependent upon its parts. Matter as such is not explanatory of the actual existence of motion.³⁵

Now, one might raise further doubts about this. First, does the argument conclude to the existence of an efficient cause? Can one derive from the material insufficiency of a mobile to

33. A similar phrasing of the argument in the second figure is given by Simplicius, *On Aristotle's Physics* 7, 16.

34. St. Thomas, *In Phys.*, lib. VII, lect. 1, n. 6 (Leon.2.323). The “first mobile” here signifies the hypothetical mobile that is moved primarily and *per se*. *Ibid.*, 16–17, has a very similar explication of the argument’s resolution to the dependence of the whole upon the part. See also Wallace, *From a Realist Point of View*, “Demonstrating in the Science of Nature,” 143.

35. In this way, the argument reduces to the principles of potency and act, but via the nature of the continuum, in contrast to the mode of the argument in *Physics* VIII, via agent causality. Hassing, “Physical Continuum,” 128: “Since the physical continuum is common to all bodies, it follows from Aquinas’s account that what all bodies have in common cannot be a source of self-motion.” *Ibid.*, 129, fn. 51, notes that this was the common opinion of major commentators about the explanatory core of the argument.

move itself the existence of the efficient cause of its motion?³⁶ What this objection suspects is that Aristotle's argument lacks a proof that what is in motion needs a mover.³⁷ Yet as Kolbeck points out, to deny this supposition would be to deny the principles of change and understanding of nature established in the first books of the *Physics*. Nothing comes from nothing; hence the necessary conjunction between mover and moved is not doubted. What is doubted is whether the mover and moved must be really distinct.³⁸ Kolbeck also points out that "in order for anything to be an efficient cause, it must first be, and for a thing as a whole to be an efficient cause, it must exist as a whole."³⁹ Now, this is precisely what the argument points out cannot happen with mobile AB: as a whole it is dependent upon its parts and even the whole motion is dependent upon the partial motions.

Yet this leads to an objection raised by Sylvester of Ferrara:

There is a difficulty in what St. Thomas assumes, *the motion of a divisible thing depends upon its parts just as [it depends upon its parts] for being*, because the case seems to be rather to the contrary. For being and motion do not belong primarily and *per se* to the parts but to the whole, for it would not exist but for the being of the whole, nor would it move but for the motion of the whole, if what moves in place is a continuum. Therefore, the being and motion of the whole does not depend upon the being and motion of the parts, but rather the being and motion of the parts upon the being and motion of the whole.⁴⁰

36. This objection is made by Ross in Aristotle, *Aristotle's Physics*, 669; Kenny, *The Five Ways: Saint Thomas Aquinas' Proofs of God's Existence*, 19 makes it as well. Kolbeck, "The *Prima Via*," 97–103 discusses this objection and argues against the solutions proposed by William A. Wallace, "The Cosmological Argument: A Reappraisal," *Proceedings of the American Catholic Philosophical Association* 46 (1972): 30; Michael J. Buckley S.J., *Motion and Motion's God* (Princeton, N.J.: Princeton University Press, 1971), 47; and Weisheipl, "Quidquid Movetur ab Alio Movetur: A Reply," 424.

37. Kolbeck, "The *Prima Via*," 103–106; see Kenny, *The Five Ways: Saint Thomas Aquinas' Proofs of God's Existence*, 18–19.

38. See Kolbeck, "The *Prima Via*," 105–106. Kolbeck helpfully cites St. Thomas, *In I Sent.*, d. 35, q. 1, a. 1, ad 3: "[Q]uamvis ad rationem scientiae exigantur scientia, sciens et scitum; non tamen exigitur quod haec tria differant secundum rem: sicut etiam de ratione motus est quod sit movens et motum: sed quod motum sit aliud a movente, non potest sciri nisi demonstratione, ante cujus inventionem multi sunt opinati aliquid seipsum movere." Here we can note that the proof of *Physics* VII.1 provides the grounds needed above in §4.4 to defend the real distinction of action and passion. Another way to take the objection is that the moving thing might just be in motion without a continuously present mover in contact with it; see Kolbeck, "The *Prima Via*," 106–11. That is, a *motor coniunctus* does not seem necessary. I will comment on this below.

39. *Ibid.*, 103.

40. Sylvester of Ferrara, *Comm. in ScG*, I.13 (Leon.13.34).

To solve the difficulty, Sylvester appeals to the distinction between formal and material causality. Since the argument concerns the order of generation, the coming to be of the motion of the whole, it is correct to use the material cause.⁴¹ However, this answer only raises the further issue of how there is a first in motion on the side of form. If all mobiles are infinitely divisible, and there is no first in motion, then how can any whole be caused to move at all? Here one must turn to the determinate natures of mobile beings: the problem must find its resolution in formal causality. A whole may be in motion due to one of its parts being primarily and *per se* in motion, due to its determinate nature. Still, even a part of determinate nature cannot be primary, essential self-mover in every way, precisely because it is a part of a whole and thus retains the mark of material dependence upon the whole.⁴²

41. Ibid.

42. Thus, wholism and the virtual presence of parts in substantial wholes, some of which parts are required as moving causes of the whole, becomes an important theme for further investigation, which cannot be pursued here. The qualifiedly virtual presence of integral parts needs closer inspection also; see Michael Storck, “*Pars Integralis* in St. Thomas and the Parts of Living Substances,” *The Thomist: A Speculative Quarterly Review* 78 (2014): 379–399. Sylvester, *ibid.*, 35, raises this theme implicitly in his next objection: “Sed tunc insurgit maius dubium. Si ideo nihil seipsum movet primo quia moveri ipsius dependet in genere causae materialis a moveri partium, sequitur quod nec etiam aliquid poterit ab alio primo moveri: quia in omni moto verum est quod moveri totius materialiter a moveri partium dependet.” Sylvester again replies by appealing to form, before going on to emphasize—fitting given the context of his commentary—that nothing is in motion by primacy of causality in every way: “Dicitur primo quod, licet aliquid moveatur primo primitate temporis et primitate informationis, quia aliquid totum simul secundum omnes partes movetur et informatur motu; tamen verum est nihil moveri primo, etiam ab alio, primitate causalitatis omnimodae” In the subsequent historical development of Sylvester’s objection and reply, inquiry into the wholism of formal causality is obviated by the whole-part reductionism and calculus of indivisibles utilizing force laws; the philosophical implications have been discussed by Richard F. Hassing, “Wholes, Parts, and Laws of Motion,” *Nature and System* 6 (1984): 195–215; Hassing, “Animals versus the Laws of Inertia”; consider also Hassing, “Physical Continuum,” 126–30, 133–34, 144–46. Consequently, the conclusion and mode of conception of the motor causality principle have ramifications for the relationship between general natural philosophy and mathematical physics, with the logo-centric conceptualization of the former and the symbol-centric and species-neutral conceptualization of the latter; see *ibid.*, 111, fn. 2.

In this respect, the argument of *Physics* VII needs supplementation, which Aristotle provides in *Physics*, VIII.4–5, arguing that a homogenous body cannot move itself (255a5–18) and that a first moved part in motion is possible (258a27–258b4). See St. Thomas, *In Phys.*, lib. VIII, lect. 11, nn. 5–6 (Leon.2.406). Thus, the argument from act and potency for a finite series of agent causes completes Aristotle’s consideration in Book VII. This supplementation is noted by *ibid.*, 129, fn. 52, who, at 123–26, considers these passages from St. Thomas. Concerning the peculiarity of this denatured physical quantity, see Hassing, *ibid.*, 125, fn. 45: “We thus have three kinds of magnitude: (1) mathematical continuum, (2) physical continuum, and (3) magnitude of a body of determinate nature. The latter cannot be divided to infinity without corrupting the nature in question. This threefold Aristotelian distinction was discussed among medieval commentators.” Hassing refers the reader to Duhem, *Medieval Cosmology*, 35–45; in particular, Giles of Rome makes this

Thus one must conclude that the issue of the relationship between form and first moved is not addressed by *Physics* VII.1. On its own, the argument in Book VII proceeds at a certain degree of abstraction—not a mathematical type of abstraction, for matter and motion are still being considered—but it is a consideration of magnitude which has not yet reached determinate and ‘natured’ (or ‘informed’) continua. Because this indeterminacy remains throughout the remainder of the argument, it constrains the conclusion about the first moved mover. The determinate nature of the first moved mover will remain outside the grasp of the argument. Consequently, this more universal and indeterminate conclusion of general natural philosophy prompts the more determinate study of the same being.

10.3 Major premise: the finite series of moved movers

That every thing moved by another is moved by some first mover is proven by *reductio*. If every thing in motion is extended and moved by another, which mover is itself in motion, this series either comes to some first mover or it does not. If not, an infinite series of movers results. This infinite mobile’s motion would occur over a finite time. However, an infinite mobile cannot be moved in a finite time.⁴³ Therefore, “it is clear that one thing being moved by another does not proceed to infinity, but rather will come to a stand at some point, and there will be a first mobile which is moved by some other immobile [mover].”⁴⁴

three-fold distinction most clearly. Kolbeck, “The *Prima Via*,” 158, 184, places too much emphasis on the mathematical character of the continuum in Book VII.1, although he too remarks upon the difference between the indeterminate physical continuum and natural body with a determinate form. His discussion of this increase in determination *ibid.*, 128–32 brings out how the indeterminacy of the physical continuum must be rooted in prime matter. Wardy, *The Chain of Change*, 94, notes that Aristotle’s argument seems to employ “geometrical terms” and, *ibid.*, 97–98, and 97, fn. 6, concludes that this makes the argument of the *textus alter* unsound, for “Aristotle’s argument does not readily lend itself to *any* physical modeling,” and hence “its applicability to real physical movers remains unclear.” (Wardy maintains that the conclusion as stated in the main text, which claims only material dependence, is sound, but too weak to produce the desired conclusion.) Later, *ibid.*, 113, fn. 22, he notes that “If anything, the proof’s generality discourages an immediate application to the cosmos without some intervening supplement.” Wardy suggests, *ibid.*, 114, that *Physics* VIII.4 provides this, when it considers determinate natures to correct *Physics* VII.1’s fallacious, abstract line of reasoning. However, because the physical continuum is being considered, and not the geometrical continuum, Wardy’s conclusion about the *textus alter*, while understandable, is inaccurate.

43. Aristotle, *Physics*, VI.7, 238a20–238b17.

44. St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 4 (Leon.2.327).

First, Aristotle establishes the contrary-to-fact scenario: a universal body of infinite size. Aristotle claims that, given the motor causality principle, “it is also necessary that everything moving in place be moved by another.”⁴⁵ Some other sufficient condition in the order of efficient causality must exist for every moving body. The series of moved movers must come to a final member “which will be primarily the cause of moving.”⁴⁶ If not, then one must postulate a series of moved movers (A, B, C, D, etc.) that is infinite. This series must be moving in one time.⁴⁷ This is because the mover must be together with the moved, and hence the action of the mover on the moved will be together with the motion of the moved and will be measured by a simultaneous time. Aristotle later qualifies that the movers are assumed to be one by contact of some sort, and this causal connectedness means that “the motion of each is no less one in number” as well as being a finite motion, “since, indeed, everything moving moves from something to something.”⁴⁸ The motion’s unity in number depends upon the numerical unity of the termini of the motion as well as its occurring in the same time.⁴⁹

45. Aristotle, *Physics*, VII.1, 242a16–17. St. Thomas notes, *In Phys.*, lib. VII, lect. 2, n. 1: “Applicat autem specialiter ad motum localem quod supra universaliter demonstratum est, quia motus localis est primus motuum, ut in octavo ostendetur; et ideo secundum hunc motum procedit hic ad demonstrandum primum motorem.” (Leon.2.326)

46. Aristotle, *Physics*, VII.1, 242a20. This “primarily” must be understood in the sense established above. That is, it is a cause of motion dependent upon no other. Whether it itself is in motion (is a self-mover) is another question. However, it must at least be immobile with respect to the type of motion of which the series under scrutiny stands in need of some other cause, as St. Thomas observes, *In Phys.*, lib. VII, lect. 2, n. 1: “Accipiatur igitur aliquid quod movetur secundum locum; hoc movetur ab altero; aut ergo illud alterum movetur, aut non. Si non movetur, habetur propositum, scilicet quod aliquid sit movens immobile; quod est proprietas primi moventis.” (Leon.2.326) my emphasis. No bodily mover can possess this type of causality (as the motor causality principle demonstrates); rather, the terminus of this series must possess the sufficient condition of universal motion. This thesis should be compared to *Physics*, VIII.5–6, which further determinations establish that this primary cause of motion must be wholly unmoved, immobile *per se* and *per accidens*, in order to be the truly primary cause of motion.

47. *Ibid.*, 242a20–b8. As an aside, this portion of the text, ending with “These things were also said in the prior discussions,” referring (as Coughlin suggests, *ibid.*, 155, n. 7) to V.4, 227b3–228a1, establishes a further basis for the argumentative unity between Book VII and the prior books, if in fact its editorial unity is historically unfounded.

48. *Ibid.*, 242a29–32.

49. Bodies could traverse the same distance from A to B but on different days and would not have motions the same in number but only in kind. Thus, their total motions would be one in the sense of quantity of motion discussed below; see Aristotle, *Physics*, VI.4, 234b28–29. This seems to dissolve the objection raised by Wardy, *The Chain of Change*, 109–10.

This unity of mover and moved considered in this argument must be carefully considered. Does the impossibility of the infinite series result from their assumed unity or from their assumed infinity? If the impossibility results from their assumed unity, then the argument is unsound, since it assumes something contrary to our experience. If the impossibility results from their assumed infinity, then can the argument conclude something about efficient causes of motion in the universe despite the counterfactual assumption about the unity of these mobile movers?

Aristotle next proposes the main argument.

Let the motion of A, therefore, be taken, and let it be E, and of B, Z, and of CD, IT, and the time in which A moves, K. The motion of A, then, being determined, the time will be determined and K will not be infinite. But both A and B and each of the remaining ones were moving in the same time. It therefore happens that the motion EZIT, being infinite, is moving in the determined time K. For in that in which A was moving, all the ones in succession to A, being infinite, were also moving. Whence, they were moving at the same time. For either the motion of A will be equal to that of B, or greater. However, it makes no difference. For in every way an infinite motion happens to be moving in a finite time; and this is impossible.⁵⁰

The time K must be finite, through which the infinite mobile ABCD is moving with motion EZIT, because all motion is between termini and thus is measured by a finite time.⁵¹ The consequent impossibility arises because an infinite motion cannot occur in a finite time.⁵² The two conditions which must be examined are, first, how the infinity of mobiles produces an infinite motion (when it seems that the finite time K is deduced from the finitude of the motion), and second, why this is impossible.

50. Aristotle, *Physics*, VII.1, 242b8–19.

51. St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 2: “Sed quia motus ipsius A est determinatus, idest finitus, etiam tempus in quo est iste motus, scilicet K, est determinatum et non infinitum: quia sicut in sexto ostensum est, finitum et infinitum simul invenitur in tempore et motu.” (Leon.2.327) The prior proof is discussed *ibid.*, lib. VI, lect. 9, n. 10 (Leon.2.306), the commentary on *Physics*, VI.7, 238a32–b22.

52. St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 2: “Ergo sequetur quod motus infinitus sit in tempore finito; quod est impossibile. Hoc autem ideo sequitur, quia in quo tempore movetur A, moventur omnia alia, quae sunt infinita numero.” (Leon.2.327)

The infinity of the motion arises because the series of mobiles is infinite. The motion is finite insofar as it goes from something and to something. However, the quantity of motion of the infinite mobile ABCD is infinite. Aristotle notes that “either the motion of A will be equal to that of B, or greater,” but which it is “makes no difference.”⁵³ By quantity of motion, I mean the Aristotelian sense: “the whole motion [being] the motion of the whole magnitude.”⁵⁴ What does “equal . . . or greater” mean in this context?⁵⁵ It seems that it cannot mean a greater magnitude traversed, for the motion of ABCD is numerically one, between the same termini and in the same time. Perhaps the speed of each mobile is greater or equal? St. Thomas interprets this qualification to be about an equal or greater speed:

Nor does it make a difference to the proposition whether the motion of all the mobiles be of equal speed or whether the inferior mobiles are moved more slowly and in a greater time, because it follows in every way that an infinite motion will be in a finite time. For each mobile must necessarily have a finite speed or slowness. However, this is impossible, namely that an infinite motion be in a finite time. Therefore the first proposition is also impossible, namely that one can proceed to infinity in mobiles and movers.⁵⁶

However, if speed is meant, “then what is moving will be disturbed, or there will be no corporeal motion.”⁵⁷ That is, the mobiles could come apart and no longer be in contact. Besides, the image that St. Thomas’ interpretation brings to mind is the nested spheres of Aristotle’s ball cosmos, where the lower spheres move with the same diurnal motion at a lower speed than the higher spheres. Aristotle’s argument, however, does not expressly

53. Aristotle, *Physics*, VII.1, 242b8–19. See also Apostle, in Aristotle, *Aristotle’s Physics*, fn. 17, 301, which is discussed below.

54. Aristotle, *Physics*, VI.4, 234b28–29. This Aristotelian notion is contrasted with a Newtonian conception of momentum by Hassing, “Physical Continuum,” 143–46.

55. Apostle, *ibid.*, fn. 24, 301, provides a physical reason (besides the mathematical reason of avoiding a convergent infinite series of mobiles) for why Aristotle specifies that B have an equal or greater motion: “Since A receives its motion only from B, which is itself in motion, the motion of A cannot be greater than that of B, and it may be less (267a2–10). The motions of B and C are similarly related, and likewise for the rest.” The passage to which Apostle refers is a universal claim that grounds Aristotle’s explanation of projectile motion.

56. St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 2 (Leon.2.327).

57. Philoponus and Simplicius, *On Aristotle’s Physics 5-8, with On Aristotle’s “On the Void”*, 115.

specify a particular cosmology, only that, in general, there is an infinite cosmos of moving movers.⁵⁸ The cogency of the proof, if it is in fact universal, cannot depend upon a particular cosmological theory (ancient or modern).

Perhaps, instead, a greater quantity of motion would belong to a mobile with a greater size: a whole would have a greater motion than its parts. Then the statement is just a roundabout way of saying the mobiles are of equal or greater magnitudes.⁵⁹ At the very least, this qualification is important because it rules out the case where mobile ABCD is a convergent series. For instance, if one assumed a mobile A with a determinate quantity being moved by B with a magnitude of one-half that of A, and B being moved by C of one half the size, a finite and not an infinite magnitude would result. However, Aristotle claims (242b20–243a2), the same impossible result follows if the body ABCD is a finite whole.⁶⁰ This qualification allows the proof to proceed in abstraction from any determinate cosmological arrangement.

Note that the argument does not attempt to prove the impossibility of an infinite series of movers, but *assumes* this infinity. Nor does the proof argue that an infinite body cannot move, but rather *assumes* its motion and then proves that an impossibility follows. In this way, our understanding of the middle term in the overall argument is based upon the same fundamental insight that supported the minor premise, viz., the divisibility of the mobile.⁶¹

58. Some commentators do specify a particular cosmology, for instance, Sylvester of Ferrara, *Comm. in ScG*, I.13 (Leon.13.36).

59. See the summary of Philoponus in *On Aristotle's Physics 5-8, with On Aristotle's "On the Void"*, 115, which gives both speed and magnitude as possibilities, but settles on the latter.

60. Note that this makes the middle of the argument slightly different. Instead of arguing that an infinite body cannot move in a finite time, one would have to argue (in this case of a finite arrangement of numerically infinite mobiles) that this infinite series can never be causally actuated. Consequently, this variation requires an argument focusing on individual agents, which is found later in Book VIII. See the summary of Philoponus in *ibid.*: "He means that it makes no difference for what we have said whether the body which is formed out of the bodies is finite or infinite. When the number of motions is infinite, then the motion which is composed of these is infinite, for the magnitude which is composed of an infinite number of magnitudes must be infinite, and similarly the motion composed of an infinite number of motions must be an infinite motion."

61. Berquist, "The Proof of the First Mover in Physics VII, 1," 61–62. Also, Wardy, *The Chain of Change*, 103.

How, then, does the proof proceed? The basic structure is as follows:

If there is no first unmoved mover, there must be an infinite mobile, and this must move in a finite time, the time in which the last mobile moves a finite distance. But, being infinite, it can only move in an infinite time.⁶²

Before the qualification is made (242b20–243a2), why does the contradiction follow, that the infinite mobile must move in both a finite and an infinite time?

The proof of this impossibility comes from *Physics*, VI.7, 238a32–b22. The proof relies on the divisibility of the mobile and the notion that the mobile measures out the space through which it traverses.⁶³ A finite mobile cannot move through an infinite space in a finite time, therefore, because (whether its speed is constant, 237b26–33, or varies, 237b34–238a31) the finite cannot measure the infinite. The argument works just as well in reverse, however: an infinite mobile cannot move through a finite space in a finite time. Thus, for the first case, a single, finitely long locomotive could not traverse the platform of an infinitely long train station in a finite time, whereas, for the second case, an infinitely long train could not traverse the span of a finite train station platform in a finite time. Since ABCD, considered indeterminately, is an infinite mobile which was supposed to be moving through a finite space in a finite time, the contradiction arises and the *reductio* obtains.

The objection to this procedure is clear: perhaps the infinite body could “shift over” the required finite distance?⁶⁴ That is, the objection claims, there is an equivocation taking

62. Berquist, “The Proof of the First Mover in Physics VII, 1,” 63.

63. *ibid.*, 63–64.

64. See Sylvester of Ferrara, *Comm. in ScG*, I.13 (Leon.13.35). Sylvester’s reply, however, relies upon a determinate cosmological arrangement. He maintains that Aristotle is considering an infinite series of concentric spheres, for the revolution of which it would be required that a finite space—namely the finite angular distance of one day—be traversed by an infinite body in a finite time. Alternately, Coughlin, *Physics*, 155, n. 11, answers this objection by suggesting that a partial motion presupposes a complete motion, so that a partial motion is impossible if the complete motion is impossible. He also (as does Sylvester) suggests that Aristotle’s arguments against the possibility of an infinite body are more apropos. However, Aristotle’s argument does not do this. *ibid.*, 64–66, proposes a resolution that respects the assumptions of the argument, viz., that an infinite body is in fact moving. This article, a transcript of Marcus R. Berquist, *The Proof for the First Mover in Physics VII, 1*, Thomas Aquinas College, June 2010, does not include a transcript of the question and answer period following when Mr. Berquist clarified his argument. A recording of this session was consulted.

place: Aristotle's proof in *Physics* VI.7 proves that an infinite whole cannot traverse a finite space in a finite time, but the parts of that infinite can—so Aristotle's proof equivocates between whole and part.⁶⁵

To resolve this objection, first consider that the mobile ABCD cannot be occupying a place larger than itself (for then there would be an infinite larger than an infinite). ABCD cannot occupy a place equal to itself, for then it would lack a place to which to move.⁶⁶ Paradoxically, this requires that the place occupied by ABCD be less than itself. ABCD stands, somehow, "outside" the available space and moves through it.

Given this scenario, one must guard against a fallacy of the imagination. The imagination suggests that the infinite ABCD can be "shifted over just a foot," just as it seems that the infinitely long train can be shifted just a foot down the finite station platform. To reveal the fallacy in this train of thought, consider *ray* XZ, infinite in the direction of Z. Beginning from X, cut off a finite distance XY. Consequently, *ray* YZ seems to be less than *ray* XZ.⁶⁷ The paradox with the infinite ray arises if one omits to consider that *ray* XYZ is called infinite only *per aliud*, namely in virtue of *ray* YZ. So the finite part XY makes no more real addition to *ray* YZ insofar as we, in our imagination, take two rationally distinct instances of the ray in question and ask about how they compare as if really distinct. Likewise, a three-dimensional series of moved movers—of which we have taken the first, A—if it is to

65. Berquist, "The Proof of the First Mover in Physics VII, 1," 64–65.

66. If the body were rotating, then Sylvester's argument would apply. However, the argument in *Physics* VII.1 proceeds without attending to any particular cosmological arrangement or species of agency, such as Aristotle considers in *Physics* VII.2. For Sylvester's argument, see *Comm. in ScG*, I.13 (Leon.13.36).

67. An analogous paradox asks whether or not the set of all even numbers is less than or equal to the set of all integers. Both comparisons are from Berquist, *The Proof for the First Mover in Physics VII, 1*. Compare Bertrand Russell, *A History of Western Philosophy and Its Connection with Political and Social Circumstances from the Earliest Times to the Present Day* (London: George Allen / Unwin Ltd., 1947), 858; Berquist's teacher, De Koninck, "Random Reflections on Science and Calculation," 96–99, discusses these paradoxes as they arise in Russell's presentation, noting, 96–97, that the paradox arises because of an equivocation on "whole" and "part," i.e., not distinguishing between the universal and the particular. That is, the argument notes a member-to-member correspondence of a *particular* instance of the series of integers and a *particular* instance of the series of even integers and then attempts to draw a conclusion about the universal series, viz., that all the integers—the whole—is equal to the evens—its part.

move, stands in an analogous way to the segment XY of *ray* XYZ .⁶⁸

To return to the argument: to interpret Aristotle's use of the theorem from *Physics*, VI.7, one must say—given that the infinite mobile ABCD cannot be placed in a place greater than or equal to itself—that ABCD is moving through a place that is less than itself. That is, the space through which the mobile is moving is the only place available. Call it LMN, with ABCD occupying half of it in LM, waiting to move into the available space MN. Our imagination and the argument tells us that beyond B, C, and D is the remainder of the infinite mobile—E, F, G, . . . , etc.—occupying a place “outside” the available place. However, reason tells us that if ABCD moves a finite distance, from place LM to MN, and we maintain by supposition that it is being moved by a series of infinite moved movers, then this can only be true if the whole infinite body is moving through *that* finite space in the given finite time, for the remainder of the infinite body (contrary to the fallacy of the imagination) is not yet in place and consequently is not moving in place (analogously: *ray* YZ does not decrease in length with the subtraction of XY). Thus, the infinite mobile ABCD must be moving through a finite space in a finite time: an impossibility. Thus, Berquist's exposition explains what St. Thomas means when he says of the conclusion to the *reductio*, “This conclusion follows, however, because in the time in which A moves, all the others move, which are infinite in number.”⁶⁹ That is, the finite available space can be filled indifferently by any part of infinite mobile ABCD, so the infinite as a whole must be able to move through a finite space.

After drawing the conclusion to the argument supporting the major premise, Aristotle makes a qualification (242b20–243a2). The objector asserts that the impossibility would not arise were the infinite mobiles not moving with one motion—that is, were they not one mobile. Aristotle therefore makes his assumption clear, viz., that the unity by continuity of

68. The argument is abstracting from the mobiles being pushed, pulled, or whirled about, let the shape and arrangement of the mobile be considered indifferently. After decluttering the imagination, the argument will work just as well for the infinite train as it would for an infinite sphere one takes to be expanding (the radius, being infinite, would result in a flat-sided volume that is trying to “move” in one direction).

69. St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 2 (Leon.2.327).

contact of this mobile is a condition of the argument. St. Thomas comments:

Therefore, let one of these ways be taken, namely that from all the infinite mobiles and movers, one thing is made, *namely the whole universe itself*, through a certain kind of continuous stretch [*per continuationem quandam*]. Because this is contingent, let it be supposed. This whole, which is a certain kind of magnitude and continuum, let it be ABCD, and its motion be EZIT. Because someone could say that EZIT was the motion of finite mobiles, and thus cannot be the motion of an infinite whole, he adds that it makes no difference to the proposal at hand whether one takes a finite or an infinite magnitude which is in motion. For just as when A moved in a finite time K any of the remaining finite mobiles, infinite in number, are simultaneously in motion, so also in the same time the entire infinite magnitude moves at once. Therefore, the impossible results regardless of which one of these one grants, either there is a finite magnitude composed from magnitudes infinite in number or there is an infinite magnitude whose motion is in a finite time (since it was shown above that an infinite mobile cannot move in a finite time). Therefore that from which this followed is impossible, namely that the series of movers and mobiles goes to infinity.⁷⁰

ABCD is Aristotle's continuum-universe, a de-natured conception of the physical continuum of the entire cosmos. It possesses a certain kind of continuity, or continuous stretch. Thus, the argument conceives of the universe as a system of indeterminate and indefinitely many bodies that are numerically one through causal contact.⁷¹

Nor can the objector thinking ABCD to be a convergent infinite series overturn the argument: whether ABCD is finite or infinite makes no difference to the argument, for an impossibility results either way. In the case of a finite ABCD, St. Thomas takes the impossibility to be the fact that an actual finite, continuous magnitude would be composed

70. Ibid., n. 4 (Leon.2.327). My emphases.

71. Simplicius, *On Aristotle's Physics* 7, 22, makes this specification about their continuity, that the moving movers will be one "in virtue of contact." This is a passage where the main text (Coughlin's alternative text) is clearer, see 242b59–63: "But if it is necessary that what is moving [another] primarily according to place and bodily motion be touched by or continuous with the moved, as we see this happening in all cases, it is necessary that the things being moved and the movers be continuous with or touching each other, so that there will be something one from all." That this "continuous" or "contiguous" universe does not actually obtain in reality is a position taken even by Aristotle; see below, p. 196.

of an actual infinity of magnitudes.⁷² Wardy suggests that the motions cannot decrease in quantity because this would imply a decrease in causal power: effects cannot exceed their causes.⁷³ Thus, what Aristotle later discusses in *Physics* VII.5, the proportions between movers, power, and motions, would be a crucial supplement to this reading of the argument in *Physics* VII.1.⁷⁴ Contrary to Zeno, it is not true that “any part of the millet makes a sound.”⁷⁵ Another way that this finite ABCD would lead to impossibility is suggested by Apostle:

If the motion of the mover is not less than that of the thing moved and if the ratio of the magnitudes of mover to moved is always the same and less than unity, the motion of ABCD . . . will still be infinite.⁷⁶

That is, if the *motion* of each mover is the same in quantity as that which it moved (for a mover with a lesser motion would be unable to move the moved), while the magnitudes of these mobiles were decreasing as a convergent series, the motion of the mobile itself would still be infinite. That is, the motions of each member (even though they are all one by causal contact) is of some size and over some determinate space. Yet they are infinite in multitude. Here again the imagination provides the image of a *finite* mobile; but the limit of the convergent series is, in reality, never actually reached. Thus, the magnitudes infinite in

72. See St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 7. “Sequitur ergo impossibile, quodcumque horum detur, sive quod sit magnitudo finita constans ex magnitudinibus numero infinitis, sive quod sit magnitudo infinita, et motus eius in tempore finito; cum sit ostensum supra quod mobile infinitum non potest moveri tempore finito.” (Leon.2.327) The former case requires a specification regarding numerically infinite but spatially finite mobiles; see above, fn. 60. Apostle, in *Aristotle’s Physics*, fn. 17, 301, makes a similar suggestion, that “If the motions of A, B, C, . . . decrease according to the same ratio, as in $a, ar, ar^2, . . .$ where $r < 1$, all these motions converge to a finite and not to an infinite motion. But the existence of A, B, C, . . . as an actual set and at the same time as something infinite is impossible according to Aristotle, for no thing can have the same attribute both potentially and actually at the same time and in the same respect. In the alternative text, $r \geq 1$, so no problem arises.” Recall that Apostle’s alternative text is Ross’ main text. However, both this main text and the *textus alter* seem to state the same $r \geq 1$ condition, which occurs *before* the qualification about continuity.

73. Wardy, *The Chain of Change*, 108. Apostle, in *Aristotle’s Physics*, fn. 24, 301, makes a similar suggestion.

74. Wardy, *The Chain of Change*, 332.

75. Aristotle, *Physics*, VII.5, 250a20.

76. Apostle, in Aristotle, *Aristotle’s Physics*, fn. 26, 301.

multitude would still function as an infinite series.⁷⁷ How does an impossibility result from this?

Kolbeck makes an apt suggestion, one still based upon the same qualification Aristotle makes, viz., the continuum-universe.⁷⁸ If one does not come to a halt in movers that are in motion, then the infinite continuum ABCD, taken as one body, must contain *all* of the movers, which are all in motion. No mover outside this set can exist, by supposition. However, by the motor causality principle, the set as an infinite continuum universe still requires a mover for it to be in motion. Lacking this, ABCD cannot be in motion, and hence motion cannot exist. Yet this is contrary to our experience of motion. Therefore, the set must be finite and some primary mover outside the set of movers in motion must exist. In short: the totality of changing things cannot be self-explanatory.

The argument can now be concluded: all things in motion are things moved by another, and all things moved by another are moved by some immobile first mover. Aristotle draws the conclusion in this fashion: “Whence it is necessary to come to a stand and for there to be some first mover and moved.”⁷⁹ St. Thomas paraphrases:

Therefore, it is clear that the series of one thing being moved by another does not go on to infinity but stops somewhere, and there will be some first mobile [*primum mobile*], which, certainly, is moved by some other immobile mover.⁸⁰

First, note that Aristotle does not draw out the predicate “immobile” from his conclusion to a first mover.⁸¹ The route to this predicate seems direct, if implicit, for were the first mover

77. Since *Physics* VI.7 also shows that a finite mobile cannot move with an infinite motion in a finite time, the proof would still work if an infinite motion were being traversed by a finite mobile. This is how Simplicius, *On Aristotle’s Physics* 7, 22–23, takes the argument, as does Coughlin, *Physics*, 155, n. 11. Yet with the convergent series this is not the case. While Wardy, *The Chain of Change*, 108, mentions the Zenoic, paradoxical nature of the convergent, infinite series, he does not make this remark into a clear solution.

78. The following summarizes Kolbeck, “The *Prima Via*,” 160–63.

79. Aristotle, *Physics*, VII.1, 243a27–28; Coughlin’s “Alternative Text.”

80. St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 4 (Leon.2.327).

81. In Ross’ *textus alter* he states he will prove a “primary mover” in his thesis statement but only mentions the *primum mobile* in his conclusion; Ross’ main text uses “first mover” both times.

itself in motion *per se* it would not be the first or primary cause of motion.⁸²

Second, note the corollary to Aristotle's main conclusion, which is in fact our objective: there must be a penultimate to the series which terminates ultimately in the first mover unmoved. There must be a *primum mobile* because the series terminates in a mover other in kind which acts upon a series of moving movers; of necessity there is a first moved. Some qualifications to this corollary are drawn out below.

10.4 Issues following from the conclusion

The argument just completed for the *primum mobile* has a long history within inquiry into the principles of nature. I will remark briefly on three issues.

82. Now, it might seem that because the argument only considers *per se* motion, it cannot conclude that the first mover is wholly immobile, both *per se* and *per accidens*. Aristotle only explicitly argues to this further conclusion in *Physics*, Book VIII. The reason it might seem this way is the character of the middle term used in Book VII's argument, viz., the mobile continuum. Because the mobile continuum belongs only to *per se* mobiles and not to *per accidens* ones, it seems we cannot immediately exclude the first mover being in motion *per accidens*, e.g., were it some ultimate point-mover or a soul—both of which are in motion *per accidens* when the body moves. (Indeed, such a cosmic soul is an alternative Aristotle seeks to eliminate in Book VIII.) However, this is not the case. The argument *considers* the physical continuum as such—not a mathematical continuum separate in thought but the form-matter composite—subject to divisibility that is the condition of being mobile, and yet only conceived of without determination on the side of form. The argument *concludes* that the primary mover must be *other* in kind than such movers (otherwise the series of moving movers does not terminate). This mover must be a mover outside the genus of “physical-continuum-movers,” and hence moving in no way that belongs to mobiles in the physical continuum. This excludes the possibility that this first mover is a natural form (e.g., a cosmic soul or cosmic mind naturally joined to the world) or an accident (e.g., a point) or other accidental mobile.

As a further consequence, since the argument proceeds from the property which all mobile movers have, viz., physical quantity, the mover to which the argument concludes, insofar as it is immobile *per se*, cannot have quantity. Since this physical continuum is proper to that substance whose matter is prime matter, this first mover cannot have prime matter as its principle, and so must be immaterial in the sense of lacking prime matter as a principle of its substance. Thus, such a first mover must be *per se* immobile and a mover whose causal action occurs without prime matter as its ultimate substratum. Because this mover is a being or substance, but possesses action without a substratum and is thus beyond the fundamental theorem of *Physics* I just as it instantiates the logically possible option that some movers move without suffering motion (above, Ch. 2, fn. 64), this conclusion raises questions that the natural philosopher cannot answer.

The principles of motor causality and inertia

The mobile AB in Aristotle's argument, in motion primarily and *per se*, can bring to mind certain similarities to inertial motion.⁸³ Likewise, many have thought that the argument for God's existence through motion, dependent upon various defenses of the motor causality principle, is vitiated by Newton's first law of motion—and many have attempted to show this is false.⁸⁴ In this connection, three opinions are worth noting: first, that the motor causality principle trumps the principle of inertia; second, that they are merely found in different levels of conception; finally, that inertia is the wrong opponent to motor causality.

First, some defend Aristotle's motor causality principle by appealing to the universality of his arguments in terms of the general principles of matter, form, and privation. The two arguments singled out are the one based upon divisibility in *Physics* VII.1 (241b24–242a15) and the one based on act and potency in *Physics* VIII.5 (257b6–11). The former argument resolves to the definition of motion (via the divisibility thesis of *Physics* VI.4), while the latter argument resolves to the principle of contradiction. I have examined the former argument above and will examine the latter argument in Chapter 4. If one accepts the reality of change (including the reality of local motion),⁸⁵ the principles of change, and the definition of motion, then the two arguments for the motor causality principle are sound.⁸⁶ For instance, if local motion cannot be a change in relation (for relation does not change *per*

83. Berquist, "The Proof of the First Mover in *Physics* VII, 1," 56–57.

84. See, for instance, Reginald Garrigou-Lagrange, *God: His Existence and His Nature*, trans. Dom Bede Rose, vol. 1 (St. Louis: B. Herder Book Co., 1939), 275; William A. Wallace, "Newtonian Antinomies Against the Prima Via," *The Thomist* 19 (1956): 151–192; Antonio Moreno, "The Law of Inertia and the Principle *Quidquid Movetur Ab Alio Movetur*," *The Thomist* 38 (1974): 306–331; John King-Farlow, "The First Way in Physical and Moral Space," *The Thomist* 39 (1975): 349–374, and the reply by William A. Wallace, "The First Way: A Rejoinder," *The Thomist* 39 (1975): 375–383; Michael Augros, "Ten Objections to the Prima Via," *Peripatetikos: The Journal of the Society for Aristotelian Studies* 6 (2007): 59–101. Most recently, see Michael Augros, *Who Designed the Designer?: A Rediscovered Path to God's Existence* (San Francisco: Ignatius Press, 2015), in "Appendix 4: Musings on Newton's First Law," 238–44.

85. And this despite the fact that "among motions, the thing moving is removed from its substance least in being borne." (261a20–23) The reality of local motion seems tenuous just as the existence of place and the new "where" acquired by the mobile is tenuous.

86. Coughlin, *Physics*, "Appendix 10: A Brief Note on Inertia," 275.

se) the new place acquired must be given some sufficient cause. This thesis stands in stark contrast to the language of mathematical physics.⁸⁷ Most particularly, such a thesis runs into trouble explaining projectile motion, yet Aristotle's "much maligned" solution, clearly inadequate given the experiences available to modern science, still needs to be replaced if in fact the motor causality principles have universal scope.⁸⁸ If ignorance of what this new cause is differs from knowledge that a cause must exist, one may still defend the universality of the motor causality principle. To do so in a convincing fashion, the specific cases of contact between mover and moved would require close examination.

Second, others rely on the conceptual distance between natural philosophy and mathematical physics to defend the motor causality principle against Newtonian antinomies. Newton's principle of inertia is, like all axioms, a principle that does not enter into the equations of mathematical physics directly. Rather, it states a limit-case of motion which allows for a clearer application of mathematical concepts in kinematics and dynamics.⁸⁹ While the concept of inertia depends upon a limit concept (and is thus usable in mathematical physics), it does have some empirical basis by which it is still applicable to nature, without being verified in ordinary experience.⁹⁰ Galileo's rolling sphere, Newton's cannonball launched from a mountaintop, and Einstein and Infeld's pushcart provide the primitive experiences of nature

87. Ibid., 275–76, Coughlin raises several philosophical difficulties with the Newtonian notions of "state of motion or rest" and "force." See also Marcus R. Berquist, "Concerning the Third and Fourth Definitions and the First Law in Newton's *Principia*," *The Aquinas Review* 2, no. 1 (1995): 61–67. The full scope of these difficulties cannot be explained here, but do bear directly on whether mathematical physics can give an adequate self-understanding of the terms which it borrows from nature, motion, and matter.

88. Coughlin, "A Brief Note on Inertia," 276–77. Wallace, "Newtonian Antinomies Against the Prima Via," 172–73, suggests that some medium could be suspected as the cause of gravitational motion, which in any event is a necessary condition for an adequate explanation of violent projective motion.

89. *ibid.*, 176. Moreno, "The Law of Inertia and the Principle *Quidquid Movetur Ab Alio Movetur*," 307–309, discusses the genesis of the inertia-concept in Galileo and Newton in terms of limit-cases as well. Drawing from arguments made by N. R. Hanson and Eddington, he observes a twofold isolation: the concept itself is found only in counter-factual conditions of perfectly isolated bodies, and in a self-contained conceptual system of the basic, interdependent notions of Newtonian physics. See also Coughlin, *Physics*, "Appendix 1: Method in Aristotelian and Modern Philosophy," 215–16, and "Appendix 8: Void," 263–64, who also considers this limiting process which begins with the senses and experience motions but ends in an idealized case.

90. Wallace, "Newtonian Antinomies Against the Prima Via," 178.

from which the limit concept is taken and yields profound results.⁹¹ The notion of a limit, however, is such that what is verified of the members of the series approaching the limit is not necessarily verified of the limit itself: the polygons in a series approaching a circle as a limit are rectilinear, while the circle is not. Consequently the principle of inertia, while applicable to natural phenomena, is not adequate to them—it is theoretically false but practically true.⁹² Inertia's limited applicability might stem from a quasi-natural counterpart in nature, akin to a second nature or habit.⁹³

Finally, some also note that the motor causality principle should not be opposed to inertia at all. Its real enemy is not Newton's first law but rather "the opposition between the premodern and modern accounts of motion is situated in the Aristotelian teaching on contact action in compulsory motion."⁹⁴ This result emerges most clearly in the derivation of inertia through a counter-factual limiting process.⁹⁵ Inertia provides the physicist with a new conception of motion (as velocity) and causality, for a body can possess constant velocity (zero net force) yet require external causes to sustain this state. Indeed, to instantiate constant velocity motion in the world, external causes that provide the conditions of zero

91. See Galileo Galilei, *Two New Sciences*, trans. Stillman Drake (Madison: University of Wisconsin Press, 1974), 169–70; Newton, *Principia*, 406 (comments on Definition 5); and Albert Einstein and Leopold Infeld, *The Evolution of Physics from Early Concepts to Relativity and Quanta*, Scientific Book Club Review (New York: Simon & Schuster, 1938), 7–9.

92. Wallace, "Newtonian Antinomies Against the Prima Via," 178. He refers the reader to two other sources: see Weisheipl, "Natural and Compulsory Movement," 72, for the claim about the unverified character of the first law. The second source to which Wallace refers is Juvenal Lalor, "The Notion of Limit" (Ph.D. Diss., Université Laval, 1943), of which Juvenal Lalor, "Notes on the Limit of a Variable," *Laval théologique et philosophique* 1, no. 1 (1945): 129–149, is an extract. Lalor's dissertation was directed by De Koninck. De Koninck's thoughts on the notion of a limit will be discussed in Part II.

93. Wallace, "Newtonian Antinomies Against the Prima Via," 181–83. The limited applicability of inertia to natural phenomena is guided by a knowledge beyond that of mathematical physics. If this knowledge directs the mathematically idealized principles to applicable areas of the material (non-idealized) world, such a knowledge seems to possess architectonic characteristics. Indeed, to see that inertia is not "universally verified in all real motions" presupposes the ability to adequately speak about motion.

94. Hassing, "Physical Continuum," 154; see also 150–51.

95. *ibid.*, 147–48, 151–52.

net force are required.⁹⁶ Now, this state of affairs is not natural, but violent.⁹⁷ The premise provided on behalf of Aristotle, that a state of constant velocity would be violent and not natural, is drawn from the observation that inertial motion (a counter-factual that is never observed in nature) can only be approximated in laboratory conditions. It is thus *artificial* in the intentional order of human purposes but *violent* in the sense that it is outside the nature of the thing in question, *praeter naturam*. Thus, if this laboratory condition is universalized, an unnatural result obtains.⁹⁸ Inertial motion is thus closest to a case known to Aristotle, viz., projectile motion, which, as a violent motion, must be “produced by causes that (1) are external, (2) act continuously, and (3) are in contact with the mobile.”⁹⁹ Since it is a violent motion the motor causality principle requires that an external, continuously moving cause be in contact with the mobile. This is precisely because the motion is against nature—the violent is *praeter naturam* and cannot last.¹⁰⁰ Consequently, the principles that cannot be “smoothly reconciled” with the cases of natural elemental motion and the argument in *Physics* VII.1 are that of the Aristotelian requirement for causal contact over against inertial

96. Hassing, “Physical Continuum,” 147–48. See also Hassing, “Animals versus the Laws of Inertia,” 56–61. This requirement is illustrated by Hassing’s use of the air track. While in a laboratory, an air track can illustrate the existence of constant velocity motion without impressed force in the direction of travel. Were the air track extended indefinitely (off the surface of the earth), further force components would be required to maintain rectilinear, constant velocity motion. An inertial state of motion, then, is possible only through artificed conditions (which is to say, conditions accidental to nature), 148: “This is the real lesson of the air track: the gravitational effects of bodies in the universe necessitate the introduction of force components and external causes of motion acting along the direction of motion precisely to produce the condition of zero net force corresponding to constant velocity”

97. Hassing, “Physical Continuum,” 150; Hassing adds, *ibid.*, fn. 85: “This result applies as well to projectile motion. The problem is not with the motor causality principle but with the doctrine of contact action in violent motion.”

98. This nexus between modern physics and its artifice and a prior type of natural philosophy must be considered later. This relationship between the basic concepts of physics and the mode of human artifice is explored by Sean Collins, “Animals, Inertia, And Projectile Motion — Or, What is Force?,” *The Aquinas Review* 15 (2008): 84–85.

99. Hassing, “Physical Continuum,” 149. The passages from Aristotle to which he refers are *Physics* VII.2 and *Physics* VIII.10, 266b28–30.

100. See also St. Thomas, *In De Caelo*, lib. II, lect. 1, n. 9: “Cum enim id quod est violentum sit quaedam exorbitatio ab eo quod est secundum naturam, non videtur quod possit esse maius tempus eius quod est violentum, quam eius quod est secundum naturam: quia id quod est secundum naturam est quasi semper aut sicut frequenter.” (Leon.3.122)

and projectile motion: “A unified and comprehensive interpretation of the motor causality principle is lacking.”¹⁰¹

These three positions are in some ways opposed and in some ways not. Recall that my interpretation of the argument for the motor causality principle requires universally some “other mover” and that this conclusion was reached using the divisibility of the mobile in such a way that this other could be intrinsic or extrinsic quantitatively or qualitatively to that mobile. The third position is such that it does not require the continuous contact of the mover.¹⁰² By contrast, the first view requires the universality of the motor causality principle through causal contact. The second position maintains that inertia is a violent principle, while the second position maintains it has a natural aspect akin to a second nature or habit. Yet all agree that it is an idealization from real motion. Indeed, if it is right to maintain the universal applicability of the proofs for the motor causality principle, and if these proofs proceed according to a mode of conception that is different from that of mathematical physics but to which the latter is subordinate, then the substance of the first and second points are in harmony. Yet such a unified and comprehensive account of motor causality has yet to be presented. A way forward towards such an account would need to bring together the mathematical and species-neutral mode of modern mathematical physics

101. Hassing, “Physical Continuum,” 150.

102. This opinion is also that of Weisheipl, who maintains that the motor-causality principle must be modified in the case of gravitating bodies—they have no conjoined mover, and only those agents causes that generated them are their movers. Once generated, the *per se* cause is separated and the body falls spontaneously: see “Medieval Natural Philosophy and Modern Science,” in *Nature and Motion in the Middle Ages*, 268–69, as well as “The Principle *Omne quod movetur ab alio movetur* in Medieval Physics,” and “The Spector of *Motor Coniunctus* in Medieval Physics.” Kolbeck, “The *Prima Via*,” 107–111, qualifies Weisheipl’s conclusion by extending the notion of “contact” to include the alterations brought about by the agent causes that lead to the gravitating body’s motion; see 109: “The generator is present to the body in that it has given the body its specific nature that is the principle or source, but not cause, of the body’s motion. We clearly have here an extended sense of being conjoined or being with, but one that is common in everyday speech.” He appeals to two passages from St. Thomas; see *In Phys.*, lib. VII, lect. 3, n. 7 (Leon.2.331–32), which discusses the alteration produced by a lodestone; *De Pot.*, q. 3, a. 11, ad 5 (discussing the “*virtutem . . . impressam*” on an arrow and comparing this to form handed on to the falling body by the agent generating it), where St. Thomas concludes: “*Oportet autem movens et motum esse simul quantum ad motus principium, non tamen quantum ad totum motum, ut apparet in proiectis.*” See also Augros, “Ten Objections to the *Prima Via*,” 68–72, and Moreno, “The Law of Inertia and the Principle *Quidquid Movetur Ab Alio Movetur*,” 318–23.

with the mode proper to natural philosophy.¹⁰³

Causality, contact, and a finite universe

Physics VII.1's argument for the *primum mobile* must be kept separate from primitive conceptions of causality through contact. This is nowhere more evident than in Aristotle's condition that the series of movers in motion are to be thought of as one continuous whole. This counterfactual "continuum-universe" meets two objections.

Aristotle implicitly raises the first himself while providing its answer:

For it makes no difference that the impossibility happens from a supposition. For the supposition taken is possible, but a possible thing being posited, nothing impossible can come to be in addition because of it.

Let it make no difference that we have supposed something to show this [fact]: for, putting down what can be, nothing strange can have happened. (*textus alter*)¹⁰⁴

That is, it does not matter if an impossibility is deduced from a conjunction whether, on the one hand, it be made out of one conjunct (that is in fact impossible) along with a possible but true conjunct or, on the other hand, if it be made out of one conjunct (that is in fact impossible) with a possible but false conjunct—"quia sicut ex vero non potest sequi impossibile, ita nec ex contingenti."¹⁰⁵ For example, when Euclid shows in Book III, Proposition 16 that a straight line cannot be interposed between the circumference of a circle and its tangent, he first supposes that it is possible, and then additionally supposes, given the first supposition, that a perpendicular line is drawn from the center of the circle to the line so interposed. The

103. See below, §19.2.

104. Coughlin's "Alternative Text," of Aristotle, *Physics*, VII.1, 242b72–243a2, is quoted first, then Ross's *textus alter* is quoted, 242b34–243a2. The background of this reponse is Aristotle, *Prior Analytics*, I.15, 34a5–33; the key passage is 34a25–34: "Since this is proved it is evident that if a false and not impossible assumption is made, the consequence of the assumption will also be false and not impossible: e.g. if A is false, but not impossible, and if B follows from A, B also will be also but not impossible. For since it has been proved that if B's being follows from A's being, then B's possibility will follow from A's possibility, and A is assumed to be possible, consequently B will be possible; for if it were impossible, the same thing would at the same time be possible and impossible."

105. St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 5 (Leon.2.328).

impossibility follows that this perpendicular line is both greater than and less than itself. This impossibility does not follow from the contingent premise concerning the perpendicular line (a possible and true supposition, given the nature of perpendiculars), but rather from the hypothetical interposed line, because the perpendicular is merely contingently supposed upon the basis of the interposed. Analogously, since the continuity of the infinite series of movers and mobiles is only contingently supposed upon their existence, the impossibility results from the fact of their infinity, not their continuity (which is possible, but false given the nature of particular bodies).

Yet this raises a second difficulty. Perhaps this cosmic continuity is not possible but is itself another intrinsic impossibility (as if Euclid had supposed in III.16 that two right angles be drawn which do not equal each other). St. Thomas supports this suspicion by pointing out that the boundaries of corruptible earthly substances and incorruptible heavenly substances cannot be one.¹⁰⁶ St. Thomas replies:

The contingent and impossible are taken differently when one demonstrates something of a genus and when one demonstrates something of a species. When one treats of a species, it is necessary to take as impossible that which is incompatible with either the genus or the difference of the species, out of which the notion of the species is constituted. Yet when one treats of the genus, what is not incompatible with the notion of the genus is taken as contingent, even if it is incompatible with some difference constituting a species: just as if I were to speak of animal, I could take as contingent that every animal is winged, but if I descend to a consideration of man, it is impossible that this animal be winged. Therefore, because Aristotle is speaking here of mobiles and movers in common, not yet making an application to determinate mobiles, the contiguous or continuous are indifferently related to the notion of movers and mobiles, and therefore he takes it as contingent that

106. St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 6 (Leon.2.328). This is why the natural relation of place and placed, founded on action and passion, must be qualified in the case of the heavens, for the aether of celestial bodies touches without being touched; see *De Generatione*, I.6, 323a26–32 and Decaen, “Aristotle’s Aether and Contemporary Science,” 392–93, fn. 50, and 389, fn. 40: “St. Thomas and Aristotle are more explicit in claiming that the aether can touch and move (*per se* and in all species of motion) sublunary matter without being touched and moved in return; the (in their minds) bizarre situation I am describing of aether being moved (*per accidens* and merely locally) by sublunary matter would be contrived and more of a thought-experiment for them, but not absolutely impossible.”

all mobiles be continuous among themselves. This, nonetheless, is impossible if mobiles are considered in their determinate natures.¹⁰⁷

Hence, even though it is impossible that a continuum-universe exist, this is a contingent determinability of the entire genus of “mobile being.” This means that continuity cannot be the source of the impossibility in the *reductio* argument, just as if one were to draw an impossibility from the notion “soulless, winged animal” and conclude that animals cannot be soulless.

This indeterminacy of the argument’s conception of the universe as a whole was noted above.¹⁰⁸ It allows us to conditionally conceive an essentially ordered series of moving movers, but this conception must be corrected by a consideration of more determinate species of movers. A more determinate consideration of the *primum mobile* in general natural philosophy would have to consider how causal contact is found in particular instances.¹⁰⁹

Remarks on the conclusion to the first moved mover

From the above, I conclude that the argument mounted by *Physics*, VII.1 is successful. The natural philosopher has achieved a vague but epistemically certain resolution to the existence of an ultimate principle of the cosmos. The nature of the middle terms used in the proof (the common material contingency found in all mobiles) and the conditions placed upon one’s consideration (the “continuum-universe”) require his conception of the nature of this *primum mobile* to be vague. Generically, this mobile contingency is what allows one to conclude that all mobiles are divisible bodies. This notion of generic contingency limits our knowledge of the precise nature of the first moved mover. The first moved mover must be in

107. St. Thomas, *In Phys.*, lib. VII, lect. 2, n. 6 (Leon.2.328).

108. See p. 188. The universe was conceived of as one continuum—a single body whose parts were one by causal continuity.

109. I will return to this topic in §19.2. In this endeavor, the species neutrality of modern physics makes comparisons especially difficult: Hassing, “Physical Continuum,” 150–51, fn. 86: “Are the force fields of post-Newtonian physics subjects of per se change; are they somehow divisible? What is the relation between the electromagnetic field and the theory of the physical continuum in *Phys.* VI and VII?” Such questions are not easily answered.

the genus ‘corporeal’ in a relevant respect. But that it is tangible or elemental or possesses any determinate nature of the corporeal beings of common experience does not follow.

Further, given the conditional of the continuum-universe, that the *primum mobile* is one in number is not clearly established. The unmoved mover acting on such a continuum is a mover acting on a type of unity. The argument does not possess enough clarity to numerically distinguish which moving movers are first acted upon by the extra-cosmic agent in the essentially ordered series of moving movers. For all we are allowed by the argument, the *primum mobile* may be one or many in number, if the conditional is removed and specific natures are taken into account (e.g., perhaps five penultimate moved movers are coordinated by the first). Further arguments must be made on this point.

Because of the terms of the argument of *Physics*, VII.1, the *primum mobile* must also be involved in causing local motion at a minimum. This conclusion is again proportionate to the conceptual indeterminacy with which Aristotle frames his premises. What else is to be expected from an argument that relies on little more than the experience of moving things, movers, and certain theorems about their quantitative properties?

Now, because the *primum mobile* is first in an essentially ordered series, it *ipso facto* becomes the *per se* condition for motion in the cosmos. Whether its motion allows for indeterminacy or chance is a separate question. That is, does the *primum mobile* have a fixed and invariant order to its subordinate movers? The medieval conception, following Aristotelian cosmology, held that no chance could be found in the heavens.¹¹⁰ A further argument might

110. This leads to difficulties concerning fate (our analog is Laplacian determinism) and the efficacy of cosmic powers on terrestrial and human affairs. See De Koninck, *Writings*, Vol. 1, “Reflections on the Problem of Indeterminism,” 417–20, where De Koninck explores the Thomistic reply to Suarez. Suarez’s view amounts to the assertion that chance is contingent only after a fashion, for once the initial constellation of determinate causes is arranged by God, nothing can impede the resulting effects. This Stoic denial of future contingents due to the fact that there are no external factors to prevent what occurs fails due to the fact that matter as such is indeterminate and hence the constellation of causes as such is contingent—this touches upon a debate of the existence of real possibility as old as Diodorus Chronus’ “Master Argument,” whose assertion that only those things are possible which in fact do happen is to deny what Aristotle takes to be the root of all contingency; consider St. Thomas, *Exp. Per.*, lib. I, lect. 14, n. 8. Coughlin, “Appendix 4: Chance and the Indeterminacy of Nature,” in *Physics*, 235–37; the conclusion he reaches is as follows, 237: “Since, then,

be able to show that their relationship is not perfectly determined; even so, the *primum mobile* would still be necessary for the existence of a cosmos admitting of indeterminate events. At the very least, the argument already presented can conclude by corollary that the relationship between the *primum mobile* and the extra-cosmic agent is a determinate one, since the first agent is the necessary and sufficient condition for the remainder of the series.¹¹¹

Because the *primum mobile* is in local motion, it must bear some relation to place. If it itself is not in place by being contained, and if it possesses the requisite seat of immobility, then by the understanding established in §6, the *primum mobile* is also the principle of place. Furthermore, since the *primum mobile* is the fundamental moving cause of motion in the universe, and if it were found to be one in number, then by the conditions discussed in §7, the *primum mobile* would also be the first measure of cosmic time.

The argument for the *primum mobile* in *Physics*, Book VII, therefore, proceeds at a level of indeterminacy and conclusions appropriate to this character can be drawn from it. The logical order of Book VII's argument for the *primum mobile* also follows the constraints of the natural path, for it uses theorems established in Book VI as its ground to say in very general terms how all movers and moved things are related in the universe. In this last regard, however, the generality of our conception or argument (what is *universale in praedicando*)

the matter of substance is wholly indeterminate, and is ultimately the matter of all changes insofar as it is the matter of substantial changes and the matter of the material of accidental changes, the indeterminacy of this matter leads to the radical contingency of all natural events." Thus, even a determinate agency can be impeded due to the contingency of the matter that it must work on. However, this explanation through the indisposition of material causes falls upon some difficulty in the scholastic scheme, for the celestial spheres—hindered by no chance—were supposedly the necessary and sufficient causes for material conditions in the terrestrial order. See De Koninck, *Writings, Vol. 1*, "Reflections on the Problem of Indeterminism," 419–20 and fn. 35; De Koninck refers us to St. Thomas, *ST*, Ia, q. 115, a. 6, which asks whether the heavenly bodies impose necessity on those things subject to their action, answers in the negative; Cajetan raises the difficulty with the necessitating celestial causes in n. 11 of his lengthy commentary on the question.

111. Compare Aristotle, *Physics*, Book VIII.10, 267b16–17: "For it is always disposed similarly in itself and is always disposed similarly and continuously in relation to the moved." If the series is to exist, this first agent must exist, and the *primum mobile* is that by which the series is related to the first agent. The reverse does not obtain, given the evidence presented by the argument. That is, one cannot conclude that the first mover is necessarily related to the *primum mobile* and the cosmos which it moves.

has reached a principle with generality of causality (what is *universale in causando*)—that is, the first immobile mover. To obtain more determinate conclusions about the *primum mobile*—but still within the level of generality of the level of natural philosophy contained in the *Physics*—we must turn to Aristotle’s inquiry in *Physics*, Book VIII.

§11 THE CONCLUSIONS ABOUT THE FIRST MOBILE BODY FROM ARISTOTELIAN COSMOLOGY ARE NOT PERENNIAL ONES. (SELECTIONS FROM *De Caelo*)

Hence the sun and stars and the whole heaven are always active, and there is no fear that some day they may cease, which is what the physiologists feared. Nor are they worn out by their activity. For the movement is not for them connected with the potentiality of the opposite, as it is for the perishables, so that the continuity of movement would be toilsome.

ARISTOTLE
Metaphysics, IX.8

There would be no problems for Aristotle, if one accepted his assumptions regarding the fifth body.

PLOTINUS
Ennead II 1.2.12–13

In this section I will examine the further determinations which Aristotle makes concerning the nature of the first moved mover. The conclusions of general natural philosophy about the first mobile are perennial in a way that those of more particular considerations are not. In this section, I will separate the level of determination found in *Physics*, Book VII, from its closest analogues in *De Caelo*. In §11.1, I will consider this juncture between the common, primary experience with which the natural philosopher begins the natural path and the mode in which more determinate sciences of nature must make use of experience. This will allow §11.2 to place in proper context the contributions which ancient and medieval cosmology attempted to provide about the first mobile being and §11.3 to extricate the perennial philosophical account about the *primum mobile* from them.

11.1 *Leaving the natural path?*

St. Thomas remarks on what the natural scientist requires to advance his study of nature beyond that of general natural philosophy in his *prooemium* to his commentary on Aristotle's *De Caelo*. These remarks provide principles by which we can sort out the perennial elements in natural philosophy from the elements which pass away.¹¹² In his commentary, St. Thomas recalls the general method of natural philosophy laid down in *Physics*, I.1: the order in science is to proceed from the first principles and causes to proximate causes, e.g., the elements of a thing's essence. Since both speculative and practical reason are characterized by order, he uses a comparison of the one to the other to clarify what he means. First, he sets out a fourfold order which is found in practical reason:

Now, a process from prior to posterior is found in the consideration of practical reason according to a fourfold order. The first is that according to the order of apprehension, as the craftsman [*artifex*] first simply apprehends the form of the house and afterwards realizes it in matter. The second is according to the order of intention, insofar as the craftsman intends to perfect the whole house, and because of this performs certain works in regard to the parts of the house. The third is according to the order of composition, insofar as he first shapes the stones and then lays them in one wall. The fourth is according to the order of preserving the work, as the craftsman first lays the foundation and upon that the remaining parts of the house are held up.¹¹³

This is St. Thomas' consequent comparison of the practical to the speculative order:

Likewise, one also finds a fourfold order in the consideration of speculative reason. First, insofar as reason proceeds from common things to the less common. And this order answers proportionately to the first order, which we called the order of apprehension, for universals are considered according to form absolutely, while particulars according to the application of form to matter. As the Philosopher says in *De Caelo*, Book I, that he who says "heaven" speaks of the form, but he who says "this heaven" speaks of form in matter.

112. For a helpful overview of this theme in terms of Aristotle's scientific method, see Benedict M. Ashley, "Aristotle's Sluggish Earth," *The New Scholasticism* 32 (1958): 1–31, 202–234.

113. St. Thomas, *In De Caelo*, pr., n. 2 (Leon.3.1).

The second order is that according to which one proceeds from the whole to the parts. And this order answers proportionately to the order which we called intention, insofar as the whole is prior in consideration to the parts, and not just any kind, but the parts which are according to matter and which belong to the individual: as the semicircle, which is defined by the circle (for a semicircle is the half part of a circle), and the acute angle, which is defined by the right angle (for an acute angle is an angle less than a right angle). Now, circle and right angle happen to be thus divided: whence these are not parts of their species. These types of parts are prior in consideration to the whole, and are placed in the definition of the whole, as flesh and bone in the definition of man, as is said in *Metaphysics*, Book VII.

Now, the third order is that according to which one proceeds from simples to composites, insofar as the composites are known through the simples, as through their principles. And this order is comparable to the third order which we called composition.

The fourth order is that according to which the principal parts must be considered first, as the heart and the liver before the arteries and the blood. And this is proportionate to the practical order according to which the foundation is laid first.¹¹⁴

Now, this fourfold order within speculative reason is found within natural philosophy. The first order is begun in Aristotle's *Physics*, while the other three orders can be found within the *De Caelo* itself.

And this fourfold order can be seen even in the process of natural science. For first common things are determined in the *Physics*, in which one treats of the mobile insofar as it is mobile. Whence it remains in the other books of natural science to apply these common things to the proper subject. However, the subject of motion is magnitude and body: because nothing moves except the quantified. Now, the other three orders apply to bodies: the first way insofar as the entire corporeal universe is prior in consideration to its parts, the second way insofar as simple bodies are considered before mixed bodies, and the third way insofar as among simple bodies one must first consider the fundamental one, namely the celestial body, through which all the others are supported. And these three are treated of in this book, which among the Greeks is entitled *De Caelo*. For in this book certain things are treated which pertain to the whole universe (as is clear in Book I), other things pertaining to the heavenly body (as is clear in Book II), and certain things pertaining to the simple bodies (as is clear in Books III

114. Ibid., (Leon.3.1-2).

and IV). And thus this book is logically placed first after the *Physics*. Because of this, body is immediately considered in the beginning of this book, to which one must apply all of that which is carried over from the treatment of motion in the *Physics*.¹¹⁵

The key line occurs near the beginning. What is determined in common in the books of the *Physics* must be applied to the proper subject of motion, namely body. The *De Caelo* contains the three ways in which this application is first made: the consideration of the priority of the whole universe to its parts, the consideration of simple bodies prior to mixed bodies, and the consideration of more fundamental bodies to the ones that are derivative or dependent. This application requires more determinate sense experience than can be found by those studying nature at the level of common and primary sense experience.

Consequently, while the observations and astronomical data available to Aristotle and medieval cosmologists were insufficient, the threefold task of cosmology remains. In the 20th century, particularly with the advent of radio astronomy, scientists have been able to provide the determinate and particular experience necessary to more adequately achieve these three tasks, namely, to understand the whole cosmos in relation to its parts, to understand the derivation of compounds from elements and certain elements from prior particles, and the dependence of more evolved compounds and bodily forms upon the existence and causality of prior bodies and cosmological conditions.

Now, the movement between *Physics* Book VII and Book VIII is an instance of the *processus in determinando*. However, a much greater determination or concretion takes place between general natural philosophy as a whole and one of the species of natural philosophy (e.g., cosmology or chemistry or biology).¹¹⁶ For instance, along the order of concretion in the study of biology, one begins with the study of the soul in a certain mode abstracted from its unity with determinate matter. This peculiar manner of abstraction arises insofar as the

115. Ibid., n. 3.

116. I discuss this process in more detail in Chapter 6.

study requires that we begin with what is more certain to us about life, and this requires that we base the study of life upon the very internal experience of life.¹¹⁷ In the case of biology, the order of concretion which occurs between the study of the soul “*in quadam abstractione*” and the living organism as a whole is to move from studying the nature and operation of the soul from internal sense experience to identifying the nature of the organic conditions which the soul needs for such operations, both in general and in specific organic kinds, for without such concretion the knowledge of the soul as form of the body is incomplete.¹¹⁸

In the study of the elements, however, an immediate internal experience is not available. Aristotle’s own beginnings in the *De Caelo* or the *De Generatione et Corruptione* used the proper sensibles of touch as definitional qualities of matter (hot and cold, wet and dry). These qualities were taken as revelatory of the essences of the elements themselves. Yet this inquiry by natural philosophy, defining its object with sensible matter, was in this case too immediately and easily fulfilled to be adequate; in this respect, De Koninck applies Aristotle’s observation about the distance of the heavenly bodies and the difficulty in obtaining certain knowledge of their nature to tangible matter.¹¹⁹ The true elemental principles are too distant from the senses to make use of immediate sense experience as a necessary *and* sufficient guide. When attempting to provide sufficient experience to account for the species of generation and corruption (as opposed to generation and corruption in general), one requires more determinate sensations and experiences than that available at a general level (where living and non-living, and the change between alive and dead, are paradigmatic). A new approach, beyond that available to common experience and the immediately sensible, is required.

The turn of modern science from the immediate proper sensibles—color, sounds, smells, flavors, and textures—to the common sensibles anterior to them—viz., quantity and motion—

117. St. Thomas discusses this in his *prooemium* to the *De Sensu*; in particular, he states that in the *De Anima*, Aristotle “consideravit de anima secundum se quasi in quadam abstractione.” (Leon.45/2.4:39–41)

118. See *ibid.*, (Leon45.4:41–47), and De Koninck, “Introduction a l’etude de l’âme,” 42.

119. *Ibid.*, 48–49.

is a “retreat before objects” and “a first step backward in the presence of objects” that provides a more effective and applicable mode of definition.¹²⁰ Because of this indirect mode of definition, scientific theories take on an essentially provisory character.¹²¹ It is at this point that one leaves the natural path via this new mode of sense experience—a mode that is regularized, measured, and experimental.¹²² This requirement was manifest even to the Greek and medieval scientists; the difficulty lies in making the transition successfully.¹²³

It is important to see what is at stake in this transition. In his study of St. Thomas’ views on the celestial bodies, Thomas Litt notes that Thomists generally pass over these cosmo-

120. De Koninck, “Introduction a l’etude de l’âme,” 51–53; here I note De Koninck’s use of the qualitative vs. quantitative to distinguish the modes of natural philosophy from that of mathematical physics. However, De Koninck, in this very passage, reduces this distinction to the act of the mind required to make the quantitative, sensible measure into an intelligible object, viz., an act of symbolization; *ibid.*: 52: “There is no need to go as far as the electron, the quantum, the potential, in order to find objects which are not homologous with the level of sensible experience. Looking more closely, even simple length, so soon as it is a number-measure defined by the description of the object and of the practical operation we have effectuated to obtain the number, is already expressible only by means of a symbol. The number-measure is not, *as such*, an object of sense; and that of which it is the sign is not an object in the manner of an apple. It is less than a name. That is why we call it symbol.”

121. *Ibid.*, 44–63.

122. I consider De Koninck’s account of this new mode in §24. In this respect, Francis Bacon’s complaints about the paucity of induction in the sciences is understandable. However, it would not apply to Aristotle and St. Thomas as they understood natural science. De Koninck refers us to St. Thomas’ *prooemium* to his incomplete *Sententia super Meteora*, where he states that “manifestum est quod complementum scientiae requirit quod non sistatur in communibus, sed procedatur usque ad species: individua enim non cadunt sub consideratione artis; non enim eorum est intellectus, sed sensus.” (Leon.3.326) De Koninck notes, *ibid.*, 27: “It is thus the proper being of things, their ultimate difference, that draws us and which liberates our intelligence from this indetermination of the universal. Since science is the perfection of intelligence, he who seeks this perfection naturally wants to know what makes a beaver a beaver, what makes a man a man, with so far as all that distinguishes them from everything else, body and soul. It is the author of the *Metaphysics* and of *On the Soul* who wanted to know why dogs run lopsided. He did not confine himself to mobile being, nor to animate body, not to beast, nor to quadruped. That is what the process of concretion consists of. So it is in this direction, so misunderstood by a certain kind of philosophy, that is found the perfection of knowledge, as St. Thomas says in beginning the study ‘of meteors, comets, rain and snow, lightning, earthquakes, *et alia hujusmodi.*’”

123. For instance, consider what St. Thomas states, *In De Caelo*, lib. II, lect. 15, n. 1: “[D]e ordine stellarum, quomodo scilicet singulae sint dispositae, ita quod quaedam sint priores et quaedam posteriores, idest superiores et inferiores; et quomodo se habeant ad invicem secundum elongationes, idest quantum una distet ab alia; considerandum est ex his quae dicuntur in astrologia, ubi de his sufficienter determinatur. Haec enim non possunt cognosci per principia naturalis philosophiae, sed per principia mathematicae, idest per proportionem magnitudinum.” (Leon.3.179) My emphasis. That is, one cannot know from a general understanding of form, matter, and privation, or even the general quantifiability of mobile being for instance, what the quantitative dispositions of certain species of mobile beings will be, such as the stars and planets.

logical details as mere examples of more general philosophical principles, which examples are extrinsic to the soundness of that philosophy. Litt considers this avoidance of the issue to be culpable.

There are at least two doctrinal points of St. Thomas where the celestial bodies are not merely examples, but they in fact enter into the doctrine itself, where, as a consequence, one alters said doctrine if one evades them. I am aware that this is a serious conclusion, but I believe that it is the result of this study. These two points are the theory of matter and form, and the series of essentially subordinate causes.¹²⁴

The reasoning behind Litt's first consequence is his understanding of how St. Thomas arrives at the existence of prime matter, viz., mutual generation and corruption of the elements. This totipotency of prime matter is "modernized" by modern Thomists in a way that excludes two essential facts. One attempts

to modernize St. Thomas by simply evading the issue of the celestial bodies, but he has transformed St. Thomas' reasoning about his own concrete universe for a reasoning bearing on a pretend, abstract universe or a philosophical universe, where bodies transform themselves one into the other without any limit: without the medieval limit of incorruptible bodies and without the modern limit of atomic simple bodies or fundamental subatomic particles.¹²⁵

In short, "One alters the reasoning of St. Thomas when one reduces it to alleged pure metaphysics."¹²⁶ One could first point out that the elementary particles themselves are not as stable as Litt makes them out to be. Further, Litt is clearly depending upon a rejection of the order of discovery which Aristotle proposes in *Physics*, I.1 and thus assumes two things about how St. Thomas argues to the existence of prime matter. First, he assumes that St.

124. Thomas Litt, *Les corps célestes dans l'univers de Saint Thomas d'Aquin*, vol. VII, Philosophes médiévaux (Louvain/Paris: Publications Universitaires/Béatrice-Nauwelaerts, 1963), 6, and see 5–6. Translation my own. Litt expands upon the two areas in the following pages; for matter and form, see *ibid.*, 6–9, and for the series of essentially subordinate causes, see 9–11.

125. *Ibid.*, 9.

126. *Ibid.*, 7.

Thomas' chain of reasoning incorporates *in advance* the distinction (to us, less known) between corruptible and incorruptible matter (a distinction the ancients thought better known by nature).¹²⁷ Second, he assumes that the argument must proceed according to a "concrete" conception of an order of nature, and thus the argument for prime matter must appeal to the mutual generation and corruption of the elements. As argued above in §2, this is a misinterpretation of the fundamental argument for prime matter.

Litt's choice of words is instructive: St. Thomas does not rely on knowledge of an "abstract" metaphysical universe and its apparent facts (such as substantial change), but on a "concrete" knowledge of the universe. This is not how the investigative arc in natural philosophy has been shown to function: the evidence for the arguments made by Aristotle and St. Thomas in the above sections do not depend upon concrete and determinate species of things, but rely only upon what is indeterminately but certainly known concerning mobile beings in general. As a consequence, one could show where the theory of the celestial spheres gets its false start by identifying that experience by which the more concrete, determinate, and false conception of the universe is proposed.

Litt reasons to his second consequence (the undermining of St. Thomas' doctrine of series of essentially subordinate causes) in a similar fashion. The cosmic chain of causality between univocal, terrestrial agents and God is only determinately realizable by an appeal to the existence of the celestial spheres, themselves equivocal celestial agent causes between the terrestrial and the divine. This is the case for both substantial and accidental change.¹²⁸ This presentation of the series of essentially subordinate causes introduces at the same time the conception of universal causality.¹²⁹ Further, Litt maintains that the First and Second

127. Notwithstanding the many texts which could be cited where St. Thomas attests to the existence of the fifth element and the celestial spheres, such texts would assume the more determinate conclusions of cosmology.

128. See Litt, *Les corps célestes*, 9–10.

129. Litt seems to conflate universality in predication with universality in causality, *Ibid.*, 152–53, 176–77, describes the order from God as universal cause to individual agents as particular causes in a manner resembling a "Porphyrian Tree" of causes and effects. God is the cause of being, a second cause is the cause

Ways in the *Summa Theologiae*, in order to be sound, rely upon this determinate order of subordinate causes obtaining, including the celestial spheres conceived as such.¹³⁰

A similar point can be made about this second consequence as the first: it was shown above in §10 that a proof such as the First Way—the proof from motion—does not rely upon a determinate conception of the universe. In fact, the proof in *Physics* VII.1 explicitly denies that it is doing so. Litt’s philosophical thesis is therefore predicated upon an implicit denial of the natural path in the investigative arc of natural philosophy. This error is once again instructive if the precise point can be identified where the perennial cogency of the proofs end and a dialectical premises are admitted in an attempt to make more determinate conclusions.

After this summary of his two consequences, Litt adds a third point of doctrine which would be shattered along with the shattered theory of the spheres: “It is no less than the most general and fundamental theory of act and potency.”¹³¹ Today, this distinction makes sense only in the realm of living beings: “In the entire domain of non-living matter, it makes no sense to speak of a perfect state and an imperfect state.”¹³² However, yet again Litt gives no due to the order of discovery. The spheres are not essential to articulating act and potency but are particular, supposedly *discovered* instances of a general doctrine independently established from prior and more general experiences. Indeed, Litt provides such examples himself.

of natural beings, a third the cause of a species of natural beings, and the individual agent the cause of the species of another individual. But the degrees of universality in a logical order are not the same as the grades of universality in a causal order. As Ronald McArthur, “Universal in Predicando, Universal in Causando,” *Laval théologique et philosophique* 18, no. 1 (1962): 93–95, argues, making God the case of *ens commune*, as it were, the genus alone, is to assign Him the most superficial, indeed an accidental, role. Litt does not clearly articulate, and at times even denies, the doctrine of the concurrence of the first cause with the secondary cause, such that the first cause does not compare to the second as genus to species but as the more actual and extensive cause to the less. To be sure, he expresses the proper distinctions following St. Thomas’ texts, e.g., Litt, *Les corps célestes*, 164–66, but it is unclear that he clearly understands its implications, e.g., *ibid.*, 176, states “Tout agent tend par son action à produire un effet semblable à lui,” and then identifies the effect of God as participated being. In his concluding statements, Litt states the doctrine more clearly, but only to reject it; see below.

130. *Ibid.*, 10.

131. *Ibid.*, 11.

132. *Ibid.*, 12.

The essential heterogeneity of the spheres and their universal causality, essential to all act and potency in the cosmos, is dependent, claims Litt, upon the physics of Aristotle. In his concluding statements, he describes the nature of universal causality, in a passage discussing St. Thomas' possible response to mechanism in biology, but only to reject it.¹³³ Here, it seems, is the core of Litt's difficulties with the concrete reliance St. Thomas has upon the celestial spheres, namely, that they are dissipated in view of modern science's species-neutral conception of the natural order.¹³⁴ This "leveling" effect of the species-neutral mode of conception is the very point being challenged here: the spheres as such are not essential parts of natural philosophy in the Aristotelian mode, and can be jettisoned while retaining the method and perennial content prior to their purported discovery.¹³⁵

11.2 *The first mobile in primitive cosmology*

To disentangle Aristotle's perennial conclusions from his primitive cosmology of the *primum mobile*, we must identify the basis which makes this cosmology primitive.¹³⁶ This is, straight-

133. Litt, *Les corps célestes*, 369: "S. Thomas répondrait que les corps célestes atteignent, par leur causalité, le plus intime des corps inférieurs, vivants ou non vivants, leur nature même. Ce concept d'un être corporel subordonné à un autre par le plus intime de lui-même est devenu tout à fait étranger à la pensée moderne, mais il avait droit de cité dans l'univers de S. Thomas."

134. Ibid., 370: "La différence entre cet univers de S. Thomas et le nôtre, c'est que le nôtre est nivelé: tous les corps y sont du même niveau ontologique, obéissent aux mêmes lois."

135. Contra, *ibid.*, 371: "Cette métaphysique—ou plutôt cette pseudo-métaphysique—des sphères célestes est entièrement périmée, comme toute la *Physique* d'Aristote dont elle est un secteur essentiel. Elle repose sur des postulats, non seulement gratuits, mais tout à fait incompatibles avec les données actuelles de la science." Now, to be fair, Litt does state in his conclusion, *ibid.*, 372, that "current Thomists" must consider whether the theory of the spheres can be amputated from St. Thomas philosophical system without serious inconvenience. The celestial spheres must not be suppressed, but replaced. To this extent, the coda to his work is consonant with my project. However, the spirit of his work seems misplaced to this extent, that it begins too far down the line of determination in theory. One need not wonder, as Litt does, *ibid.*, 371–72, why St. Thomas was so uncritical of a theory which at the time was pressed with many difficulties (as Litt notes well in the second part of his work on the astronomical theory of the day; *ibid.*, 295–366). Abstracting from the anachronism of wondering about St. Thomas' lack of a critical attitude in the face of received knowledge (*ibid.*, 371), St. Thomas' acceptance of the spheres even in the face of tensions between competing scientific theories and faith-based principles is not problematic, since the theory of the spheres was the most probable at the time.

136. The following sources should be consulted, and will be noted for specific points below: Thomas L. Heath and Aristarchus of Samos, *Aristarchus of Samos, the Ancient Copernicus: A History of Greek Astronomy to Aristarchus, together with Aristarchus's Treatise on the Sizes and Distances of the Sun and Moon* (Oxford:

forwardly enough, the most basic observational datum available to astronomy: the diurnal motion of the visible heavenly bodies from east to west. The interpretation of this given and the implications of that interpretation are the items subject to controversy. Based solely on this fundamental observation and his assumption about the true subject of that motion (viz., the heavens), Ptolemy, argues to the spherical motion of the heavens, the spherical shape of the earth, its central location in the heavens, its relative size compared to the heavens (that of a point), and its immobility.¹³⁷

Among these celestial bodies, the most fundamental division is between the fixed stars and those not fixed (the wanderers or planets, the Moon, and the Sun). This division between the fixed and the wandering stars establishes two celestial motions, the diurnal motion (that of “the Same”) and various motions along the ecliptic or through the Zodiac (collectively, “the Different”).¹³⁸ The motion of the Different, carrying the planets from west to east, does not occur about the same pole as the motion of the Same: they are inclined at an angle, determinable by observation to approximately $23^{\circ}27'$.¹³⁹ Thus, the planets, after long

Clarendon Press, 1913); Ptolemy, *Ptolemy's Almagest*, trans. G. J. Toomer (London: Duckworth, 1984); Litt, *Les corps célestes*; Grant, *Planets, Stars, and Orbs*; Pierre Duhem, *Sôzein ta phainomena: essai sur la notion de théorie physique de Platon à Galilée* (Paris: A. Hermann, 1908); Duhem, *Medieval Cosmology*; Johannes Kepler, *Selections from Kepler's Astronomia Nova*, trans. William H Donahue (Santa Fe, NM: Green Cat Books, 2004); Galileo Galilei, *Dialogue Concerning the Two Chief World Systems, Ptolemaic & Copernican*, 2nd ed, trans. Stillman Drake (Berkeley: University of California Press, 1967); Labrie, “Commentaire du traite du temps d'Aristote,” 220–45; Decaen, “The Existence of Aether.”

137. Ptolemy, *Ptolemy's Almagest*, 38–40, 40–41, 41–42, 43, and 43–45, respectively. Many of the arguments utilize *modus tollens* argumentation. For the arguments for the first and last theses, Ptolemy does utilize assumptions about the material of the heavens and the earth, and their heterogenous nature.

138. Plato, *Timaeus*, 36a–d.

139. Ptolemy, *Ptolemy's Almagest*, 61–63, and see Litt, *Les corps célestes*, 297. By the Copernican shift, the apparent motion of the Same is the daily rotation of the Earth, and the apparent motion of the Different is the actual motion of the planets around the sun. The angle of the ecliptic results from the angle of the earth's axis towards the plane of the earth's solar orbit. These two motions established two poles and two equators in the spherical heavens, viz. the celestial and the ecliptical. Now, the planets vary in the time it takes them to traverse the ecliptic west to east, and within that motion the apparent angular speed of the planets against the background of the fixed stars varies throughout the year and is not always west to east. Mercury and Venus appear “yoked” to the sun: Venus, for instance, never strays beyond approximately 45° to 47° of elongation from the Sun. Indeed, the Sun varies in its own apparent angular speed along the ecliptic. The other three visible planets (Mars, Jupiter, and Saturn) all exhibit retrograde motion, where they “backtrack” along the ecliptic east-to-west in something of a loop, before returning to their west-to-east trek. The retrograde motion of the outer planets, by the Copernican shift, becomes the effect of the

observation, were known to possess anomalous motions through the sky.

It is therefore important to note that the position that all heavenly bodies possess regular circular motion is not one directly drawn from sense experience, with the sole exception of the diurnal rotation of the fixed stars. Rather, the appearances, being irregular, had to be interpreted so as to preserve the hypothesis of regular circular motion. The appearances are “saved” from contradicting the supposition that the celestial bodies of their nature, imitations of the eternal and the divine, require sphericity and an appropriately uniform motion to fulfill this end.¹⁴⁰ Plato is the original instigator of this project that defined astronomy for centuries.¹⁴¹ Indeed, true astronomy (contemplation of mathematical spheres in motion) stands to observational astronomy as does true geometry to the diagrams of geometry in Plato’s division of knowledge.¹⁴²

To accomplish the goal of saving the appearances, theories took either a “homocentric” approach (e.g., Eudoxus, making all the spheres rotate about the same literal center, viz., the center of the celestial equator coincident with the Earth) or a “heterocentric” one (e.g., Ptolemy, whose eccentrics and epicycles preserve uniform angular motion in the heavens, but not about the same center).¹⁴³ This theoretic split spurred a tension in the development of astronomical theory between the mathematical and physical modes of consideration of the heavens. On the one hand, homocentric mathematical theories are not in conflict with the natural philosophical postulate (given to astronomers) that the heavens undergo only

Earth “overtaking” the outer planets in terms of radial position from the Sun; this explains why the planet’s retrograde motion begins and ends only before and after the sun is in opposition, i.e., in the diametrically opposite part of the ecliptic. St. Thomas is aware of all of these phenomena; e.g., see *In De Caelo*, lib. II, lect. 8, n. 2 (Leon.3.150).

140. See Plato, *Timaeus*, 29e–40b.

141. See Duhem, *Sōzein ta phainomena*, 3; Heath and Aristarchus of Samos, *Aristarchus of Samos*, 140–41; Litt, *Les corps célestes*, 324–25. The source is Simplicius, in his commentary on *De Caelo*, II.12. St. Thomas also mentions this original Platonic commission: see *In De Caelo*, lib. II, lect. 17, n. 2 (Leon.3.186–87). I cite this text below, fn. 161.

142. See Heath, *Aristarchus of Samos*, 138; Plato, *Republic*, Book VII, 529a–530b.

143. Ptolemy, *Ptolemy’s Almagest*, 141. Litt, *Les corps célestes*, 342–66, who provides the names for these two types of theories, documents how St. Thomas was well aware of both. Also, consider Grant, *Planets, Stars, and Orbs*, 275–86.

regular, circular motion. On the other hand, the heterocentric mathematical theories are in conflict with the deliverances of general physical theory and the physical conclusions of cosmology in the *De Caelo*.¹⁴⁴ St. Thomas notes these conflicts himself.¹⁴⁵

The homocentric and heterocentric debate, therefore, only arises once Aristotelian physical theory comes on the scene. Indeed, a paradox arises when trying to fit the concrete details of geocentric cosmology together with the universal reach of the motor causality principle. I will draw this out in §11.3.

The line of reasoning to the physical principles of celestial motion is reinforced by Aristotle's understanding that an eternal motion must exist, and that the only type of motion which can be eternal is a local motion (for it is the first of motions) and a circular one (for it alone would not suffer stopping points). Now, Aristotle's conclusion to the existence of the fifth element that instantiates this eternal, circular, local motion requires the observed

144. Kepler, *Astronomia Nova*, 5, famously proposes to resolve the tension and attempt to explain the apparent motions through accurate physical causes.

145. St. Thomas, *In Meta.*, lib. XII, lect. 10, nn. 2567–70. St. Thomas' list is similar as a summary to the much more expansive treatment of Moses Maimonides, *The Guide of the Perplexed*, Vol. 2, trans. Shlomo Pines (Chicago: University Of Chicago Press, 1974), (II.24) 322–27. See also Grant, *Planets, Stars, and Orbs*, 286–308. In sum, the conflict is this: how can a rolling motion exist in the heavens? The Ptolemaic hypothesis is in conflict with the three fundamental cosmological motions: to, from, or about the center. The required arrangement of spheres to contain the Ptolemaic eccentric sphere would result in a void space or sixth type of element. The sphere of the epicycle seems to require a terrestrial type of matter in order to exist, or else to allow the rotating planetary body to contravene the motor causality principle. St. Thomas' statement of the last objection is brief, *ibid.*, n. 3: "Sequitur etiam, quod ipsum corpus stellae movetur per seipsum, et non solum ad motum orbis." It seems this means that the planetary body on the epicycle, carried howsoever by the eccentric orb, would either have no orb as mover or an orb not moved by another. Litt, *Les corps célestes*, 365, concludes that St. Thomas "did not understand the importance of the Aristotelian–Ptolemaic dilemma." At the most, this is a probable argument from silence. St. Thomas' familiarity with Maimonides' and others' objections aside, this was *the* cosmological debate of St. Thomas' day; perhaps his silence springs from prudence instead. It is true that St. Albert the Great proposed a modified Aristotelian physical cosmology, allowing the real existence of eccentric orbs, not the three-orb system that would become the standard medieval view; Grant, *Planets, Stars, and Orbs*, 294–96. St. Thomas was aware of St. Albert's views, *ibid.*, 296, fn. 80; evidence of this is that he describes them (without naming his teacher as their source) in his *opuscula*, *SBdT*, q. 4, a. 3, ad 8. St. Albert allows for an additional type of celestial substance, deriving the idea from Thâbit Ibn Qurra, whose innovation is also known by Maimonides, *The Guide of the Perplexed*, Vol. 2, 325, fn. 4. Grant, *Planets, Stars, and Orbs*, 277–81, notes that a contemporary of St. Thomas, Roger Bacon, was the likely originator of the medieval compromise theory, a "three-orb system," that combined both concentric and eccentric elements (a physical arrangement) to account for the appearances (the astronomical goal). The required eccentricity was produced, in part, by ovoid-shaped orbs.

existence of true circular motion. Thus, as the planets do not have an observable, uniform circular motion, Aristotle's argument to the existence of a fifth element cannot make use of the planets. Rather: "[H]e considers this motion [of the first heaven] in particular because in this motion there is neither an irregularity according to the thing itself nor in appearance."¹⁴⁶ Thus, the heterogeneity of matter in Aristotle's theory was based on the general notion of nature as a principle and cause of motion and rest (and according to matter and form of a specific kind), as well as certain arguments posterior to the definition of nature. Among these are the conclusions that eternal motion exists, that regular circular motion is the only kind of motion which can be eternal, that it is a simple motion, and simple motions must belong to simple bodies.¹⁴⁷ To determinately prove the existence of this species of body, however, the arguments require the existence of the effect which manifests it: regular circular motion. The effect demands a proportionate cause.¹⁴⁸ Only this observation supports the conclusion that the matter of the heavens is different from that of the earth.¹⁴⁹

At least, the arguments conclude that the matter of the *visible* celestial bodies is composed

146. St. Thomas, *In De Caelo*, lib. II, lect. 8, n. 2 (Leon.3.150). Aristotle's arguments for the fifth element, in *De Caelo*, Book I, ch. 2 (268b27–269b12), are five in number. Three of these arguments (the second, fourth, and fifth) require as a key existential premise that circular motion exists in the heavens as well as the fact that this is clear from sense experience. Insofar as motion requires a subject, and a simple (non-composed) motion, requires a simple subject, the arguments would conclude that a simple body exists different in kind from the terrestrial elements. St. Thomas notes this key supposition in each case, see St. Thomas, *In De Caelo*, lib. I, lect. 4, nn. 6, 14, and 17 (Leon.3.15, 17, 18). In the case of the second argument, St. Thomas makes the assumption explicit. It is beyond the scope of this project to critique each individual argument. This has been done elsewhere: Decaen, "The Existence of Aether," 35–71. He notes, 70, fn. 75, that the fact that Aristotle uses five arguments is a sign that Aristotle himself is not proposing demonstrations but probable or dialectical arguments. Decaen also notes, *ibid.*, 71, that the weakness of the second (*De Caelo*, I.2, 269a9–18) and fourth (269a32–b2) arguments is that they both "implicitly assume that the observed nightly motion of the stars is not due to that of the earth." The fifth argument (269b2–10) similarly assumes that "the observed circular motion of the heavens is continuous and eternal." The first argument (269a2–7) attempts to infer from the existence of some simple bodies "that *all* conceivable species of simple bodies exist." The third argument (269a18–32) "assumes the universality of the claim that what is posterior by nature cannot exist unless the prior by nature exists at the same time." It suffices to note the central reliance upon the existence of regular, circular motion in the heavens.

147. These preliminaries are introduced by Aristotle in *De Caelo*, I.1, 268b10–269a3.

148. St. Thomas, *ST*, Ia, q. 66, a. 2, c.: "Cum enim corpus caeleste habeat naturalem motum diversum a naturali motu elementorum, sequitur quod eius natura sit alia a natura quatuor elementorum." (Leon.5.156)

149. See Litt, *Les corps célestes*, 58–80, for an examination of texts where St. Thomas defends, maintains, or mentions this result.

of a fifth element. Why infer that the famous spheres are also composed of such stuff?¹⁵⁰ That the diaphanous heavens are not void could be inferred from the general argument against the void in *Physics*, Book IV. That the stars are moved along with their spheres Aristotle argues in *De Caelo*, Book II, ch. 8. However, *that* the spheres exist to be the bearers of the visible celestial bodies require some argument, for transparent reasons:

A doubt can be raised here as to why Aristotle omitted to inquire about this, since the bodies of the spheres are not perceptible to sight, since they are diaphanous, and it could be said that the stars move as if in air.¹⁵¹

St. Thomas replies with five arguments. The first three merely note how Aristotle implicitly shows the existence of the spheres. First, because they lack organs of self-motion, the stars require to be moved by another; second, because there is no other reason why the circumpolar stars should be moved at a slower rate than stars at latitudes closer to the celestial equator; third, because if the stars were moved on their own, they could possess only progressive motion, since they are not bodies circumscribing the center of the universe such as to be in motion while remaining in the same spot, as is proper to circular motion.¹⁵² Of these, the first comes closest to invoking the motor causality principle. Both the second argument, which assumes that the earth is at rest, and the third rely upon the notion that the observed circular motion of bodies about a center of the world can only occur if supported by bodies whose center is also the center of the world. Otherwise, the motion of the orb-less stars would be a type of whirling, not true circular motion, and thus composed.¹⁵³ The fourth argument relies upon the general proof of the *Physics* against the void, with additional reasons from the nature of place.¹⁵⁴

150. See Grant, *Planets, Stars, and Orbs*, 274–75.

151. St. Thomas, *In De Caelo*, lib. II, lect. 13, n. 3 (Leon.3.170). See also Litt, *Les corps célestes*, 39–40.

152. St. Thomas, *In De Caelo*, lib. II, lect. 13, n. 3 (Leon.3.170).

153. See St. Thomas, *In De Caelo*, lib. I, lect. 3, n. 7: “Dicit ergo primo quod circulatio, idest motus circularis, dicitur qui est circa medium. Et est intelligendum circa mundi medium: rota enim, quae movetur circa medium sui, non movetur proprie circulariter; sed motus eius est compositus ex elevatione et depressione.” (Leon.3.11) Also, Decaen, “The Existence of Aether,” 33, fn. 60.

154. St. Thomas, *In De Caelo*, lib. II, lect. 13, n. 3 (Leon.3.170).

The fifth argument most clearly invokes the motor causality principle. It begins from the procession of the lunar nodes and analogizes this argument to the other stars. In the heavens, where circular motion alone obtains for celestial matter, no body could be moved in a way other than in a circle. Thus, where compound motions exist (e.g., a spiral) multiple motions and, by the motor causality principle, multiple movers must be present.

Fifth, it is also clear from this, that the Sun and Moon move along circles which intersect each other. This is clear because the Moon is sometimes to the south and sometime to the north of the circle in which the Sun moves. However, it is clear that the intersections of the two circles, which are called nodes, or “head and tail,” are not always in the same point, for otherwise solar and lunar eclipses (which cannot happen unless the moon in conjunction or opposition occupies one of these nodes) would always occur in these same points. However, if this diversity [of motion] occurred only by the motion of the moon, it would follow that the moon is not moved circularly but along a helix, which is contrary to the nature of celestial bodies. Thus, it is therefore clear that this circle of the moon has its own motion. And by the same argument so do the circles of the Sun and the other stars.¹⁵⁵

That is, the Moon, apart from its longitudinal west to east motion according to the Different (the motion of the ecliptic), also possesses a latitudinal shift which crosses the path of the Sun along the ecliptic. The points of intersection were the nodes. Now, were the nodes always in the same relative position, they would either be coincident or not with the points of conjunction and opposition, and thus solar and lunar eclipses (respectively) would either always occur or never occur. Now, since mathematical points cannot move, some body must be responsible for this motion; it cannot be the moon itself, unless its motion around the earth be non-circular. Thus, the existence of some other body can be inferred. From these arguments, then, St. Thomas generally supports the existence and substance of the celestial spheres.

Now, we have not yet ascended to the *primum mobile* known to the medievals. The reason for this is that the precession of the equinoxes (or axial precession, to the Copernican) had

155. Ibid.

not yet been discovered in Aristotle's time. That is, were the sphere of the fixed stars the *primum mobile*, it would possess only one motion: daily rotation. However, this is not the case. First discovered by Hipparchus, the fixed stars make a slow trek from west to east, about the poles of the ecliptic.¹⁵⁶ St. Thomas mentions this precession fifteen times.¹⁵⁷ In two of these texts the *primum mobile* figures more prominently.

However, it should be considered that in the time of Aristotle, the [proper] motion of the fixed stars had not yet been discovered. Ptolemy specifies that they move from west to east about the poles of the Zodiac, one degree every hundred years, such that their entire revolution is completed in thirty-six thousand years. Therefore, the ancients supposed the sphere of the fixed stars to be the *primum mobile*, and that its motion was only one, which is the diurnal motion. But taking into account [*supposito*] the motion of the fixed stars, it is necessary that it be in motion by two motions, namely its proper motion which is the motion of the fixed stars, and the diurnal motion, which is the motion of the highest sphere, which is without stars.¹⁵⁸

The argument parallels the reasoning which St. Thomas gives for postulating the existence of another orb for the moon. Because the fixed stars move by two motions, they cannot be moved by one celestial sphere, for celestial matter possess only regular circular motion. Thus, beyond the sphere of the fixed stars lies the ultimate sphere, “*et hoc est primum mobile, quod movetur a primo motore secundum Aristotelem.*”¹⁵⁹

156. See Ptolemy, *Ptolemy's Almagest*, 327–38. The figure obtained by Hipparchus and Ptolemy is approximately one cycle every 36,000 years, based on his estimate of 1° of motion per 100 years. The modern figure is approximately 25,771 years. That the precession is about the ecliptic's pole is determined by measuring the constant latitude of the stars in reference to the ecliptical plane.

157. See Litt, *Les corps célestes*, 308–319.

158. St. Thomas, *In De Caelo*, lib. II, lect. 17, n. 7 (Leon.3.189). The other text is *In Meta.*, lib. XII, lect. 9, n. 2558: “Considerandum est autem quod post primam lationem Aristoteles non computat nisi lationes planetarum, quia eius tempore nondum erat deprehensus motus stellarum fixarum. Unde existimavit, quod octava sphaera, in qua sunt stellae fixae, esset primum mobile, et motor eius esset primum principium. Sed postea deprehensus est ab astrologis motus stellarum fixarum in contrarium primi motus: unde necesse est quod supra sphaeram stellarum fixarum sit alia circumdans totum, quae revolvit totum caelum motu diurno; et hoc est primum mobile, quod movetur a primo motore secundum Aristotelem.” This new orb beyond the sphere of the fixed stars was not the only one hypothesized to exist; see Grant, *Planets, Stars, and Orbs*, 315–24.

159. St. Thomas, *In Meta*, lib. XII, lect. 9, n. 2558.

11.3 *Separating the perennial from the passing, and a paradox*

Knowledge of the determinate being (in species and number) of the first mobile in Aristotelian-medieval cosmology was, therefore, entirely dependent upon the most fundamental astronomical motion that the senses seem to identify, the regular revolution of the heavens about the earth. Further, discovering the first mobile was dependent upon a particular precision of that basic observation: the variety of observed motions according to “the Different,” i.e., west to east along the ecliptic.

The Platonic rule of “saving the appearances” guided the coupling of physical cosmology with this set of observations. Here is where the paradox arises, in the tension between physical theory applied universally and primitive observational determinations. Based upon the fundamental data point of the regular, diurnal rotation of the celestial bodies, the astronomers sought to save the heavens from the irregular or anomalous appearances (the Platonic commission). Aristotle, based upon his own arguments in the *Physics* which demanded that motion be eternal and that this requires a subject in circular motion, argued for the determinate existence of the requisite simple body based upon the fundamental data point and its primitive interpretation. However, as St. Thomas indicates, the existence of celestial spheres is not clear to us even then. The existence of any sphere has to be inferred from the number of motions required to preserve the visible celestial bodies from the irregularities clearly visible in their motions.

Now a curious celestial Escher-staircase in reasoning arises once the sphere of the fixed stars itself is observed to move west to east about the poles of the ecliptic. Another sphere—invisible and without stars—must now be postulated based upon observational astronomy (the precession of the equinoxes) and the physical requirement that regular circular motion exist in the heavens. Being without fixed reference points, the regular motion of this new *primum mobile* is observed indirectly via the irregularities within the diurnal rotation. The

motion previously thought regular is now irregular. Yet the regularity of the diurnal motion was the original basis for positing the existence of a celestial matter and spheres in the first place, and consequently requiring the irregular appearances of the other celestial bodies to be saved. Consequently, the motor causality principle can only be realized in the medieval, geocentric Aristotelian universe at the price of incoherence with the observations that would instantiate it.

Note that the heterogeneity of matter likewise depends upon this fundamental data point. Consequently, Litt's objection, that the natural philosophical discovery of form and matter requires the existence of the celestial spheres, is unfounded. Likewise, the disproof of the series of essentially subordinate causes instantiated by a Eudoxean cosmos depends upon the disproof of the existence of circular motion in the heavens. The proof of *Physics*, VII.1, by contrast, specifically abstracts from any particular cosmological model.¹⁶⁰

Thus, the transition between the general considerations of natural philosophy and the more determinate study of cosmology was poorly made. It incorporated a faulty interpretation of determinate data about mobiles in motion (the existence of regular circular motion), which error was compounded by making this motion universal to all celestial bodies. The influence of mathematical astronomy upon this cosmological theory (the improvement of sense experience or the data from which the determinations were being made) eventually led to the situation where the theory of regular circular motion in the heavens cut off the foundation for that theory.

Now, the critique of the existential premise in the argument for the spheres is an involved body of argument. In sum, the argument must overthrow the division among simple motions, that they are either to, from, or around the center. Granting the success of such a critique, however, the result obtained is that the initial data point upon which all the more determinate conclusions about the *primum mobile* relied is taken away. If the more determinate falls

160. As noted above in §10, p. 188.

away, only the indeterminate would remain. The indeterminate in this case is provided by the arguments logically prior, the arguments of *Physics* VII.1, which rely upon primary experiences of nature and not primitive ones. To such a development, it seems St. Thomas could only agree, as aware as he was of the probable status of argument made in the *De Caelo*.¹⁶¹

If Aristotle's natural path is still viable, there must be something more common and better known which was overlooked in the rush to take up something thought to be primary. Perhaps circular motion is not a simple motion but a composed motion. As noted above in the discussion of inertia, the precise division between violent and natural motion has to be reassessed. Yet the more general division between the natural and the violent is not necessarily under threat. Nor is the general understanding of motion and its properties. It

161. At certain points in his commentary, St. Thomas makes note of the probable status of Aristotle's reasoning. He is also clearly aware of the difference between demonstrative reasoning and the hypothetical-deductive status of mathematical models; the suppositions of the astronomers (homocentric or heterocentric alike) are not necessarily true. See *ST*, Ia, q. 32, a. 1, ad 2: "Ad secundum dicendum quod ad aliquam rem dupliciter inducitur ratio. Uno modo, ad probandum sufficienter aliquam radicem, sicut in scientia naturali inducitur ratio sufficiens ad probandum quod motus caeli semper sit uniformis velocitatis. Alio modo inducitur ratio, non quae sufficienter probet radicem, sed quae radici iam positae ostendat congruere consequentes effectus, sicut in astrologia ponitur ratio excentricorum et epicyclorum ex hoc quod, hac positione facta, possunt salvari apparentia sensibilia circa motus caelestes, non tamen ratio haec est sufficienter probans, quia etiam forte alia positione facta salvari possent." (Leon.4.350) The logical difference is articulated correctly even if the examples do not fit. See also *In De Caelo*, lib. II, lect. 17, n. 2: "Secundo considerandum est quod circa motus planetarum quaedam anomaliae, idest irregularitates, apparent; prout scilicet planetae quandoque velociore, quandoque tardiores, quandoque stationarii, quandoque retrogradi videntur. Quod quidem non videtur esse conveniens caelestibus motibus, ut ex supra dictis patet. Et ideo Plato primus hanc dubitationem Eudoxo, sui temporis astrologo, proposuit; qui huiusmodi irregularitates conatus est ad rectum ordinem reducere, assignando diversos motus planetis; quod etiam posteriores astrologi diversimode facere conati sunt. *Illorum tamen suppositiones quas adinvenerunt, non est necessarium esse veras*: licet enim, talibus suppositionibus factis, apparentia salvarentur, non tamen oportet dicere has suppositiones esse veras; quia forte secundum aliquem alium modum, nondum ab hominibus comprehensum, apparentia circa stellas salvantur. Aristoteles tamen utitur huiusmodi suppositionibus quantum ad qualitatem motuum, tanquam veris." (Leon.3.186–87) My emphasis.

Furthermore, the arguments are limited by the extent of observations, as St. Thomas notes with one of Aristotle's arguments for the unchangeability of the heaven (that we have not observed the heavens to change), that it is not a necessary but only a probable argument; see St. Thomas, *In De Caelo*, lib. I, lect. 7, n. 6 (Leon.3.29). This same mode of argument, from observed unchangeability, is what grounds part of the argument for the complete uniformity of the motion of the sphere of the fixed stars, see *In De Caelo*, lib. II, lect. 9, n. 1 (Leon.3.153). Indeed, St. Thomas is even aware of non-geocentric theories—lect. 11, n. 2 (Leon.3.162)—and relative motion—lect. 12, n. 4 (Leon.3.166). Alternative modes of explanation have only been ruled out with probability.

is the primitive divisions within the genus of natural, simple motions that precluded the possibility of considering alternatives within the context of Aristotle's more determinate cosmology. Perhaps the project of finding a determinate cosmology was only proven to have a false start and never truly restarted.

§12 THE CONCLUSION REACHED IS ATTENDED BY SOME PROBLEMS NEEDING RESOLUTION, BUT HAS ACHIEVED KEY RESULTS.

In light of the foregoing investigation, some definite conclusions have been achieved concerning the *primum mobile* and certain problems with the conclusion remain to be resolved. The determinate conclusions are as follows:

1. The *primum mobile* exists.
2. The *primum mobile* possesses a corporeal nature.
3. There must be at least one *primum mobile*. There is only one if there is only one time.
4. The *primum mobile* is the first intracosmic necessary condition for cosmic local motion.
5. As the necessary condition for cosmic local motion, the *primum mobile* must be fundamentally related to the order of place.
6. As the necessary condition for cosmic local motion, and hence the before and after in all motion, the *primum mobile* must be fundamentally related to the order of time.

The problems which remain are as follows. First, while the existence of the *primum mobile* has been shown, its nature remains unclear. The reason for this indeterminacy is that the middle terms used in *Physics*, VII.1 relied upon the general nature of body, considering only the physical continuum as such, and not determinate natures. §11 has eliminated the ancient and medieval conclusion that it was composed of incorruptible matter and a form permitting it to sustain all celestial motion. We are left in doubt about the specific substance of the *primum mobile*.

Second, because the argument of *Physics*, VII.1 relies upon the contrary-to-fact conditional of the continuum-universe, the argument on its own cannot count the number of the

primum mobile. Further, the indeterminate nature of this contact calls into question how exactly this *per se* series of efficient causes exists. So, third, how exactly is the *primum mobile* a cause? What is the extent of its causality? Is it a universal cause, as the ancients thought? The argument warrants us to conclude that it is the necessary condition for cosmic local motion. Yet the nature of this causality is unclear. For instance, how does it allow for observed chance events?

Finally, given its fundamental causal efficacy in regard to local motion, the *primum mobile* must be tied to being a principle for the immobility of place and the unity of time. How exactly the *primum mobile* and place are related is unclear, since the argument in this chapter abstracted from any particular cosmological arrangement. However, given the argument of §7, we can conclude that the *primum mobile*, as the fundamental condition of all local motion, must be one in number since there is only one time.¹⁶² However, the determinate answers provided in Aristotelian-medieval cosmology have been eliminated, viz., that the immobility of place is secured by reference to the poles of the outermost celestial sphere composed of aether and that time is unified by being measured by its motion. Is there a modern alternative?

If the investigative arc of natural philosophy seeks the first principles, causes, and elements of nature, the inquirer wants to answer such questions. If this requires the use of a separate science or a sub-part of natural philosophy, then the indeterminate conclusions serve as principles for further inquiry. They are principles because discovering “that something is so,” is prior to asking “What is this something?”¹⁶³ They are, consequently, commands, as a command is the rational representation of the necessity of a course of action given from one to another.¹⁶⁴ The goal of complete scientific knowledge grounds the necessity of the course

162. See above, p. 150.

163. See Aristotle, *Posterior Analytics*, II.8, 92b5; II.8, 93a20. To ask what something is before answering whether it exists is to seek after nothing.

164. Borrowing from Immanuel Kant, *Grounding for the Metaphysics of Morals: With on a Supposed Right to Lie Because of Philanthropic Concerns*, 3rd, trans. James W. Ellington (Indianapolis: Hackett Publishing Co.,

of action to determine the nature of something after discovering that it is; therefore, the inquiry that discovers “that something is” would function as directive to the separate inquiry (or sub-part of an inquiry) which seeks “what something is.” The conclusions in *Physics VII* could be part of the architectonic character of general natural philosophy.

1993), 24–25. Consider also St. Thomas, *ST*, Ia–IIae, q. 17, a. 1, c: “Imperare autem est quidem essentialiter actus rationis, imperans enim ordinat eum cui imperat, ad aliquid agendum, intimando vel denuntiando; sic autem ordinare per modum cuiusdam intimationis, est rationis.” (Leon.6.118) St. Thomas elsewhere implies that “to command” is a fourth act of the intellect, viz., one proper to practical reason; *ibid.*, q. 57, a. 6, c, and IIa–IIae, q. 47, a. 8, c.

CHAPTER 4
The First Mobile in *Physics*, Book VIII

INTRODUCTORY NOTE TO CHAPTER 4

This chapter will present arguments for the first moved mover based on Aristotle's texts in *Physics*, Book VIII. First, §13 will consider the context of these arguments as part of the completeness of doctrine required for natural philosophy. Two arguments are presented in §14. These arguments, used by Aristotle in the process of demonstrating properties of an immobile first mover, can be applied to demonstrating the existence of the *primum mobile*. The conclusion to the existence of the first mobile must also be removed from the various unsound specifications added in Aristotelian cosmology. Thus, §15 considers these further determinations about the first mobile which Aristotelian natural philosophy takes up in *De Caelo*, Book II and *De Generatione et Corruptione*, Book II. The demonstrative status of these arguments is evaluated and it is determined that they are unsound. However, the general conclusion reached in the *Physics*, vague as it may be, still holds. Lastly, §16 presents a resume of the conclusions reached and the problems which still remain.

§13 THE ARGUMENT FOR A FIRST MOBILE PROVIDES THE NECESSARY INTEGRITY FOR THE GENERAL INQUIRY INTO MOBILE BEING AS SUCH. (*Physics*, BOOK VIII)

The perfect natural philosopher at the height of his task will mention also the causes which are unmoved and above nature.

PHILOPONUS
On Aristotle's Physics, II.7

The arguments to be considered from *Physics*, Book VIII help to complete the investigation of general philosophical physics. This completeness is required, first, based upon the sufficient conditions for actualization of the potential which is found in every mobile as such. Second, this completeness is required on the part of demonstrating a mover for all kinds of motion, including generation and corruption.

13.1 *Completeness of doctrine about generation and corruption, act and potency*

With regard to the general conclusions about the necessary conditions for patterns of generation and corruption or potency being brought to act, the arguments in *Physics* VIII provide a completeness to the investigation of general philosophical physics. Certain logical requirements are fulfilled in this respect, as well as additional confirmation regarding the necessary, real distinction between action and passion.¹ However, other points of closure can be noted as well.

In particular, since motion is a being in potency, the generic consideration of mobile being will not be logically complete until we see how the potential found in every mobile as a mobile is resolved to some efficient cause. This is found in the argument from act and potency for a first mover. Furthermore, the argument from generation and corruption allows the natural philosopher to more clearly see how *per se* causality is ultimately prior in the whole cosmos. That is, the indeterminate circumstances required for generation and corruption are provided by the first moved mover. Because these circumstances are essential

1. See above, §9.2.

for the casual confluence of interacting elemental agents, the argument connecting the first moved mover with the cosmic generation and corruption demonstrates that the *per se* is prior to the accidental even at the level of the inanimate. By indicating how the cosmic causes of generation and corruption interact with this order, the inquiry provides a complete determination of all change universally, including the type with which the investigative arc of natural philosophy began in Book I, change simply speaking.

Indeed, it was noted previously that prime matter, as a passive and entirely potential principle of mobile being, requires a correlatively active principle.² The proof of such an efficient cause bookends Aristotle's investigative arc of natural philosophy: it moves from sheer potency to sheer actuality. If this active agent principle requires a bodily instrument, as is discussed in Book VIII, then uncovering the relationship between the extra-cosmic active principle and the fundamental intra-cosmic instrumental principle provides a certain measure of completeness to the doctrine about the efficient causes of motion in general by showing the entirely intrinsic and material cause of motion, the entirely extrinsic actuator of motion, and the medium between the two.³

13.2 *The context of the argument*

The order in determination is a process within the generality or specificity with which one understands a scientific subject-genus. A theoretical advance in this order corresponds to greater specificity of one's subject genus and requires, as one enters each new level, a new influx of experience so that the principles and definitions proper to that level are settled and firm in one's understanding. The order in demonstration, by contrast, is a process that presupposes the first process, and grasps the causal connection between the subjects under

2. See above, §2.1.

3. Compare Aristotle, *Physics*, VIII.5, 256b13–15: "And this has happened reasonably, for three things are necessary: the moved, the mover, and that by which it moves."

investigation and their properties. A theoretical advance in this order corresponds to the greater connectivity between subjects and predicates in a genus.

Now, St. Thomas points out in several places in his commentary on the *Physics* that Book VIII stands in a certain opposition to the prior seven books. Consider what he says in gloss of Aristotle's comment in Book 8, ch. 1, "Let us begin first, however, from the things determined by us before in the *Physics*."⁴

First, then, [Aristotle] says that in order to show these things, we must begin from those which were determined at first in the *Physics*, so that we can make use of them as principles. By which he gives us to understand that the preceding books, in which he determines things concerning motion in common (and because of this these books are generally called "On Natural Things"), they have a certain distinction from this eighth book, in which he begins to apply motion to things. He assumes, therefore, what he had said in *Physics*, Book III, namely that motion is the act of the mobile insofar as it is such. From this it is clear that in order for motion to exist it is necessary that some things exist which are able to be in motion in some way, because there cannot be an act without that of which it is the act. Therefore, from the definition of motion it is clear that it is necessary that there be some mobile subject, if motion is to exist.⁵

It will be recalled that this proof in *Physics*, Book III (see above, §4.3) leads to the proof that the subject to which motion belongs must be divisible (*Physics* VI.4; see above, §8.2), which in turn allows for the proofs of the first mobile in *Physics* VII.1. The eighth book seeks to make general natural philosophy's considerations more determinate by applying motion to things. This "*applicare motum ad res*" is likewise expressed in the contrast between the consideration "of motion in common, not applying it to things" and the stage where one applies "the common consideration of motion to the existence that [motion] has in things."⁶ In

4. Aristotle, *Physics*, VIII.1, 251a8-9.

5. St. Thomas, In Phys., lib. VIII, lect. 2, n. 2 (Leon.2.367). Also, lect. 10, n. 2: "[O]mnia enim quae ante hunc octavum dixit, vocat universalia naturae, quia in hoc octavo ea quae supra de motu in communi dixerat, incipit applicare ad res." (Leon.2.401)

6. See *ibid.*, lect. 1, n. 3 (Leon.2.363): "Deinde cum dicit: esse quidem igitur etc., respondet tacitae quaestioni. In praecedentibus enim libris Aristoteles locutus fuerat de motu in communi, non applicando ad res: nunc autem inquirens an motus semper fuerit, applicat communem considerationem motus ad esse quod habet in rebus."

another place, St. Thomas says that the common considerations are applied “to determinate mobile things.”⁷

Thus, Book VIII takes into account that not all mobiles are divisible *ad infinitum* without losing their specific nature. By contrast, the reasoning of Book VII considers only mobile being as such, and as such, no mobile is self-moved. Only certain determinate kinds of mobiles can be self-movers, such as living things. Certain organs of living things lose their primary and *per se* motion upon division.⁸ Another such specification, which will be discussed in §14, is that *Physics* VIII considers the series of movers in motion in the cosmos not as a quasi-individual (the continuum-universe of *Physics* VII.1), but rather under a common *ratio*, the notion of secondary movers.⁹ Thus the middle terms to be used in *Physics* VIII differ from those in *Physics* VII.1 as formal to material.

Now, does this “further determination” imply that the discussions of the First Mover and first mobile are outside the level of determination of general natural philosophy? It does not seem so, for these arguments, (1) resolve to the first agent principles of the common genus of mobile being, (2) assign certain predicates to these first agent causes in virtue of the common determinations of that genus, and (3) consider determinate mobile natures or kinds of change at a very generic level. So the arguments in *Physics* VIII are not outside of

7. See *ibid.*, lect. 5, n. 6 (Leon.2.382): “Sed sciendum est quod Aristoteles in sexto determinabat de motu in communi, non applicando ad aliqua mobilia; et ideo ea quae ibi de motu tractavit, accipienda sunt secundum exigentiam continuitatis motus: hic autem loquitur de motu, applicando ad determinata mobilia, in quibus contingit aliquem motum interrumpi et non continuari, qui secundum rationem communem motus posset esse continuus.” See also *ibid.*, lect. 10, n. 2.

8. St. Thomas offers the heart as an example. See Kolbeck, “The *Prima Via*,” 128–32; and Aristotle, *Physics*, VIII.5, 258a27–258b4. St. Thomas comments, *In Phys.*, lib. VIII, lect. 11, n. 6; in particular: “Sed nunc iam Aristoteles loquitur de motu, applicando ad determinatas naturas: et ideo ponit aliquid esse primo movens seipsum. . . . Unde si sit corpus incorruptibile, dividi non potest in actu. Si autem sit corruptibile, si dividatur in actu, non retinebit eandem potentiam, sicut patet in corde. Unde nihil prohibet in iis quae sunt divisibilia in potentia, esse unum primum.” (Leon.2.406) Hassing, “Physical Continuum,” 123–29, discusses this passage. This specification of the motor causality principle involves the difficult issue of the relationship between soul as form of the living thing and the quantitative parts of the living thing, including the first moved part; see *ibid.*, 133. St. Thomas, following Aristotle’s lead, considered the heart to be such a first moved, *De Motu Cordis*, “Sic igitur motus cordis est naturalis quasi consequens animam, in quantum est forma talis corporis, et principaliter cordis.”

9. Kolbeck, “The *Prima Via*,” 165–73.

general natural philosophy.

13.3 A brief note on eternity

The arguments from *Physics* VIII which prove the existence of the *primum mobile* must be severable from any reliance upon the cogency of Aristotle's arguments for the actual eternity of motion. Indeed, in a comment on *Physics* VIII.1, St. Thomas suggests that the eternity of motion can be taken merely as an argumentative supposition:

For this way of proving the existence of the first principle is most efficacious, against which no resistance can be offered. For if it is necessary to posit one first principle, if the world and motion exist eternally, much more so is this the case when their eternity is taken away. For it is manifest that every new being requires some innovating principle. Therefore, only in this way would it seem that it is not necessary to posit some first principle: if things exist from eternity. Whence if even upon this posit it follows that a first principle is necessary, one shows that it is in every way necessary that a first principle exist.¹⁰

This interpretive move allows St. Thomas to suggest a way in which Aristotle's arguments can avoid contradicting the Catholic Faith.¹¹ As he argues elsewhere, St. Thomas maintains that whether or not the world has a beginning in time is philosophically indemonstrable, a true antinomy of reason.¹²

Aristotle's consideration of the eternity of motion rests upon two general lines of argument: that prior to every generation there must be some motion (251a9–b28), and after every

10. St. Thomas *In Phys.*, lib. VIII, lect. 1, n. 6 (Leon.2.364). Compare Enrico Berti, "La suprématie du mouvement local selon Aristote: ses conséquences et ses apories," in *Aristoteles: Werk und Wirkung*, ed. Paul Moraux Gewidmet, vol. 1 (Berlin: Walter de Gruyter, 1985), 150: "Aristote, influencé par la science de son temps, a adopté la conception de l'univers la moins apte à justifier sa métaphysique: en effet, comme nous avons déjà vu, sa doctrine de l'éternité de l'univers ne signifiait pas seulement que le mouvement, et donc l'univers, a toujours existé, mais elle signifiait que le mouvement, et par conséquent l'univers aussi, a toujours été identique à ce qu'il est actuellement. Malgré cette doctrine, qui rendait la nécessité d'une cause transcendante plus difficile à apercevoir, Aristote, grâce à sa métaphysique et en particulier à sa doctrine de la puissance et de l'acte, a bien vu cette nécessité."

11. That they are wholly (motion never began) or partially (motion will never end) contrary to the Faith he points out at *ibid.*, n. 16.

12. See *ST*, Ia, q. 46, a. 2.

corruption there must be some motion (251b28–252a5). For both halves of the argument, two middle terms are provided, one from the nature of motion (251a9–b10 and 251b28–252a5) and another from the nature of time (251b10–b28).¹³ On the side of motion, Aristotle argues that were all mobiles originally at rest, their dispositions would not change with respect to each other so as to initiate motion unless some one of them were put into motion. That is, since there is no change in the category of relation apart from the change of one or both of the related things, the relative rest of all bodies could never end without the presupposition of one being in motion.¹⁴ This Aristotelian “Swerve” entails that no original quietism can exist between mobiles. Likewise, there can be no end of motion because every corruption requires a process to bring it about. The mobile whose motion is the destruction of some other mobile would require another motion for its destruction.

On the side of time, Aristotle argues from the nature of the now. Since every now is both a beginning and an end, there cannot be a now which is a beginning but not an end, nor a now that is an end and not a beginning. Hence, time must exist before and after any now. Since the subject of time is motion, motion must be without beginning or end.¹⁵

St. Thomas takes care to point out that Aristotle *does* intend to conclude to the actual eternity of motion.¹⁶ However, in his response to Aristotle’s arguments, St. Thomas maintains they are sound if limited to a certain scope.¹⁷

But if one rightly considers the arguments presented here, the truths of the Faith cannot be impugned by them. For arguments of this sort *are efficacious*

13. St. Thomas *In Phys.*, lib. VIII, lect. 2, n. 1 (Leon.2.366–67); he explains—*ibid.*, n. 15 (Leon.2.370)—that the argument from time does double duty, claiming to show support both halves of the position. See also Buckley, *Motion and Motion’s God*, 53–54.

14. See St. Thomas *In Phys.*, lib. VIII, lect. 2, n. 8 (Leon.2.369).

15. See *ibid.*, n. 14.

16. *Ibid.*, n. 16: “Quidam vero frustra conantes Aristotelem ostendere non contra fidem locutum esse, dixerunt quod Aristoteles non intendit hic probare quasi verum, quod motus sit perpetuus; sed inducere rationem ad utramque partem, quasi ad rem dubiam: quod ex ipso modo procedendi frivolum apparet. Et praeterea, perpetuitate temporis et motus quasi principio utitur ad probandum primum principium esse, et hic in octavo et in XII *Metaphys.*; unde manifestum est, quod supponit hoc tanquam probatum.”

17. The summaries of St. Thomas’ replies, presented below, follow *ibid.*, nn. 16–20.

in showing that motion did not begin by way of nature, as was held by some. But one cannot prove through these arguments that motion did not begin just as things produced *de novo* from a first principle of things, as our Faith holds. This is clear by considering each of the inferences offered here.¹⁸

That is, the arguments effectively show that natural principles cannot provide the self-initiation of natural motion. The key is to show that how they are unsound does not affect other conclusions Aristotle draws in the text. Thus, to properly reconfigure Aristotle's argument from motion, one can reply that God, through creation, provides natural mobiles with the disposition required for natural motion upon their coming into existence *ex nihilo*.¹⁹ To limit Aristotle's argument from time, St. Thomas points out that it assumes the eternity of motion, since motion is the subject for time. Further, the seeming necessity for positing a time prior to a now that is a beginning or a time posterior to a now that is an end is merely imposed by the imagination, which, just as when it imagines a finite universe, must also imagine a space outside that universe.²⁰ As a consequence, even though the demonstrations in *Physics* VIII for the First Mover presuppose the eternity of motion, this can be taken to mean the possible eternity of motion according to the character of the principles of mobile being.

18. Ibid., n. 17. My emphasis.

19. Ibid., nn. 18–19. See also *ScG*, II.23.

20. St. Thomas *In Phys.*, lib. VIII, lect. 2, n. 20 (Leon.2.372).

§14 THE FIRST MOVED MOVER EXISTS; THIS CAN BE SHOWN AS A COROLLARY TO THE ARGUMENT FOR A FIRST MOVER BASED ON NECESSARY CONDITIONS FOR COSMIC-SCALE CAUSALITY. (*Physics*, BOOK VIII.5–6)

We know moreover that the celestial body was in its turn moved by a separate substance, by a pure spirit. If we have, centuries since, abandoned the surpassed astronomy implied by this text of St. Thomas, we have wrongly rejected the philosophical idea beneath the argument. If we cannot put our finger on the intracosmic instrument which serves as the being endowed with the active power necessary to the cosmos, we are no less obliged to affirm its existence.

CHARLES DE KONINCK
The Cosmos

The proofs for the first mobile from *Physics* Book VIII can be drawn from the fifth and sixth chapters. First, the notions of secondary and instrumental movers must be discussed, for the *primum mobile* is essentially a secondary mover and an instrumental cause. Then the argument from act and potency and the argument from generation and corruption will be presented.

14.1 *The notion of secondary and instrumental movers*

St. Thomas develops the notion of secondary (as opposed to primary) and instrumental (as opposed to principal) movers when presenting the Aristotelian arguments against an infinite regress of movers in *Physics* VIII.5 (256a4–b3). These notions are closely joined, although not entirely identical.

St. Thomas introduces the distinction between primary and secondary movers when he glosses *Physics* VIII.5, 256a4–8. He also adds a distinction among primary movers.

As it was said that everything in motion is moved by something, it belongs to a thing to be a mover in two ways. In one way, when it does not move [another] on account of itself [*propter seipsum*], that is, by its proper power [*propria virtute*],

but because it is in motion by something else moving it, and this is a secondary mover. In another way something moves [another] on account of itself, that is, by its proper power, not because it is in motion by some other. However, it happens that such a mover moves [something] in two ways. In one way, such that the first mover moves a thing next to the last thing [moved] (that is, what is itself next after the second mover), and this happens when the first mover moves the mobile only through one [moving mover] in between. But in another way, the mover moves the mobile through many [moving movers] in between, as is clear when a stick moves a stone while being moved by a hand, which is moved by the man, who does not move [something] on account of something else being in motion. Thus, therefore, the man is the first mover on account of himself, and moves the stone through many middles [*plura media*]. However, if he were to move the stone with his hand, he would move it through one middle only [*per unum medium tantum*].²¹

St. Thomas begins to build the *ratio* of a secondary mover by noting, first, that it is a mover but not by its own power. Rather (and this is the second element), it depends upon something else for this capacity, which imparts it to the secondary mover by putting it in motion. Secondary movers thus differ from primary movers because the primary mover does not rely upon something else's putting it in motion so that it can be a mover. Among primary movers, they can use one or many *media* to produce their ultimate effect, as the man who moves a stone either using a stick (e.g., a lever) or just his hands.²²

When glossing the subsequent passage (256a8–13), St. Thomas adds to the contrast between a primary and a secondary mover, viz., which is more of a mover.

Indeed, since both the first mover as well as the last we would say move [something], we say that the first mover is more a mover than the last. And this is clear for two reasons. Of which, the first is that the first mover moves the second mover, but not conversely. The second reason is because the second mover is not able to move [something] without the first, but the first mover is able to move [something] without the second, as the stick is not able to move the stone unless

21. St. Thomas, *In Phys.*, lib. VIII, lect. 9, n. 2 (Leon.2.396).

22. One might rightly ask: is the man *in fact* a primary mover in the strictest sense? This must be addressed below.

it be moved by the man, but the man is able to move [something] even without the stick.²³

The two reasons St. Thomas gives highlight the dependence which secondary movers have upon primary movers. The primary mover is not itself moved by the secondary mover as such. Note that this recalls the discussion of agency and patiency in Book III. The mover as such might itself be moved upon moving some other mobile, but this is accidental. The primary mover, further, stands in no need of the secondary mover. Thus, a secondary mover is one whose being a mover depends upon being in motion from some other mover. Compared to the primary mover of some order, these secondary movers are therefore different in kind; the primary movers possess the nature of movers to a greater degree. Some secondary movers are “less secondary” than others; the driver hired to haul rock using a truck is more a mover than the truck, although both are secondary (for the driver is an employee).²⁴ Thus, the secondary mover is a mover “per aliud.”²⁵

Now, one might object that, as Aristotle’s argument will conclude that there is only one primary mover in the strictest sense, then our argument appeals to something we never actually sense.²⁶ This Kantian objection is very powerful.²⁷ The reply is that even in our experience the *ratio* of primary movers is still present in some way, viz., when we consider only a finite series. Thus, the truck driver is more like a primary mover in the sense that he, like his employer, can be a primary mover in some other series. St. Thomas’ example itself points out something in our common experience which provides the notion of a first in an ordered series of movers. In the regress arguments made from the notion of a secondary

23. St. Thomas, *In Phys.*, lib. VIII, lect. 9, n. 3 (Leon.2.396). To highlight the use of the active and transitive “*movere*,” I have translated it as “to move [something].”

24. Kolbeck, “The *Prima Via*,” 171.

25. *Ibid.*, 172–73.

26. *Ibid.*, 182–83.

27. Kant, *Critique of Pure Reason*, A605/B633: “The inference is too well known for it to be necessary to expound it in detail here. It rests on the allegedly transcendental natural law of causality that everything contingent must have a cause, which, if it in turn is contingent, must likewise have its cause, until the series of causes subordinated one to another has to end with an absolutely necessary cause, without which it would have no completeness.”

mover, therefore, the *reductio* points out that were all movers such as to be secondary movers in the full sense, then there would be no movers in motion at all.²⁸

That is, from the notion of secondary movers, one argues against the totality of existent movers being of such a sort. This can be done either from the notion of secondary movers as “middle” or “intermediary” movers (which St. Thomas calls an “ascending” order of proof), or from the notion of secondary movers as instrumental movers (which St. Thomas calls a “descending” order of proof).²⁹ The use of “middles” (ascending order), is as follows:

In ordered movers and moved things, namely, of which one is moved by another in order, this necessarily arises that, the first mover being removed or ceasing from motion, none of the others will move nor be moved, because the first is the cause of moving all the others. But if there were ordered movers and moved things to infinity, there would not be some first mover, but all would be, as it were, middle movers. Therefore, none of the others would be able to move, and thus nothing in the world would be in motion.³⁰

The proof does not depend upon the intrinsic impossibility of an infinite series, but upon the notion that an infinite series has no first. If one can show that moving movers are movers because they are put in motion (the motor causality principle), there must of necessity be a primary mover to the cosmos. It is at this juncture that our first argument for the *primum mobile* will be made.³¹

The second way in which one can argue against an infinite series of secondary movers is through the notion of instrumentality. St. Thomas states this as follows:

28. The qualified notion of primary movers in our sense experience thus begins our understanding of the Primary Mover beyond our sense experience in two ways: the *via negativa* requires that we deny of the absolutely First Mover what is imperfect in our notion of primary movers (since they are all secondary movers in some way), and the *via eminentiae* requires that the purified notion of primary mover be predicated analogously of the being discovered in the course of the argument.

29. See St. Thomas, *In Phys.*, lib. VIII, lect. 9, n. 4 and n. 5 (Leon.2.396–97), respectively. In the following exposition, I use *SGC*, I.13, nn. 14–15.

30. St. Thomas, *SGC*, I.13, n. 14 (Leon.13.31).

31. Now, Aristotle’s argument in *Physics* VIII.5 leads only to the outcome of a self-mover: it is not yet clear that the primary mover must be entirely separate from motion (just as the human being is a primary mover through the soul); see Aristotle, *Physics* VIII.5, 256b1ff. Indeed, it is on account of the Platonic notion of soul as a self-mover that Aristotle takes steps so deliberately in this argument. Thus, only after this preliminary stage of argument does Aristotle begin to investigate how self-movers are self-moved; see *ibid.*, 257a33ff.

That which moves [something] instrumentally is not able to move [it] unless there be something that moves [something] principally. But if one were to proceed to infinity in movers and moved things, all would be as it were instrumental movers, because were all held to be acting as moved movers, there would be nothing acting as a principal mover. Therefore, nothing will be in motion.³²

Here, St. Thomas introduces the notion of instrumental causality. The ordered universe of instrumental causes cannot be, as it were, all sticks and levers. Indeed, St. Thomas notes that this order of the argument is more evident than the first.³³ Why is the notion of instrumentality clearer than the notion of a secondary mover?

St. Thomas has occasion to discuss instruments in a variety of contexts, from which one can form a more complete notion of what an instrumental cause is.³⁴ First, an instrument possesses in common with a secondary mover that it does not act according to its own natural

32. St. Thomas, *SGC*, I.13, n. 15 (Leon.13.31–32).

33. St. Thomas, *In Phys.*, lib. VIII, lect. 9, n. 5: “Et hoc magis manifestum est in instrumentis quam in mobilibus ordinatis, licet habeat eandem veritatem; quia non quilibet consideraret secundum movens esse instrumentum primi.” (Leon.2.397)

34. The following are certain precisions taken from *loca* where he is considering whether a creature can be granted the power of creation by God, and thus create instrumentally—or rather, organically. His answer is in the negative. The *ratio* of an instrumental cause can be gleaned from his remarks, for to deny the possibility of instrumental creation, the arguments require using the essence of an instrument to manifest the impossibility. Another prime place to discuss the nature of instrumental causality in natural philosophy is, of course, the *De Anima*, since the soul is the very form of an organic (instrumental) body. Apart from natural philosophy, rational psychology, and natural theology, St. Thomas employs this notion of instrumental causality in revealed theology. Yet the occasion for making precisions about instrumental causality is not merely based upon premises available only through faith. Rather, the notion of instrumental causality available to the philosopher enters into these theological arguments in a precise and analogous way, not as a mere metaphor. For instance, St. Thomas considers the notion of instrumentality when discussing the Hypostatic Union and the theandric operations of Christ, the mode of causality belonging to the Sacraments as physical signs productive of what they signify (viz., a spiritual, supernatural effect), as well as the mode in which the glorified bodies of the saints will make use of their senses: see *ST*, IIIa, q. 2, a. 6, ad 4; q. 43, a. 2, c.: “[I]n Christo sint duae naturae, una earum est, scilicet divina, quae fulget miraculis; altera, scilicet humana, quae succumbit iniuriis; et tamen una earum agit cum communicatione alterius, in quantum scilicet humana natura est instrumentum divinae actionis, et actio humana virtutem accipit a natura divina, sicut supra habitum est.” (Leon.11.417); q. 48, a. 6, c.; q. 64, a. 1, c.; q. 65, a. 3, c.; q. 66, a. 1, c.: “In aqua autem non perficitur sanctificatio, sed est ibi quaedam sanctificationis virtus instrumentalis, non permanens, sed fluens in hominem, qui est verae sanctificationis subiectum.” (Leon.12.62); q. 72, a. 3, ad 3: “[M]ateria corporalis non est capax gratiae quasi gratiae subiectum, sed solum sicut gratiae instrumentum.” (Leon.12.128); q. 78, a. 4, c.; *ibid.*, Suppl., q. 82, a. 3, c.

power: the carpenter's hammer does not drive the nail of itself.³⁵ Thus, it retains this power to be a mover only while it retains the influence of the principal agent.³⁶ Furthermore, an instrumental cause exercises its causality through a type of motion.³⁷ The reason why an instrument is used by a principal agent is because of the fittingness of the instrument as a medium between the principal agent and the intended effect; thus, different types of hammers are used in various circumstances.³⁸ This means, crucially, that the instrument is directed towards an end which it does not naturally possess. The hammer is used by the carpenter to realize forms which exceed the power of the hammer to produce on its own, for the hammer of itself cannot move. Scissors themselves, when cutting shapes in paper, do not possess the shape which they effect except through the influence of the principal agent. Nonetheless, the instrumental agent is chosen for its aptitude or fittingness precisely because of some proper action that is connatural to it, which connatural action is proportionate to the intended end.³⁹ Thus, the hammer is chosen for its hardness, or certain types of scissors for their sharpness and size with an eye to the intended incision.⁴⁰

35. St. Thomas, *De Pot.*, q. 3, a. 4, c.: "Instrumentum efficit actionem instrumentalem non per virtutem propriae naturae, sed per virtutem moventis; sicut calor naturalis per virtutem animae generat carnem vivam, per virtutem autem propriae naturae solummodo calefacit et dissolvit."

36. *Ibid.*, a. 11, ad 5: "Instrumentum intelligitur moveri a principali agente, quamdiu retinet virtutem a principali agente impressam; unde sagitta tamdiu movetur a proiciente, quamdiu manet vis impulsus proicientis."

37. St. Thomas, *ScG*, II.21: "Instrumentum autem nunquam adhibetur nisi ad causandum aliquid per viam motus: est enim ratio instrumenti quod sit movens motum. Creatio autem non est motus, ut ostensum est. Nulla igitur substantia praeter Deum potest aliquid creare." (Leon.13.313)

38. *Ibid.*, n. 5: "Instrumentum adhibetur propter convenientiam eius cum causato, ut sit medium inter causam primam et causatum et attingat utrumque, et sic influentia primi perveniat ad causatum per instrumentum. Unde oportet quod sit aliquid recipiens primi influentiam in eo quod per instrumentum causatur. Quod est contra rationem creationis: nam nihil praesupponit."

39. *Ibid.*, n. 6: "Omne agens instrumentale exequitur actionem principalis agentis per aliquam actionem propriam et connaturalem sibi: sicut calor naturalis generat carnem dissolvendo et digerendo, et serra operatur ad perfectionem scamni secando."

40. In the realm of the living, it is most especially the sense organs *qua* material which realize this part of the notion of instrumental causes. That is, the sense organs are used by the soul in an immaterial mode which exceeds the matter of those organs. They possess the sensible object in a way that differs from how the object exists in the thing sensed; see Aristotle, *De Anima* II.5, II.12 and St. Thomas, *Sent. De Anima*, lib. II, cap. 24, (Leon.45/1.169:54–56): "Nam in re sensibili habet esse naturale, in sensu autem habet esse intentionale et spirituale." Consequently, the organs *qua* material fit the character of instruments as discussed below, for they each possess a "materialis immutatio annexa" (which is not sensation!) but which is a necessary

In this way, the *ratio* of instrumental causality is a specification of a secondary mover (all instrumental causes are secondary causes, but not necessarily vice-versa). The instrumental cause possesses the intention of the higher mover in a qualified way, precisely in virtue of being used by the principal agent to the end sought, by an action connatural to itself as instrument, yet exceeding its proper scope. In this way, the inanimate are instruments for the animal, those lacking intellect for those possessing it. The *primum mobile* proven to exist through the arguments in *Physics* VII.1 is undoubtedly a secondary mover in the sense defined here. It remains to be seen whether or not natural philosophy can offer a specification of the *primum mobile* that manifests how it is an instrument—namely, to what end is it directed.

14.2 *The argument from act and potency*

The first argument for the existence of the *primum mobile* is from act and potency. It runs as follows:

It was determined that it is the mobile that is moved, and this is a thing moved in potency, not in actuality; what is in potency, however, goes into actuality; and motion is the imperfect actuality of the mobile. The mover, however, is already in act, as the hot heats and, generally, the thing having the species generates. Whence, the same thing will be hot and not hot in the same way. So too, however, [in the case of] each of those of which it is necessary that the mover have a univocal name. So of the thing moving itself one part moves and one part is moved.⁴¹

condition for sensation itself as an act of the soul; see *Q. De Anima*, a. 13, c. (Leon.24-1.). Indeed, even the external sensible medium possesses the sensed object in an intentional mode; St. Thomas, *Sent. de Sensu*, cap. 4: “Color est quidem in corpore colorato sicut qualitas completa in suo esse naturali; in medio autem incompleta secundum quoddam esse intentionale. Alioquin non posset secundum idem medium videri album et nigrum.” (Leon.45-2.28) Unpacking the implications for natural philosophy (and the philosophy of science) which flow from this intentional mode of being, present in both animate and inanimate instruments, lies beyond the scope of this project. Yet just noting this mode of being serves to indicate that properly understanding the notion of instrumental causality insofar as it exists by nature, and not just as a mode of human activity, is a requirement for an adequate natural philosophy.

41. Aristotle, *Physics* VIII.5, 257b6–13. This text occurs in the middle of Aristotle’s argument that there must be a first immobile mover. It follows upon the determinations Aristotle makes (outlined in the previous section) that it is necessary to arrive at a primary mover which is self-moved. Aristotle intends to show that there must be some immobile mover even of a self-mover. The argument from act and potency, when placed

This argument is the familiar proof St. Thomas borrows for the first premise of his *Prima Via*. It relies upon the definition of motion, the potency of the subject of motion, and the activity of the mover. The mobile as such is only incompletely in act.⁴² Were the mobile in motion in act as its own mover, it would be both in act and in potency at the same time and in the same respect, an impossibility.⁴³ As motion is an incomplete act, a mobile moving itself as a whole (primarily and *per se*) would possess the terminus of its motion both as effect and as cause. Consequently, the agent in question must be other than the supposed self-mover itself as a whole. Thus, this compressed proof of the motor causality principle resolves *not* to a property of mobile beings (as *Physics* VII.1 did, namely to divisibility), but rather to the definition of motion itself.⁴⁴

How can this argument be used to show the existence of a *primum mobile*? First, this argument can be used to establish that causes in motion cannot be primary causes; this is its function in the First Way, for instance. Thus, as Aristotle's arguments against an infinite series of secondary movers are successful, the *primum movens* reached by that argument, one might claim, is a self-mover. The entire cosmos would depend upon an intracosmic first cause, some self-moving body in motion, by this suggestion. However, this is shown to be impossible by the argument from act and potency. The *primum mobile* is, therefore, a thing moved by some part that only induces motion. This mover is later identified as *per se* immobile (258a5ff), and *Physics* VIII.6 argues that it must be wholly immobile, that is, even immobile *per accidens* (258b14–16, 259b21–33). This latter qualification excludes the

in the context of *Physics* VII.1, can be applied to an argument for the first mobile mover. For this purpose, an analogous argument can be drawn from *ScG*, II.22; De Koninck provides the insight for this application, brought to bear within a sweeping range of argument in an early portion of the second part of *The Cosmos*, De Koninck, *Writings*, Vol. 1, 270–75. See also Ide, “La philosophie de la nature de Charles De Koninck,” 462–64, 476–90.

42. St. Thomas, *In Phys.*, lib. VIII, lect. 10, n. 4 (Leon.2.401–402).

43. *Ibid.*

44. This places the argument upon a foundation that is much clearer to us, viz., the general definition of motion and (consequently) nature; Berquist, “The Proof of the First Mover in *Physics* VII, 1,” 47. For this reason, it seems, St. Thomas calls the First Way the “manifestior via,” for it proceeds from principles which are the most manifest to us.

immobile first mover from being something akin to the soul of the outermost celestial sphere. The *primum mobile* is, then, the first among secondary movers. Here again, it does not seem clear that it is only one in number; only, there must be at least one of them.

However, one might object against this that the argument assumes the perfect coordination of movers in motion such that they are all in one system. Akin to the argument from *Physics* VII.1, where an objection was raised that no absurdity arises if the infinite motion be taken to belong to infinitely many and separate mobiles, here the objector demands why the cosmos is arranged out of orderly secondary movers which demand a first.⁴⁵ What necessity forces us to place all the movers in the cosmos in one system of secondary movers?

For this, De Koninck's consideration of the inorganic cosmos as such, found in *The Cosmos*, can provide an answer. The crucial premise is motion cannot exist for the sake of motion. The cosmos as material and mobile, therefore, must be ordered to the immobile, and, more specifically, to a being through which the cosmos is brought to rest: "Man is manifestly the *raison d'être* of the whole of nature."⁴⁶ De Koninck thus adaptively applies to the dynamic order of the massively evolutionary cosmos what St. Thomas applies to the static medieval universe: some intellectual creature must exist in order that the cosmos may be perfect.⁴⁷ To phrase the basis of the argument another way: can the principles of natural philosophy, namely the principles of change for existing mobile beings and the definition of nature, considering in abstraction only the inorganic, be a complete domain of all reality? First, I will provide an exegesis of De Koninck's text, then a summation of the argument.⁴⁸

45. See above, p. 185.

46. De Koninck, *Writings*, Vol. 1, 264.

47. See St. Thomas, *ScG*, II.46 (Leon.13:374–75). See also III.22–23 (Leon.14:52–62). Here I wish to also note that De Koninck stresses, although only as an aside which some interpretation seem to miss, that his treatment of the evolution in the cosmos is based on a hypothesis; *ibid.*, 262–63: "An important point for the form under which we treat this question is that from the existence of the first composite (*supposing that the world had a beginning in time*) all possible natural forms were *given* in the potency of prime matter." My emphasis.

48. The following recapitulates De Koninck's *The Cosmos*, *ibid.*, 270–75; slight alterations were made to the translation based on the French text in De Koninck, *Oeuvres I.1*, 46–50.

The inorganic cosmos is an essentially passive natural mobile system.⁴⁹ Abstracting from organic life, there is no self-mover as such within the cosmos. An entirely inorganic cosmos would still contain natural beings, for the definition of nature is broad enough to countenance active or passive principles and causes of motion and rest. All essentially passive natural mobile systems require a corresponding essentially active cause proportionate to that system.⁵⁰ This is where one applies the argument from *Physics* VIII.5. As a passive nature, the inorganic world could never be in ordered motion. Indeed, it would never move at all. As a consequence, the inorganic cosmos requires a corresponding, essentially active cause proportionate to that system (if the inorganic provided this for itself it would be alive, contrary to the supposition).⁵¹ There cannot be any infinite regress in moved movers as a general truth. When applied to the cosmos in question, the motor causality principle requires that the primary mover be such as to cause motion in the strict sense (in this case, local motions and alterations). The same motor causality principle, manifested through the definition of motion as above, is required to realize the potency of matter as such. The inorganic cosmos under consideration requires a proportionately active cause.

Indeed, not only must this active power exist, it must be the active power of a living being (a self-mover) that is also outside the cosmic order.⁵² Were it not living in some sense, it would stand in need of an active cause. Were it part of the universe, and a body, it would not be a self-mover in the required sense. This source of motion must be separate from the

49. De Koninck, *Writings*, Vol. 1, 272.

50. *Ibid.*, 273.

51. *Ibid.*

52. Previously in his text, *ibid.*, 272, De Koninck notes that “If interiority, self-movement, is the essential character of life, we ought to define the non-living by denying of it all interiority.” Thus, the “life” of this being will be intellectual and not of a merely material order (starting and stopping its own motion, or having nutritive, appetitive, or generative powers). Self-determination or self-motion via immanent interiority belongs most of all to intellect: see St. Thomas, *ST*, Ia, q. 18, a. 3, c.: “Sed quamvis intellectus noster ad aliqua se agat, tamen aliqua sunt ei praestituta a natura; sicut sunt prima principia, circa quae non potest aliter se habere, et ultimus finis, quem non potest non velle. Unde, licet quantum ad aliquid moveat se, tamen oportet quod quantum ad aliqua ab alio moveatur. Illud igitur cuius sua natura est ipsum eius intelligere, et cui id quod naturaliter habet, non determinatur ab alio, hoc est quod obtinet summum gradum vitae. Tale autem est Deus.” (Leon.4.228)

cosmos. Were it not, but an animate cosmic mover, this would go against the hypothesis that living beings had not yet emerged in the cosmos: “The motion of the inorganic world is necessarily presupposed for intracosmic life.”⁵³ Furthermore, prime matter as such requires an active principle of this kind. The implication is that the underlying sheer potency for material beings cannot itself be the subject for a primary agent principle within the cosmos, for such a being would be subject to the same passive limitations consequent to prime matter.⁵⁴

This last argument requires that we understand what St. Thomas says of potency to apply also to prime matter:

To every passive potency there corresponds an active power. For potency is for the sake of act, just as matter is for the sake of form. However, it cannot happen that a being in potency be in act unless in virtue of something existing in act. Therefore, potency would be useless [*otiosa*] unless there were the power of an active agent which could reduce it to act. However, nothing is useless in natural things. In this way, we see that all things which are in potency, as the matter of generable and corruptible things, can be reduced to act through the active power which exists in heavenly bodies, which is the first active agent in nature. However, just as the heavenly bodies are the first agent with respect to inferior bodies, so also is God the first agent with respect to the whole of created being.⁵⁵

The context of this argument from St. Thomas is a passage where he is considering the omnipotence of God. The argument concludes that God is the sufficient active cause for the

53. De Koninck, *Writings*, Vol. 1, 273.

54. Ibid.; the relevant passage: “This active power is necessarily the power of a living thing. But this living thing cannot be intracosmic for two reasons: first, because the motion of the inorganic world is necessarily presupposed for intracosmic life, and, in the second place, because it is prime matter, the potency of every natural being which as such and in advance calls for this corresponding active power.” At this point, although De Koninck does not note it, one could refer to what St. Thomas says concerning a self-mover which is not part of the cosmos, *ScG*, I.13: “Et ad hoc dicendum est quod, si primum movens non ponitur motum ex se, oportet quod moveatur immediate a penitus immobili. Unde etiam Aristoteles sub disiunctione hanc conclusionem inducit: quod scilicet oporteat vel statim devenire ad primum movens immobile separatum, vel ad movens seipsum, ex quo iterum devenitur ad movens primum immobile separatum.” (Leon.13.33) Pursuant to Chapter 3, fn. 8, one should note that De Koninck’s speculative indifference here requires that he take the position that physics must provide the philosopher with his entry into metaphysics; see De Koninck, “Abstraction from Matter,” II:60–61, and n. 1: “The mere fact that the possible expression ‘a wholly immaterial substance’ reveals no contradiction does not entail that there can be such a substance.”

55. St. Thomas, *ScG*, II.22 (Leon.13.320–21).

realization of the passive potency of matter. Without His influence, prime matter would exist in vain. Now, if this is the conclusion of the argument, then we seem to have skipped a step and gone too far, for we are trying to establish the existence of a first mobile. De Koninck is aware of this.

We know moreover that the celestial body was in its turn moved by a separate substance, by a pure spirit. If we have, centuries since, abandoned the surpassed astronomy implied by this text of St. Thomas, we have wrongly rejected the philosophical idea beneath the argument. If we cannot put our finger on the intracosmic instrument which serves as the being endowed with the active power necessary to the cosmos, we are no less obliged to affirm its existence.

By that argument we do not mean to establish the identity of this cause—is it God or a created transcosmic being, a species of demiurge? But it does show that the cosmos is open to another world which acts on it. And this cause can only be a living being; it is necessarily a pure spirit, a transcosmic being. For if we placed it within the cosmos, the same problem would arise again.⁵⁶

Thus, while the argument can be taken to “overshoot” and reach the Divine Being, this is not necessary. All that is required at this point is that some entirely immaterial active cause be at work: whether it is God or an angel makes no speculative difference at this point—“*Non differt autem, quantum ad praesentem intentionem.*”⁵⁷ Nonetheless, some return must be made to the cosmos itself. While the separate spiritual cause is sufficient to explain the motion of the inorganic cosmos, how, in fact, does it move the cosmos?⁵⁸

The answer is that it must act on a composite:

56. De Koninck, *Writings*, Vol. 1, 274. Translation slightly modified.

57. This is from the text to which De Koninck refers the reader at the end of the quotation just provided: *ScG*, III.23, the conclusion to St. Thomas’ consideration of whether the heavens are moved by an intellectual principle: “*Non differt autem, quantum ad praesentem intentionem, utrum corpus caeleste moveatur a substantia intellectuali coniuncta, quae sit anima eius, vel a substantia separata; et utrum unumquodque corporum caelestium moveatur a Deo immediate, vel nullum, sed mediantibus substantiis intellectualibus creatis; aut primum tantum immediate a Deo, alia vero mediantibus substantiis creatis; dummodo habeatur quod motus caelestis est a substantia intellectuali.*” (Leon.14.58)

58. It is not a problem that the cosmos, as essentially passive, is dependent upon a supernatural cause. Its motion is nonetheless natural, since it is moved according to its nature as passive, see De Koninck, *Writings*, Vol. 1, 274: “If the cosmos is thus essentially suspended from the spiritual universe, this does not prevent the tides that rise in it from being natural. It is natural for the world to receive its impetus from above. A nature that has in itself only a passive principle of motion is nonetheless nature.”

The spiritual impulse exercised on the cosmos cannot bear directly on prime matter—since it does not have in itself any consistency, and is by definition associated with a form—but on a composite being. Moreover, the pure spirit cannot be the form of a matter. Acting on the cosmos, he unfolds it according to laws inherent in the cosmos, just as the sculptor submits to the exigencies of stone in order to extract his work. But the pure spirit acting on the world does not make a work of art. His influence brings forth natures.⁵⁹

If prime matter as such cannot be acted upon, this is no limitation on the power of the angelic or Divine being responsible for the cosmos, for acting on prime matter itself would be a contradiction in terms. Acting on composites as such as their necessary and sufficient condition of motion, this principal agent therefore uses them as secondary agents. Now, if the transcendent cause acts on a composite in order to be the sufficient for all cosmic motion, then a first mobile nature must exist which is the secondary cause used by the separate first mover ordered to the actuality of motion at least at the inorganic level.

De Koninck's language in this conclusion seems to imply the existence of an instrumental and universal cause that is responsible for the generation of natures. It is through this secondary cause that the *primum movens immobile* "brings forth natures" in the cosmos, as a sculptor through a chisel. Determining the end of this influence would also clarify how the *primum mobile* is an instrumental cause. Yet he himself notes: "It is hard to keep one's mind on this level and not give free rein to imagination which could falsify the idea."⁶⁰ All that is required of the conclusion reached is that the secondary movers exist which are sufficient to produce the arrangement of observed beings and their motions.

Now, the peculiarity of this argument lies in its parameters: the "abstract" universe that admits only of inorganic natures. Does it answer the objection raised above, that the argument for the *primum mobile*, based only on the notion of secondary movers, assumes the perfect coordination of movers in motion such that they are all in one system? Must all secondary movers exist in a perfect, interlocking, "clockwork?? cosmos? It does not seem so.

59. De Koninck, *Writings*, Vol. 1, 274.

60. *Ibid.*, 274–74.

Unlike the defense of Aristotle's argument in *Physics* VII.1, the qualification that can be made here, based upon the evidence, is not that all the secondary movers are as one *per se* system. Rather, the qualification is that all such movers are, alike, secondary movers.⁶¹ They are one in kind, not number (as *Physics* VII.1 supposed). This qualification of the argument based on *Physics* VIII has this advantage over the qualification in *Physics* VII.1: the generic unity of these secondary movers is not a supposition.

De Koninck's argument itself has the advantage of indicating that, if the inorganic had a temporal priority to organic natures in the cosmos, there would have to exist some secondary mover in the cosmos by which the First Mover brings about living beings. Yet given this limitation, the *primum mobile* to which the argument concludes only possesses a very generic nature, that of a secondary, inorganic moved mover. We know very little else about it. Further, given the limitation, living beings might be outside the causality of this *primum mobile*.⁶²

Nonetheless, even if there are numerically many first mobile bodies which are instruments of the First Mover, they could be ordered *per se* or *per accidens* to one another. Some type of convergence proof is required. Whether or not the first mobile body is able to defend the existence of chance on a cosmic scale is another question to be considered. Finally, De Koninck does call the *primum mobile* in this argument an instrument of the transcendent spiritual agent. He also notes that, although we can no longer "put our finger on it," it must be there. While his argument yields very little by way of determinate conclusions, it does provide some basis for further inquiry.

61. A similar point made by Kolbeck, "The *Prima Via*," 180–81.

62. This was, in any event, partially the case even for St. Thomas, who maintained that human beings as such were not subject to causal influence of the celestial bodies; see, for instance, *ST*, Ia, q. 115, aa. 3, 4, and 6.

14.3 The argument from generation and corruption

A second argument for the existence of the first moved mover occurs in *Physics* VIII.6. In context, Aristotle has already attempted to show that motion must be perpetual and has offered arguments that the First Mover must be wholly immobile (in motion neither *per se* nor *per accidens*). He proceeds to show that the first motion belonging to the first mobile mover must be perpetual.⁶³ The reasons he adduces provide us some further clues as to how the *primum mobile* is an instrumental cause, namely, it is that by which the First Mover generates natures in the cosmos.

Aristotle notes that the requirement that there be one mover “which contains [all], and this is beyond each, which thing is the cause of some of them being and some of them not being, and of continuous change,”⁶⁴ is sufficiently fulfilled by one wholly separate and immobile mover. This immobile mover thus bears a fixed relationship to the universe which it moves. The universe, for its duration, is permanently fixed in its reception of the first immobile principle’s causal influence.⁶⁵

Given the wholly immobile mover and the fixed disposition of the cosmos to its influence, the existence of the first mobile is derivable from arguments made for what type of motion the first cosmic motion must be. Aristotle offers two:

63. This argument is summarized as follows by John of St. Thomas, *Curs. Phil.*, II.459b31–46: “[T]um quia primum movens est perpetuum et immobile, ita quod nec per se nec per accidens movetur; ergo id, quod immediate ab ipso est motu, aeternum est. Tum, quia nisi daretur primum mobile, quod sempiterno motu et indefectibili moveretur, non essent perpetuae generationes et mutationes horum inferiorum. Si enim non daretur corpus mobile et variabile et medium inter primum motorem et ea, quae corruptioni sunt subiecta, cum primus motor eodem modo semper se habeat, haec inferiora semper eodem modo se haberent nec variationi essent subiecta.”

64. Aristotle, *Physics*, VIII.6, 259a3–5.

65. St. Thomas, *In Phys.*, lib. VIII, lect. 13, n. 5: “Sed sicut supra dictum est, in rebus naturalibus inveniri debet quidam motus immortalis et incessabilis, et quod totum ens, idest dispositio huius universi, maneat in sua dispositione et in eodem statu. Ex immobilitate enim principii quod ponitur manere immobile, sequitur quod totum universum habeat quandam permanentiam sempiternam, secundum quod continuatur primo principio immobili, recipiendo influentiam ab ipso.” (Leon.2.413)

But indeed, if something is always such, some mover, itself immobile and eternal, it is also necessary that the first thing being moved by this be eternal.⁶⁶

The argument implies that from the *per se* and *per accidens* immobility of the First Mover, which is proven from the continuity and perpetuity of motion in general, the continuity and perpetuity of a single first motion can be deduced.⁶⁷ This seems weak if it tries to infer from “There is perpetuity of motion” to “There is one being that is always moved.” This assumes the numerical identity of some motion. Yet this is only true if from “There is perpetuity of motion in general” we can infer “There is one perpetual motion.” (If there are always people in Times Square, it would not follow that there is one person, Smith, who is always in Times Square.) Consequently, Aristotle seems to be in need of a proof of its numerical singularity, such as the one contained in the determinate Eudoxean cosmology of his time.

The second argument is as follows:

This fact is clear also by this, that not otherwise would there be coming to be and destruction and change in others, unless something moved will move [them]. For what is immobile will move according to the same motion in the same way and according to one motion, insofar as it is not changing at all in relation to the thing moved. However, what is moved by something moved, the latter being moved directly by the immobile, [such a mover], through being related to things in different ways, will not be the cause of the same motion, but, through being in contrary places or species, will yield each of the other things being moved in contrary ways, and at times resting, at times, moving.⁶⁸

The argument assumes, again, the general perpetuity of change. Now, the various changes, especially of generation and corruption, fall into a general pattern. As Simplicius interprets this argument, Aristotle is referring to seasonal cycles of generations and corruptions. He parses the argument as “If there is nothing eternal that both causes motion and is moved,

66. Aristotle, *Physics*, VIII.6, 259a32–260a1.

67. Thus, St. Thomas points out, Aristotle is not arguing in a circle in this chapter; *In Phys.*, lib. VIII, lect. 13, n. 7 (Leon.2.414).

68. Aristotle, *Physics*, VIII.6, 260a1–10.

there cannot always be generation and perishing.”⁶⁹ That is, without a mover that is “in contrary places or species,” the First Mover would cause only one invariant type of change, “insofar as it is not changing at all in relation to the thing moved.” Thus, there would only be generation or corruption, but not both. Following St. Thomas’ paraphrase, we can add that if it is true that the First Mover is an invariant causal influence on the cosmos, an instrument would be required since variable conditions are required for such patterns of generation and corruption.⁷⁰

Now, what excludes the immobile principle from being the immediate cause of generation and corruption? It is because the First Mover’s “*dispositio et habitudo ad mobile*”—its arrangement or disposition and its very bearing upon the things it moves—does not change nor can it be changed, as it is wholly apart from change both *per se* and *per accidens*. Its causality is intensively simple. This seems objectionable. Why can’t the first cause have a simple causality that contains in one way what the cosmic causes can have only in various species? That is, why can’t the First Mover through a simple mode cause diverse effects? This is the limitation of natural philosophy. Since the argument is only considering the conditions for perpetual generation and corruption, it is concluding to an immobile cause of all motion, but still a cause of motion. Detailing a mode of immaterial causality is beyond its principles, so according to its own resources, natural philosophy can only say that the causality of the First Mover is one and simple. Indeed, an immaterial mode of causality can produce diverse effects: an intellect as a cause or knowledge as a cause can produce contrary effects (the doctor’s knowledge can cure or kill). From a consideration of physical causality, however, contrary effects must have contrary causes; the First Mover considered only under this light is cause of motion in one way.⁷¹

69. Simplicius, *On Aristotle’s Physics 8.6–10*, trans. Richard McKirahan, *Ancient Commentators on Aristotle* (Ithaca, NY: Cornell University Press, 2001), 31, see 31–32.

70. St. Thomas, *In Phys.*, lib. VIII, lect. 13, n. 8 (Leon.2.414).

71. Aristotle, *De Generatione*, II.10, 336a32. See also *Physics*, VIII.10, 267b16–17: “Whence, motion alone is continuous according to which the immobile moves. For it is always disposed similarly in itself and is

Why does this prevent it from causing generation and corruption? Aristotle tells us that “nature by the same cause, provided it remain in the same condition, always produces the same effect.”⁷² The first immobile mover cannot itself be subject to the regular variation of substantial generations and corruptions in nature—“contrary effects demand contraries as their causes.” These rising and subsiding patterns of substantial change especially pertain to the living, with their life-cycles, mating and flourishing seasons, and general periods of decline and death—all driven by the accession and recession of the sun, itself eventually moved by the first mobile mover. This rise and fall itself must have a mover to explain it, and a mover capable of contrary effects insofar as they are explainable by physical principles. Hence physical movers, those that can be in motion as movers, are required to physically cause contrary effects—a car must be put in reverse to drive in the contrary direction; the tongue must be placed in opposed positions to pronounce dentals versus guttural consonants; raising or lowering the temperature of an object requires approach or recession of a heat source. Since we observe patterns of substantial generation and corruption in nature, there must be a moved mover—not just an immobile mover—that sustains the pattern of such changes.

De Koninck also comments on an argument of this type in *The Cosmos*. In a section dealing with the question of how the less perfect can be temporally prior to the more perfect, he considers two possible scenarios where generation and corruption occur: in a non-evolutionary universe and in an evolutionary one. In a non-evolutionary universe, the only “ascendance” between kinds is through nutritional assimilation, not evolution.⁷³ In an evolutionary cosmos, however, intra-cosmic, univocal causes could not bring about the emergence of a higher species from a lower species. Some equivocal agency is required.⁷⁴ The key is the argument

always disposed similarly and continuously in relation to the moved.”

72. Aristotle, *De Generatione*, II.10, 336a27-28.

73. De Koninck, *Writings*, Vol. 1, 285.

74. Ibid.

made by St. Thomas:

Nothing acting according to its proper species intends a form higher than its own form, for every agent intends something like itself. However, the heavenly body, insofar as it acts through its motion, intends an ultimate form, which is the human intellect, which, indeed, is higher than every corporeal form, as is clear from the above. Therefore, the heavenly body does not act for generation according to its proper species, as a principal agent, but according to the species of some higher intellectual agent, to which the celestial body is related as an instrument to the principal agent. However, the heavens, insofar as they are in motion, do act for generation. Therefore the heavenly body is moved by some intellectual substance.⁷⁵

The argument concludes expressly to the heavenly bodies being the instrument of some intellectual substance because of the fact that the heavenly body, as secondary mover, is directed to an end which it does not itself realize in its own species or mode of causality.

The basis that must be established for the argument to work is that the heavens are ordered to the generation of the human intellect. Now, in the non-evolutionary cosmos, if the heavens are required for substantial generation and corruption, then they are also ordered to the production of those conditions that sustain the human race. The key is therefore showing that the heavens are required for substantial generation and corruption. If the heavenly bodies of Aristotle and St. Thomas are no longer present, then the key is showing that the first mobile nature is the requisite necessary condition for generation and corruption in the cosmos. However, this was established by the second of Aristotle's arguments presented above. The presence of this order between the secondary agency in the cosmos as a necessary condition and its effect (generation and corruption) is proof both of the intellectuality of the principle moving the heavens as well as the instrumentality of the heavens, provided that all generation and corruption are ordered to the human species.

If the argument is effective for a non-evolutionary cosmos, then *a fortiori* it is effective for the evolutionary cosmos which begins in an entirely inorganic state. De Koninck comments:

75. St. Thomas, *ScG*, III.23, n. 2 (Leon.14.56–57).

This same pressure *naturally* exerted on the cosmos—since natures themselves demand it and a nature is not only a form—suffices to extract from the potency of a composite given at the origin all the forms necessary to achieve the goal. And since this pressure is natural, it must act on natures according to the laws inscribed in them. In this ascendant movement, by which more perfect beings are drawn from imperfect composites, the given and intracosmic composite is only an instrument, the spiritual agent being the principal cause. Spiritual pressure would not extract any nature whatever from no matter what composite. The instrument, even while producing under the influx of the principal cause an effect superior to itself, entails however essential limits. The more perfect the engendered substance, the more perfect instruments will they be in their turn.⁷⁶

Here, the separate intellectual causality, acting in the mode of nature on cosmic composites, uses “the composite given at the origin” of the cosmos as its temporally first instrument. The evolutionary process which results, given a form as a process from the laws inscribed within the natures of the progenitor species, gives the First Mover more and more perfect instruments (more perfect non-living and, eventually, living species) by which to produce the intended end: the human being.⁷⁷ While De Koninck has performed the necessary key

76. De Koninck, *Writings*, Vol. 1, 286. In his footnote, De Koninck cites various texts from St. Thomas affirming that the heavens were moved by separate substances (angels) or God as instruments: “St. Thomas along with the ancients thought he recognized in the celestial bodies the instrument used by the spiritual substance directing the cosmos. . . . [C]orpus caeleste etsi non sit vivum, agit tamen in virtute substantiae viventis a qua movetur, sive sit Angelus, sive sit Deus. . . . virtus substantiae virtualis moventis relinquitur in corpore caelesti et motu eius, non sicut forma habens esse completum in natura, sed per modum intentionis, sicut virtus artis est in instrumento artificis.’ . . . If we are today incapable of identifying that instrument, we are no less obliged to affirm its existence.” The two passages from St. Thomas are from *De Pot.*, q. 3, a. 11, ad 13 and ad 14. Both the English and French editions identify a. 12, but this is incorrect.

Note that this “pressure” on the cosmos from without arises from an intellectual agency. As noted above, p. 247, intellect, since it is immaterial, can be the cause of contraries, since the intellect as a power is open to contrary states; see Aristotle, *Metaphysics*, IX.9, in particular 1046b5–24. See also St. Thomas, *In Meta.*, lib. IX, lect. 2, nn. 1789–93.

77. By “according to the laws inscribed in them [Aristotelian natures],” De Koninck seems to mean something different than the invariant laws of mathematical physics, for these latter are constituted by a different mode of thought. The statistical laws of physics could be related to natures in the Aristotelian sense insofar as nature is not a completely deterministic principle. De Koninck treats this division (laws of identity or conservation laws and statistical laws) in his dissertation on Eddington, in *Ibid.*, 131–38. For instance, the first type of invariant conditions (the conservation of momentum and energy) would be expressed in the mathematical laws describing the varying distances of the earth-sun-moon system which creates conditions for biological generation and corruption. The second type, statistical laws dependent upon the stability of natures, would be used by astronomers when they measure the spectral shift of light from distant stars based upon the emission or absorption lines of certain elements present in a spectrograph. By comparing these spectra from Earth-based sources to stellar sources (and assuming the constancy of behavior over

change to transpose St. Thomas' argument from the static Aristotelian cosmos to the modern evolutionary one, the instruments of the transcendent active cause still require conditions of generation and corruption. Some secondary, instrumental cause of this sort must exist. Further, even the non-evolutionary cosmos requires the presence of conditions that permit a continuity of generation and corruption. In either case, this cosmic condition requires the First Mover to operate on the cosmos through a medium, a prime mobile nature, which is both secondary cause and instrument.

14.4 *The conclusion, its scope and limitations*

The arguments above concluded to the existence of a first mobile nature. The general consideration of primary and secondary movers demonstrates that a cosmic series of secondary time as well as the presence of these known elements in stars), the shift is able to be measured. This is a key assumption in modern cosmology: the constancy of natural laws and the stability of the natures of the elements.

St. Thomas comes closest to the modern sense of a mathematical or statistical "law" in texts where he alludes to Anselm's *Monologion*, c. 22; see St. Thomas, *ST Ia*, q. 53, a. 2, c.: "Hoc autem, scilicet moveri de extremo in extremum et non per medium, potest convenire Angelo sed non corpori. Quia corpus mensuratur et continetur sub loco, unde oportet quod sequatur *leges loci* in suo motu. Sed substantia Angeli non est subdita loco ut contenta, sed est superior eo ut continens, unde in potestate eius est applicare se loco prout vult, vel per medium vel sine medio." (Leon.5.33) See also *In I Sent.*, d. 37, q. 2, a. 1, obj. 3. The sense of De Koninck's use of "laws inscribed in [natures]" is closer to the meaning of St. Augustine's *rationes seminales* and St. Thomas' redefinition of nature in terms of a divine art "indita rebus." This second source—see St. Thomas' gloss on *Physics* II.8, 199b27–32, *In Phys.*, lib. II, lect. 14, n. 8: "Unde patet quod natura nihil est aliud quam ratio cuiusdam artis, scilicet divinae, indita rebus, qua ipsae res moventur ad finem determinatum: sicut si artifex factor navis posset lignis tribuere, quod ex se ipsis moverentur ad navis formam inducendam." (Leon.2.96)—or nature as a "divine *logos*," De Koninck takes as his basis in a text quoted below in Chapter 6, at the end of §22.5, see p. 379. St. Augustine's seminal reasons are alluded to by De Koninck later in *The Cosmos* when discussing how this evolutionary progression leads to the human body; see De Koninck, *Writings*, Vol. 1, 290: "If by the human body we understand a subject disposed *ultimate dispositione*, we should then indeed say with St. Augustine and St. Thomas that this body was in the potency of matter from the very origin *secundum rationes causales*. And by these *causal reasons* we understand the initial composite (matter and form) of the cosmos, its ultimate end (man), [and] the efficient cause (the spiritual agent and the composite)." See *ibid.*, fn. 95 and 96, where De Koninck refers us to St. Thomas in the following places: *De Pot.*, q. 4, a. 2, ad 20 and 28; *ST Ia*, q. 65, a. 4, c. and ad 2; *ScG* III.24.

De Koninck notes that the path which this evolutionary process takes is indeterminate both in itself and with respect to the general concepts available to the natural philosopher. Only the goal (an intellectual organic being), is certain. The trajectory "entails deviant ramifications and failures" and, *ibid.*, 285–86: "it is for experimental science to find the traces, to reconstitute the ways which have in fact been followed, and to deduce from them those which ought to have been followed to attain the end actually realized." Here, then, is a possible sapiential relationship for natural philosophy: it draws from the results of evolutionary science to explain what it knows in a general and more certain fashion.

movers cannot be infinite. The argument from act and potency shows that the universe could not be a self-sustaining system; some purely active mover is required. This conclusion is sharpened by considering the passivity of the inorganic cosmos as such; indeed, as De Koninck points out, the composite nature of mobile being, rooted in a pure passive potency, requires a corresponding purely active potency. This results in the conclusion that the First Mover acts upon at least a general kind of being: the secondary movers in the cosmos.

The further considerations of the existence of generation and corruption in the cosmos showed that some first mobile nature is required. This argument, whether on the supposition of an evolutionary or non-evolutionary cosmos, shows that the first mobile nature is an instrument of the First Mover, insofar as the first mobile is the necessary condition for generation and corruption in the cosmos as well as the fact that this generation and corruption is all ordered to the production of the human intellect. This argument is much more closely tied with determinate ideas in cosmology and even biology. Here, more determinate studies in natural science are required to inform general natural philosophy.

In both arguments, the number of the first mobile is left indeterminate, because it is only considered under the notion of a necessary secondary mover. Further, the motions that lead to this conclusion include varying patterns of generations and corruptions. The conditions for these must still be explained. Now, the conditions required for generations and corruptions are (1) the presence of fit composites that serve as the matter out of which a new substance is generated and (2) the environmental circumstances that sustain the accidental changes leading up to the generation or corruption. If we now know that matter throughout the whole cosmos is subject to generation and corruption (not just a limited terrestrial region), it is now the whole cosmos that requires dispositive causality for such changes, even if—as seems likely—the changes as a sum total have a very indeterminate and accidental relationship to each other (as opposed to the more determinate relationship exhibited between the celestial spheres and generation and corruption in the terrestrial region).

§15 THE DETERMINATE FEATURES ASSIGNED TO THE FIRST MOBILE BODY FROM THE ARISTOTELIAN THEORY ABOUT COSMIC SOURCES OF GENERATION AND CORRUPTION ARE NOT PERENNIAL OR PRIMARY CONCLUSIONS. (*De Caelo* BOOK II.3 AND *De Generatione*, BOOK II.10–11)

Motion is compared by likeness to the life of natural bodies, not in a proper sense. For the motion of the heavens in the universe of corporeal natures—just as the motion of the heart in an animal—is that by which life is preserved.

ST. THOMAS
ST, Ia, q. 18, a. 1, ad 1

The arguments which can be advanced, based only on the resources of general natural philosophy, in defense of the determinate nature of the *primum mobile* are clearly limited. Aristotle tried, in his primitive cosmology and chemistry, to propose more determinate theories about the nature of the *primum mobile* and its causality. This causal role was developed in medieval cosmology to include the notion that the celestial spheres were universal, equivocal causes.

15.1 *The causality of the celestial spheres*

St. Thomas draws the distinction between something universal in predication and universal in causality in various places, including his commentary on the *Physics*. St. Thomas hints that the two correspond to each other, but only “in a certain way.”

It should be noted, however, that a universal cause and a proper cause, or the prior and the posterior, can be taken either according to a community of predication (according to the examples given here of the doctor and artificer), or according to the community of causality, as when we call the sun the universal cause of heating, but fire the proper cause. And these two correspond to each other.

For it is manifest that what power soever extends to things insofar as they share in the nature of an object; and to the degree that it extends to more things, so much the more is it necessary that the nature be the more common. Since the power is proportioned to the object according to its nature, it follows that the superior cause acts according to a more universal and less contracted form. And this can be seen in the order of things, that the more some things are superior

among beings, so much the more do they have forms which are less contracted and more dominating over matter, which limits the power of form. Whence also that which is prior in causality is found to be prior in a certain way according to the order of universal predication, as for instance, if fire is the first agent of heating, then the heavens are not only the first in heating but also in altering.⁷⁸

It is clear that St. Thomas' exposition relies upon purported discoveries made further along the way in natural scientific inquiry. We must attend, therefore, to how the distinction between the two types of universality is made. A commentator notes:

It is the universal *in praedicando* which, as it is the more general, is also the more potential, but the order of universal causes bears no resemblance to the intentional order in this respect. The more universal cause has a more universal form, but it is at the same time more actual and dominant in its causality.⁷⁹

The intentional order increases in potency as its generality increases—this is characteristic of genera, viz., that they contain their species in potency. However, the causal order increases in actuality as the generality of its scope increases. A more universal agent, such as Aristotle's sun, would not only be the cause of heat along with fire but also the cause of alteration. The natural philosopher in his order of inquiry not only searches for proximate causes of heat, but also universal causes or conditions of heat in the cosmos, if they exist. What this is or what it is like, the discoverer could only guess at beforehand.

The causality of the celestial spheres and their influence on the terrestrial region is a broad topic in medieval cosmology.⁸⁰ The spheres were assigned responsibility for phenomena which were accounted beyond the power of the elements to produce, such as magnetism and spontaneous generation.⁸¹ They also exercised an influence on every generation and motion

78. St. Thomas, *In Phys.*, lib. II, lect. 6, n. 3 (Leon.2.73).

79. McArthur, "Universal in Predicando, Universal in Causando," 93.

80. Grant, *Planets, Stars, and Orbs*, 569: "If celestial motion and its causes represented the category with the greatest number of cosmological questions, the second largest category was easily the influence of the celestial region on the terrestrial."

81. Litt, *Les corps célestes*, 113–29, 130–43; for instance, consider St. Thomas, *ScG*, II.68: "Super has [aliquas infimas formas] inveniuntur formae mixtorum corporum, quae licet non se extendant ad aliqua operata quae non possunt compleri per qualitates praedictas, interdum tamen operantur illos effectus altiori

in general.⁸² The celestial bodies are also the equivocal, universal causes of the species of generated things.⁸³ They use the elements as instrumental causes, and are themselves used by separate substances as instruments, whether for generation and corruption or other motions, such as that of the tides.⁸⁴ These cosmological theories, as discussed in §11, stand or fall with the observations upon which they depend. Nonetheless, it is instructive to consider a few precise points of concretion or determination which Aristotle's cosmology offered when discussing the causal role of the *primum mobile*.

15.2 *The elements and their causes in Aristotelian cosmology*

In *De Caelo* II.3, Aristotle asks why there are many motions in the heavens besides the diurnal motion. He answers with a teleological argument.⁸⁵ The argument has six steps;

virtute, quam sortiuntur ex corporibus caelestibus, quae consequitur eorum speciem: sicut adamas trahit ferrum.” (Leon.13.441) Also, *ibid.*, III.104, n. 10: “Viventia perfecta non solum generantur virtute caelesti, sed etiam ex semine: homo enim generat hominem et sol. Quae vero ex sola virtute caelesti sine semine generantur, sunt animalia generata ex putrefactione, quae inter alia ignobiliora sunt.” Also, *De Pot.*, q. 6, a. 6, ad 10: “[C]orpora caelestia etiamsi non sint animata, moventur a substantia vivente separata, cuius virtute agunt, sicut instrumentum virtute principalis agentis; et ex hoc causant in inferioribus vitam.”

82. Litt, *Les corps célestes*, 143–46, 146–48; for instance, consider St. Thomas, *De Pot.*, q. 3, a. 7, c.: “Et propter hoc nihil agit ad speciem in istis inferioribus nisi per virtutem corporis caelestis, nec aliquid agit ad esse nisi per virtutem Dei.” Also, *ScG*, III.149: “Nullum agens particulare potest universaliter praevenire actionem primi universalis agentis: eo quod omnis actio particularis agentis originem habet ab universali agente; sicut in istis inferioribus omnis motus praevenitur a motu caelesti.” (Leon.14.439)

83. Litt, *Les corps célestes*, 149–73.

84. *Ibid.*, 174–85. For instance, see St. Thomas, *ScG*, II.21; *De Pot.*, q. 4, a. 1, ad 20: “Quod autem in elementis ex impressione caelestium corporum accidit, non est contra naturam, ut dicit Commentator in III *De Caelo et Mundo*, ut patet in fluxu et refluxu maris; qui licet non sit naturalis motus aquae, in quantum gravis est, eo quod non est ad medium, est tamen naturalis motus eius in quantum est a corpore caelesti mota, sicut eius instrumentum.” Consider also St. Thomas' *De operationibus occultis naturae ad quendam militem ultramontanum*. These conclusions about the physical causality of the heavens were based upon astronomical observations and their correlations to patterns of change on Earth. This wide range of details about celestial causality arose as part of a tradition interpreting Aristotle's arguments in *De Caelo* and *De Generatione*, as well as his famous dictum that “man and the sun beget man.” (Aristotle, *Physics*, II.2, 194b14.) While at the minimum this dictum implies that celestial conditions, in particular the Sun, were necessary for living beings, “there was often a tendency to overemphasize the causative role of the celestial region, to the detriment of terrestrial causation.” (Grant, *Planets, Stars, and Orbs*, 579.) The Sun was assigned as cause of the change in seasons and cycles of generation and corruption attendant to these. The Moon took responsibility for the tides, and (based on this tie to influence on water) also took the blame for the state of humors in animals; the various planets also had unique roles (see *ibid.*, 576–79).

85. Mariska E. M. P. J. Leunissen, “Why the Stars Have No Feet: Explanation and Teleology in Aristotle's Cosmology,” in *New Perspectives on Aristotle's De Caelo*, ed. Alan C. Bowen and Christian Wildberg

Aristotle introduces them in a synthetic order (286a7–286b4), arguing for each step, and then summarizes them in an analytic order.⁸⁶ This is the analytic conclusion:

For the present so much is clear, that the reason why there is more than one circular body is the necessity of generation, which follows on the presence of fire, which, with that of the other bodies, follows on that of earth; and earth is required because eternal movement in one body necessitates eternal rest in another.⁸⁷

The synthetic order in which Aristotle presents the six steps, from the first principle to the desired conclusion, is given by St. Thomas as follows:

He makes the following argument: (1) If the heavens is a certain divine body, it is necessary that its motion be eternal and circular. (2) If its motion is eternal and circular, it is necessary that earth exist. (3) If earth exists, it is necessary that fire exists. (4) If fire and earth exist, it is necessary that the other bodies in between exist. (5) If there are bodies of this kind, however, it is necessary that

(Leiden/Boston: Brill, 2009), 224, notes, following Simplicius, that Aristotle “*must* refer to teleology here, since material causes alone cannot account for the differences in locomotions in the heavens (for all spheres are made from the same material, which is aether).” It is important to note that Aristotle offers in this context a defense of the knower’s “epistemic modesty,” who nonetheless remains undeterred from seeking further knowledge: “We have to pursue our inquiries at a distance—a distance created not so much by our spatial position as by the fact that our senses enable us to perceive very few of the attributes of the heavenly bodies. But let that not deter us.” (Aristotle, *De Caelo*, II.3, 286a4–6.) The phrase “epistemic modesty” is found in M. F. Burnyeat, “Introduction: Aristotle on the Foundations of Sublunary Physics,” in *Aristotle’s On Generation and Corruption I Book 1*, ed. F. A. J. De Haas and J. Mansfeld, Symposium Aristotelicum (Oxford: Clarendon Press, 2004), 15: “*De Caelo* I contains an unusually high number of occurrences of words like εἰκότως and εὐλόγον which express epistemic modesty: this or that is a *reasonable* thing to believe.” Leunissen, “Why the Stars Have No Feet,” 223: “Interestingly, the other two teleological explanations that stand on their own and explain the presence of heavenly phenomena are also immediately preceded by a discussion of the methodological problems related to this very enterprise of providing explanations in the strong sense for phenomena at such a remove (see *De Caelo* 2.5, 287b29–288a2; 2.12, 291b24–28, 292a14–18). In all these methodological introductions, Aristotle expresses his conviction that, even though the empirical evidence is scanty, it is still possible to state the phenomena; and that given all the limitations, the explanations offered are the best ones possible.” Bolton, “Two Standards for Inquiry,” 81, likewise notes this epistemic modesty; he argues it is in line with Plato’s offering an εἰκῶς μῦθος found in the *Timaeus*, but Aristotle, maintaining that natural philosophy is a science, “felt the need to use and emphasize in the *De Caelo* the distinction, which is entirely absent in Plato, between εὐλόγος and φυσικῶς procedure in the study of the natural world.” This dialectical cast of the argument indicates replaceable details relying upon prior, more certain determinations.

86. St. Thomas, *In De Caelo*, lib. II, lect. 4, n. 4: “Et primo assignat eam per viam compositionis, procedendo a primo ad ultimum quod quaeritur; secundo per viam resolutionis, procedendo ab ultimo quod quaeritur usque ad primum, ibi: nunc autem tantum manifestum est et cetera.” (Leon.3.136)

87. Aristotle, *De Caelo*, II.3, 286b5–9.

generation exist. (6) However, if generation exists, it is necessary that there be many motions in the heavens, and consequently many mobile bodies.⁸⁸

The necessity present in each step is not of the same type. Steps (1), (2), (3), (4), and (6) are hypothetical necessity (“In order that *A* exist, it is necessary that *B* exist”); step (5) uses material necessity (“If *C* exists, then *D* must exist”).⁸⁹ Thus, the synthetic mode of the argument presents teleological reasoning sandwiching an argument about what follows upon matter as a cause: “[T]he use of the teleological principle allows Aristotle to draw an organic picture of the cosmological system in which all the observed motions can be explained by the purpose they serve.”⁹⁰ The picture Aristotle is trying to draw is complex and the teleological capstone that gives the motion of the heavenly body a purpose beyond itself is of keen interest.

The first step maintains that if the heavenly body exists, then eternal, circular motion must exist. It follows upon the general teleological principle that “everything which has a function exists for its function.”⁹¹ If the heavenly bodies are divine, viz., imitating the divine activity of God (which is eternal life), then they must possess an eternal motion, and thus, a circular motion. Just as the bird’s end is essentially to be a flying thing, and consequently requires wings, so also the heavens, to fulfill their function as an eternal, divine body, require an eternal motion.⁹² The second step argues that if the heavens possess an eternal circular

88. St. Thomas, *In De Caelo*, lib. II, lect. 4, n. 4 (Leon.3.136). I have inserted numbers for clarity.

89. Leunissen, “Why the Stars Have No Feet,” 225–26 and fn. 24. Leunissen maintains that steps (3) and (4) use material necessity; however, based upon the understanding of the argument given by St. Thomas, it seems these steps actually imply teleological necessity. The “*via compositionis*” and “*via resolutionis*” of the argument and its summary, respectively, are not the same as the type of necessity within each step.

90. *Ibid.*, 226–27.

91. Aristotle, *De Caelo*, II.3, 286a7–8.

92. Leunissen, “Why the Stars Have No Feet,” 224–25, who refers us to *De Partibus Animalium*, IV.12, 693b6–14, where Aristotle uses the analogous reasoning about the bird. In the background to this teleology of function are the foundational texts in *Nicomachean Ethics*, I.1, and *De Anima*, as St. Thomas notes, *In De Caelo*, lib. II, lect. 4, n. 5: “Hoc igitur modo etiam Aristoteles hic loquitur, dicens quod unumquodque quod habet propriam operationem, est propter suam operationem: quaelibet enim res appetit suam perfectionem sicut suum finem, operatio autem est ultima rei perfectio (vel saltem ipsum operatum, in his in quibus est aliquod opus praeter operationem, ut dicitur in I *Ethic.*); dictum est enim in II *De Anima* quod forma est actus primus, operatio autem est actus secundus, tanquam perfectio et finis operantis. Et hoc est verum tam

motion, then a heaviest element must exist. That is, there must be a center of the universe about which the heavens can move—for they themselves cannot be naturally in the center and hence some other body must provide fixity for the center of their motion.⁹³ Aristotle notes that he is assuming the rest of the earth at the center and will prove it later. If earth exists to provide fixity, then the element contrary to earth must also exist. St. Thomas notes that, were fire not present, the common material subject of contraries would exist “in vain,” and that the existence of the worse contrary implies the existence of the better.⁹⁴ Aristotle notes that the mutual implication of contraries must be shown later. As a consequence, the fourth step can maintain that if the extremes (earth and fire) exist, so also must the intermediate elements to which these are contrary, by a reasoning similar to step three. Did the other contraries not exist, those that did exist would exist in vain—unable to fulfill their natural operations of acting and being acted upon. The fifth step is the first to use material necessity as a principle, viz., that necessity which follows upon the nature of contraries. Since there exist contraries, they will act and react upon each other based upon their material nature (at the very least, not considering higher-order efficient causes); consequently, since the elements exist, generation and corruption will exist.

After this fifth step, Aristotle returns to the line of hypothetical reasoning. If there is generation and corruption, then there must be many heavenly motions to sustain it, “for a single movement of the whole heaven would necessitate an identical relation of the elements

in corporalibus quam in spiritualibus, puta in habitibus animae; et tam in naturalibus quam in artificialibus.” (Leon.3.136)

93. This image of an omnidirectional, cosmic ball-joint was the source of many medieval disputes regarding the immobility required for place in general. Was it founded in the heavens or on earth? Did the heavens depend upon the earth for their place or vice-versa? See Duhem, *Medieval Cosmology*, 139–78; Grant, *Planets, Stars, and Orbs*, 122–35. The Condemnations of 1277 in particular targeted the implication (whichever side was correct) that God could not move the heavens with a translational motion; Duhem, *Medieval Cosmology*, 181. This theological pressure led to the development of alternate theories of place, *ibid.*, 361–62. Duhem notes that the mathematical-mentalization of place was followed by the elimination of a universal, absolute clock (*ibid.*, 362, and see 295–61 generally), and as a consequence, the real existence of immutable magnitudes of unit length in the universe, and lastly, number.

94. St. Thomas, *In De Caelo*, lib. II, lect. 4, nn. 7–8 (Leon.3.137).

of bodies to one another.”⁹⁵ St. Thomas comments:

Seeing that the first circular motion which belongs to the highest sphere revolving the entire heaven from east to west is uniform, it would not cause diverse dispositions in inferior bodies. Thus, the corporeal elements and the other simple bodies would be similarly disposed to each other. Whence, generation and corruption would not exist. And this will be made clear later, namely, in *De Generatione*, Book II. Whence it is necessary that there be another motion, which is the one through the ecliptic [*obliquum circumulum*], which properly causes generation and corruption through the elongation and approach of the planets to us, just as the first motion causes permanence and eternity in things.⁹⁶

Since generation and corruption require bodies to be variously disposed towards each other, there must be a sufficient condition for these dispositions to occur. The diverse celestial spheres provide these varying conditions.

Aristotle’s argument, then, clearly relies both upon prior determinations in the *Physics* and the *De Caelo*, as well as upon ones which are determined later in the *De Caelo* and even the *De Generatione*. The argument’s steps are also based upon teleological reasoning and imply later determinations about the material causes which fulfill these ends (e.g., the fixity of the earth at the universe’s center). The only thread of the argument that does not depend upon determinate ideas in cosmology is the need for generable and corruptible bodies in the cosmos to be provided with necessary conditions for their generation and destruction. Consequently, the details of the cosmology can be removed without harming the more general argument. Just as indeterminate knowledge about the nature of the *primum mobile* in *Physics* VII provides a principle for further cosmological study, so also the indeterminate knowledge of the cosmic conditions for generation and corruption in *Physics* VIII is a principle for further study.

95. Aristotle, *De Caelo*, II.3, 286a2–3.

96. St. Thomas, *In De Caelo*, lib. II, lect. 4, n. 12 (Leon.3.138). Without this motion, St. Thomas concludes, in a proto-heat death theory, that the elements would cease to interact with each other; *ibid.*, n. 13. While St. Thomas appeals to the motion of the planets, the effect of the sun in this regard is much more incontrovertible.

15.3 *The first moved mover and other causes in Aristotelian cosmological chemistry*

This general argument from the *Physics*, made somewhat more determinate in the *De Caelo*, is given its final form by Aristotle in *De Generatione* II.10. Aristotle begins by noting what he has already proven or discussed: the nature of change and its principles, the continuous and eternal existence of motion, the priority of local motion to generation and corruption, and the priority of one local motion that sustains generation and corruption.⁹⁷ Because of these things, it follows that the generator of the elements can sustain that change through a local motion of approach and recession.

He takes this as an occasion to manifest how this explains why many motions exist in the heavens. The basic principle guiding the argument is first repeated.⁹⁸ As discussed in §14.3, the requirement is that there be a variable cause for variable effects. Nature (unlike intellect) is as cause determined to one. Hence physical causes must themselves change to cause contrary effects. The main argument is then presented.⁹⁹ Aristotle makes a cosmological precision: it is not the motion of the highest sphere which causes generation and corruption proximately, but the motion of the Sun and planets along the ecliptic. Only these motions possess the necessary correlative patterns to explain the observed patterns of continuous generation and corruption. These seasonal and life-cycle changes are most of all tied to the motion of the Sun. Now, while the *per se* causality of the celestial body is given a character that, in point of fact, is due to the contingent arrangement of the earth's axial inclination to its orbital plane, the *conditions* described are still necessary to explain the various observed patterns of change.

St. Thomas adopts this cosmological foundation for chemical and substantial change. His presentation lends itself to more clearly grasping the argument's perennial character:

97. Aristotle, *De Generatione*, II.10, 336a13–23.

98. *Ibid.*, 336a25–32.

99. *Ibid.*, 336a32–b35.

An active principle is not found in the lower bodies except for the active qualities of the elements, which are hot and cold and the like. And if it were the case that the substantial forms of lower bodies were not diversified except by accidents of this sort (the ancient natural philosophers maintained rarity and density to be the principles of these bodies), it would not be necessary to posit some active principle above these lower bodies, but they themselves would suffice in regard to acting. But, when rightly considered, it is clear that accidents of this sort are related as material dispositions to the substantial forms of natural bodies. Therefore, it is necessary to posit some active principle beyond these material dispositions.

Whence the Platonists posited separate species according to participation in which the inferior bodies obtained substantial forms. But this does not seem to suffice. Because the separate species always maintain themselves in the same way, since they are immobile, and thus it would follow that there would not be any variation in generation and corruption in the lower bodies, which is clearly false.

Whence, according to the Philosopher in *De Generatione*, Book II, it is necessary to posit some active mobile principle which causes, through its presence and absence, the variation in generation and corruption of the lower bodies. And the celestial bodies are of this sort. Therefore, whatsoever thing generates [another] among lower bodies is moved to its species as an instrument of the celestial body, as is said in *Physics*, Book II, that man and the sun generate man.¹⁰⁰

St. Thomas begins with a “principle of holistic generation.” The active qualities of lower (terrestrial) bodies are the instruments through which they act upon each other. However, since it is not the case (as the Pre-Socratic natural philosophers maintained) that the forms of substances are merely accidental forms, the elemental qualities are not sufficient to explain the generation of substantial forms of natural bodies (e.g., elements, plants, or animals). Merely accidental active agencies such as heat or weight suffice only for accidental changes. The generation of a substantial form is not an accidental change, although it requires dispositive accidental changes. These dispositive changes thus relate as the material dispositions for the substantial forms of things. As a consequent of the motor causality principle (argued through the middle term of act and potency), some active cause must exist beyond the elemental qualitative powers. St. Thomas notes that this active causality cannot be provided

100. St. Thomas, *ST*, Ia, q. 115, a. 3, ad 2 (Leon.5.542).

by an invariant cause such as the Platonic Forms. Rather, a principle that is proportionate to the physical order, and itself variable, is needed. This is provided by the variable celestial bodies in Aristotelian-medieval cosmology. However, it is unclear what would replace this particular determination of the general requirement that follows upon this account of holistic generation.

15.4 *Separating the perennial from the passing*

In summary, the preceding excursus into the determinate theses of Aristotelian cosmology has shown that it is possible to separate the arguments in the *De Caelo* and *De Generatione* from the arguments in the *Physics* concerning secondary movers and the role which the *primum mobile* plays in generation and corruption. The more determinate arguments all depend upon assumptions taken for granted by Eudoxean astronomy. Consequently, as were the arguments in Chapter 3, they can be severed from the more general arguments made in the *Physics*.

What remains of the primitive cosmological foundation for chemical interaction is the assumed reality of generation and corruption and the argument that they require conditions under which to occur. Thus, at a minimum, the instrumentality of the *primum mobile* is required to provide these cosmic conditions. At this point, perhaps the natural philosopher could guess that subordinate motions in the cosmos depend upon or use the motion of this first moved mover to provide the proximate conditions for generations and corruptions. For instance, whatever the *primum mobile* is specifically, it must allow the sun–earth–moon system to interact as it does and produce varying conditions for substantial changes. It may be—although this is not something determinable by general natural philosophy—that the cosmic timeline is not infinite (or circular) and static, but linear and evolutionary, in which case the function of the *primum mobile* would be identified by those sciences making more determinate conclusions about the cosmos and the historical route taken to its *telos*.

§16 THE CONCLUSION REACHED IS ATTENDED BY SOME PROBLEMS NEEDING RESOLUTION, BUT HAS ACHIEVED KEY RESULTS.

As a result of the arguments made in §§13–15, the existence of a *primum mobile* has been demonstrated. Yet the nature of the argument necessarily left the conclusion indeterminate.

The results are as follows:

1. The *primum mobile* exists.
2. The *primum mobile* is a secondary cause.
3. There must be at least one *primum mobile*.
4. The *primum mobile* is the first intracosmic necessary condition for the actuality of motion.
5. The *primum mobile* is the first intracosmic necessary condition for cosmic generation and corruption.
6. As the necessary condition for cosmic generation and corruption, the *primum mobile* possesses its own motion that is used instrumentally by the principal cosmic agent.

Given that the investigative arc of natural philosophy seeks the first principles, causes, and elements of nature as its goal, the inquirer immediately wants to go beyond the above conclusions. If, from a logical standpoint, this requires the use of a separate science or a separate part of the same science, then our conclusions serve as principles for that inquiry. Aristotelian and medieval cosmology attempted to provide these more determinate conclusions. However, these more determinate theories have called the wrong man “Dad.” They proceeded beyond the general and certain, but indistinctly known, conclusion of general natural philosophy without proper warrant.

While the arguments conclude to the existence of a first mobile nature as a secondary cause, its precise species remains undetermined. Its number is also indeterminate from this argument, precisely for the reason that the argument utilized a generic kind (“secondary mover”) to resolve to a primary mover. If the corollary from the unity of time is borrowed

from above, we can conclude that there must be only one such first, instrumental mobile mover.¹⁰¹ While the argument from Chapter 4 did not need a contrary-to-fact supposition as did the main argument in Chapter 3, the arguments that support the idea that the first mobile is an instrumental cause do make certain suppositions. De Koninck's suggestion in the *Cosmos* is based on the hypothesis of a universe in an initial inorganic state. A new inquiry must provide specific details.

One area in which such an inquiry will be needed regarding the specific topic of this chapter is how the generation and corruption of the elements is sustained in the cosmos. Are there no chance occurrences in the heavens? The reason why this was thought to be the case was due to the nature of the aether which composed the heavenly bodies: since generation, corruption, alteration, or growth are not possible in heavens composed of such a matter, but only determinate local motions, there is no room for the material indeterminacy requisite for chance occurrences.¹⁰² However, if the heavens were not so determined by their material nature but shared a common nature with the terrestrial elements, chance would exist in the motions of the heavens. Because secondary, instrumental, cosmic movers require a first, principal, and transcendent agent, the question raised in §3.3 concerning the priority of the *per se* to the *per accidens* has been settled. Whatever the *primum mobile* is exactly, its existence is still necessary as a *per se* condition of generation and corruption, even if it gives a wide berth to indeterminate causality.

101. See §12 above, and also p. 150.

102. See St. Thomas, *In De Caelo*, lib. II, lect. 9, n. 2 (Leon.3.153); *ibid.*, lect. 11, n. 4 (Leon.3.163); *ST*, Ia, q. 115, aa. 2, 3, and 6; *In Meta.*, lib. VI, lect. 3.

CHAPTER 5

**Dialectical Indications of the First Mobile
from Modern Cosmology**

INTRODUCTORY NOTE TO CHAPTER 5

We should not, therefore, ask each scientist every question, nor should he answer everything he is asked about anything, but only those determined by the scope of his science. . . . One should not argue about geometry among non-geometers—for the man who argues badly will escape notice. And the same goes for the other sciences too.

ARISTOTLE
Posterior Analytics, I.12

Whoever seeks to work towards the integrating of philosophy and experimental sciences must be at once on his guard against both a lazy separatism and a facile concordism and re-establish a vital bond between them without upsetting the distinctions and hierarchies which are essential to the universe of knowing.

JACQUES MARITAIN
The Degrees of Knowledge

In this chapter, utilizing the tools of dialectic, I will ask the specialists questions which they are able to answer and which help further the conclusions reached in general natural philosophy. I will also try to avoid the lazy escape route Maritain warns against. In order to accomplish this, I will first discuss what “dialectical” (§17) means. Among its many meanings,

three senses will be defended that are pertinent to this project. Then (§18), some basic elements of modern cosmology will be reviewed. Modern cosmology is now in a position to propose, in a dialectical fashion, a new answer to the question “What exactly is the first mobile mover?” I propose a dialectical answer based on this review (§19). Finally (§20), I will examine some of the limits of these proposals and the nature of cosmology itself.

§17 “DIALECTIC” IS SAID IN MANY WAYS; THE PROCEDURE OF THIS CHAPTER WILL BE DIALECTICAL IN THREE WAYS.

Dialectic is not in this way concerned with any determined set of things, nor with any one genus. For then it would not ask questions: for one cannot ask questions when demonstrating because when opposites are the case the same thing is not proved.

ARISTOTLE
Posterior Analytics, I.11

[Dialectic] has a further use in relation to the principles used in the several sciences. For it is impossible to discuss them at all from the principles proper to the particular science in hand, seeing that the principles are primitive in relation to everything else Dialectic is a process of criticism wherein lies the path to the principles of all subsequent paths.

ARISTOTLE
Topics, I.2

In this section, I will discuss in what senses the conclusions in this chapter are dialectical. “Dialectic” or “dialectical” is said in many ways. The generic notion denotes a process of reasoning which does not rest in a fixed conclusion that excludes the possibility of an opposite conclusion, contrary or contradictory.¹ Three senses in particular concern us. In one sense,

1. See St. Thomas, *In Po. An.*, lib. I, lect. 1, n. 6: “Secundo autem rationis processui deservit alia pars logicae, quae dicitur inventiva. Nam inventio non semper est cum certitudine. . . . Per huiusmodi enim processum, quandoque quidem, etsi non fiat scientia, fit tamen fides vel opinio propter probabilitatem propositionum, ex quibus proceditur: quia ratio totaliter declinat in unam partem contradictionis, licet cum formidine alterius, et ad hoc ordinatur topica sive dialectica. Nam syllogismus dialecticus ex probabilibus est, de quo agit Aristoteles in libro topicorum.” See also *SBdT*, q. 6, a. 1a, c., discussed below, p. 269.

the application of the conclusions from general natural philosophy to the particular subject matter of cosmology are dialectical. In a second sense, conclusions reached by the particular sciences can be dialectical or probable. The final sense of dialectical is when the evidence of beings of reason—including, as De Koninck points out, symbolic constructions—substitute for what is lacking in first intentions.

17.1 “Dialectic” is said in many ways

“Dialectic” is said in many ways. The Greek ἡ διαλεκτική, derives from διαλεγειν, to converse or dialogue. As such, the word can be applied to many aspects of that activity: the power for carrying on a discussion, what the power carries out, as well as the parts or result of the discussion. Two interlocutors are implied, or one inquirer who is of two minds, puzzling out or arguing over two sides of an issue. More precisely, their views are contrary or contradictory to one another, and the discussion insofar as it is in process is not yet resolved. Thus, the meaning of “dialectical” as something uncertain or only known with probability arises; the issue or conclusion is not settled. The word acquires a set of meanings in Aristotelian logic which will be the focus here.²

Aristotle’s logical treatise on dialectic, the *Topics*, takes as its subject the “inquiry whereby we shall be able to reason from reputable opinions about any subject presented to us, and also shall ourselves, when putting forward an argument, avoid saying anything contrary to it.”³ The probable matter or opinions are the opinions of all, the many, or the wise.⁴ The reason why the mind, teleologically ordered towards truth, turns to *endoxa* is due to ignorance in the face of the desire for scientific knowledge in the strict sense.⁵ In con-

2. See Yvan Pelletier, *La dialectique aristotélicienne: Les principes clés des Topiques*, 2nd ed., Monographies Philosophia Perennis 2 (Québec: Société d’Études Aristotéliciennes, 2007), 3–8.

3. Aristotle, *Topics*, I.1, 100a20–22.

4. See Aristotle, *Topics*, I.1, 100b20–22; also I.10, 104a10; I.11, 104b3–5.

5. This leads Aristotle to state apparently contradictory things, as Pelletier himself notes, “The Articulation of Aristotelian Dialectic,” *Peripatetikos: The Journal of the Society for Aristotelian Studies* 7 (2009): 4, 8–9. On the one hand, human beings frequently achieve the truth or something of the truth; see *Rhetoric.*, I,

trast to scientific knowledge, which proceeds from necessary matter and premises that are understood through themselves, dialectic relies on “substitute evidence.”⁶ That is, the truth that is found in the judgments made by the mind is either evident without a middle term or requires some connection. It is the hunt for a middle term where the mind admits opinions as aids where it cannot find evidence from its own experience. As Pelletier notes, the way in which the mind accepts these opinions is based upon the marks which evidence would ideally possess, e.g., unquestionability or universal acceptance. Nonetheless, this “substitute evidence” is just that: it does not give the mind an essential grasp of the natures in question, the prerequisite for science.

When the mind makes use of this matter or substitute evidence, “dialectic” is, in various senses, the power, method, process, and result of reasoning from *endoxa*.⁷ The natural power corresponds to the natural directedness towards the truth, and in particular the truth of a scientific conclusion. However, just as the mind requires an art or method to direct it to the attainment of scientific truth, so also in the case of dialectics.⁸ The method by which the power of dialectic is honed is therefore also termed dialectic. Insofar as it provides a method or rules for guiding an activity, it is an art; dialectic as a science is the study of the second intentions the mind uses in so seeking probable conclusions from probable premises. Insofar as it directs an act or operation of reasoning, the operation can be named dialectic, or dialectical. Therefore, the parts (terms, premises) and result (conclusion) of this dialectical reasoning can be denominated in like fashion.

1, 1355a15-16: “Men are fairly well endowed by nature for truth and they attain truth most often.” See also 1355a21-22 and 1355a35-38. On the other hand, Pelletier notes, 8-9: “The relationship nature puts between reason and truth is not such that it makes reason unable to err; on the contrary, it errs a lot, and sometimes even in what’s endoxal, i.e. generally admitted.” See *De Anima*, III, 3, 427b1-2. Some resolution is found in *Metaphysics*, II.1, 993a26-993b8: truth is the door which is difficult to miss entirely; truth can be grasped partially but it is difficult to grasp completely.

6. Pelletier, “The Articulation of Aristotelian Dialectic,” 5, a translation of the French original, “L’articulation de la dialectique Aristotelicienne,” *Angelicum* 66, no. 4 (1989): 603-620.

7. Pelletier refers us to Aristotle’s *Rhetoric*, I.1, 1354a1 and I.2, 1355b25-26, and see his Pelletier, “The Articulation of Aristotelian Dialectic,” 6.

8. *Ibid.*, 6-7.

It is important to see that a *science* can be “dialectical” in a certain sense. This can be drawn from St. Thomas’ presentation of two senses of “rational process” in his *Expositio super Boetium De Trinitate*, q. 6, a. 1a, c.⁹ The first of these senses is as follows:

Some process by which one proceeds in the sciences is said to be rational in three ways. In one way, on the part of the principles from which one proceeds, as when someone proceeds to prove something from the works of reason, such as genus and species and opposite and the like intentions which logicians consider. And thus some process [*processus*] is said to be “rational” when one uses [*utitur*] propositions in a science which are treated in logic, namely, insofar as we make use of [*utimur*] logic, as teaching [*logica, prout est docens*], in the other sciences. But this way of proceeding cannot belong properly to one of the particular sciences, which err unless they proceed from their proper principles. However, this happens properly and fittingly in logic and metaphysics, because each is a common science and, in a way, is concerned with the same subject.¹⁰

In this first sense, St. Thomas introduces the first half of the classical distinction between *logica docens* and *logica utens*. “Teaching” logic is either logic as such or logic employed by metaphysics. “Utilized” logic is the second sense of a rational way of proceeding, which St. Thomas explains as follows:

Another way a process is called rational is from the terminus in which, by proceeding, it comes to a rest [*sistitur*]. For the ultimate terminus to which the inquiry of reason ought to lead is the understanding of principles, resolving to

9. As we shall see, De Koninck has these two meanings in mind in his article “Are the Experimental Sciences Distinct from the Philosophy of Nature?” in De Koninck, *Writings*, Vol. 1, 455, n. 10. One of De Koninck’s students discusses these, Sheila O’Flynn, “The First Two Meanings of ‘Rational Process’ According to the *Expositio in Boetium De Trinitate*” (Ph.D., Université Laval, 1954). In the context, St. Thomas is examining Boethius’ attributions of three methods to the speculative sciences: *rationabiliter* to natural philosophy, *disciplinabiliter* to mathematics, and *intellectualiter* to metaphysics. In assigned the “rational” mode of proceeding to natural philosophy, Boethius could be taken to imply that the other sciences do not proceed rationally. St. Thomas must therefore distinguish how the other sciences proceed in a rational mode as opposed to natural philosophy. The first two senses of *rationabiliter* he discusses, then, are ways in which logic (the science of reasoning itself) enters into the other sciences and thus they are said to proceed “according to reason.” The third sense of *rationabiliter*, the one which is proper to natural philosophy, is the sense corresponding to “the natural path,” discussed in Chapter 1. We will return to this text below, in Chapter 6.

10. St. Thomas, *SBdT*, q. 6, a. 1a, c. (Leon.50.159:120–36). Concerning the use that both logic and metaphysics make of this first mode of proceeding, see James B. Reichmann, “Logic and the Method of Metaphysics,” *The Thomist: A Speculative Quarterly Review* 29 (1965): 341–95.

which, we make a judgement. When this occurs the process or proof is not called rational, but demonstrative. However, sometimes the inquiry of reason is not able to lead all the way to the aforesaid terminus but rests [*sistitur*] in the inquiry itself, namely, when inquiring up to a point, the way remains open to either side. This happens when one proceeds by probable reasons which are apt to produce opinion or belief, not science. Thus [in this sense] the rational process is divided against the demonstrative [process]. This mode of proceeding rationally can be in any of the sciences, so that, from probable things, the way is prepared to necessary proofs. And this is another way in which logic is used in the demonstrative sciences, not as teaching [*docens*], but as made use of [*utens*]. And these two ways are denominated rational processes from the rational science, for these ways employ [*usitatur*] logic, which is called the rational science, in the demonstrative sciences, as the Commentator says.¹¹

This means that, whether a science attains a demonstrative or dialectical conclusion, both ways of proceeding are a part of that science in some sense. Thus, “science” means at least two things: narrowly, the habit of demonstration, and broadly a subject of rational inquiry which can include a rational mode of proceeding distinct from the demonstrative. A science in this latter sense can therefore include dialectics. For instance, this second way of proceeding prepares the way to necessary proofs.¹²

17.2 Three senses of “dialectical” introduced

Based on this general exposition, I will focus on three specific meanings of “dialectical” drawn from the above senses.¹³ A process of reasoning can be called dialectical because (1) it proceeds from probable reasons, or (2) from common instead of proper principles, or (3)

11. St. Thomas, *SBdT*, q. 6, a. 1a, c. (Leon.50.159:136–59). We should note that both *logica docens* and *logica utens* are “used” (or “employed,” *usitatur*) in a general way.

12. Discussed by Christopher A. Decaen, “The Impossibility of Action at a Distance,” in *Wisdom’s Apprenticeship: Thomistic Essays in Honor of Lawrence Dewan, O.P.*, ed. Peter A. Kwasniewski (Washington, D.C: Catholic University of America Press, 2007), 189–90.

13. See O’Flynn, “The First Two Meanings of ‘Rational Process,’” 67–96.

from intentional beings supplying what is lacking in our knowledge of real beings.¹⁴ The third sense is most formally dialectical.

As noted above, the mind makes use of probable reasons (the opinions accepted by all, the many, or the wise) when it cannot achieve resolution to principles for itself. Note, it is not reality that is in a state of indeterminacy here, but the mind.¹⁵ In lieu of insight into the nature of the subject and its predicate, the intellect must rely on a sign. This sign, if it turns out to be a proper effect, makes this dialectical stage of argument based on something more stable than a dialectical argument whose sign is fallible.¹⁶ The sign may be something sensible or a guess at the essence of the thing in question. The agreement of all, many, or the wise would indicate the presence of such signs.

O'Flynn gives the following example:

In a dialectical proposition, then, the sign takes the place of the necessary cause in the necessary proposition. For example, the proposition *All bodies are of a finite quantity* would be probable, if we were given as a reason that all bodies, which we have ever known or considered are bounded by surfaces; this reason is not a necessary cause for some one may object that, precisely, an infinite body could not be contained by surfaces and that it is not essential for a body to be thus limited.¹⁷

Here, then, the premises are held with probable knowledge; indeed, the universal definition of body proposed could only be a universal *ut nunc*. Thus, while the inference (“no thing bounded by surfaces is infinite, and all bodies are bounded by surfaces, therefore no bodies are infinite”) uses a necessary major premise, the minor premise is only probable if based on such an induction. Since the formal character of the inference is sound, it is the matter of

14. O'Flynn, “The First Two Meanings of ‘Rational Process’,” 90; see St. Thomas, *In Meta.*, lib. IV, lect. 4, n. 574: “Philosophus igitur ex principiis ipsius procedit ad probandum ea quae sunt considerata circa huiusmodi communia accidentia entis. Dialecticus autem procedit ad ea considerata ex intentionibus rationis, quae sunt extranea a natura rerum. Et ideo dicitur, quod dialectica est tentativa, quia tentare proprium est ex principiis extraneis procedere.”

15. O'Flynn, “The First Two Meanings of ‘Rational Process’,” 69–70.

16. *Ibid.*, 72–73.

17. *Ibid.*, 69. O'Flynn refers us to St. Thomas, *In Phys.*, lib. III, lect. 8, nn. 1, 2, and 4 for this example (Leon.2.125).

the propositions as known only with probability that causes the conclusion to be dialectical, or probable.¹⁸

This probable character arises necessarily when dialectic uses what is common instead of what is proper to the subject at hand.¹⁹ If the premises used are not proper to the subject, then the conclusion cannot be scientific even if the premises are necessary in themselves. Since using a reason totally alien to the subject at hand would not even be probable, a dialectical argument resorts to reasons that are not proper, but common to many subjects. Thus, from the common reason that, in any genus where there is a greater and a less, there is an equal, one could propose a dialectical argument that the square and the circle can be equated.²⁰ This reasoning is not necessary because the mind makes up for what it lacks: insight into the specific natures of the subjects of the conclusion.

The common propositions of dialectic, therefore, do not have the universality of a necessary proposition, fully founded in reality, and perfectly applicable to each of its inferiors, as a nature or genus; but rather a universality that is constructed by the mind regardless of whether or not there are sufficient grounds in reality, and not necessarily attributable (at least, not without qualification) to all its inferiors.²¹

Some aspect of the common reason, therefore, is *made* necessary and universal by the consideration of the mind. In this respect, an application of what is common as if it applied to a more particular genus or species without qualification is a dialectical process of reasoning.

Now, in certain cases, this necessity or universality is provided by the mind from its own resources, i.e., from the character of the second intentions that arise when it considers things.²² St. Thomas provides an example of this when he states that one could reason from

18. O'Flynn, "The First Two Meanings of 'Rational Process'," 73–76.

19. Ibid., 77–78.

20. Ibid., 80. If this type of argument is taken for a demonstration simply speaking, it is an error; see Aristotle, *Posterior Analytics*, I.9, 75b36–76a2.

21. Ibid., 81–82.

22. See Ibid., 85: "Dialectical principles are opposed to proper principles not only because they are common but also because they are logical, for proper principles are principles of the thing itself." Also, *ibid.*, 79: "An

the fact that contraries belong to the same subject that hate, being contrary to love, is likewise found in the concupiscible appetite as in a subject.²³ That is, the mind compensates for its lack of sufficient evidence by using second intentions. Nonetheless, the dialectician is still considering real things when he does so:

Hence we specify that dialectic proceeds from second intentions (i.e., from logical *relations*) and not from beings of reason in general, nor wholly free from beings of reason, since the concepts and certain propositions, considered in themselves and not as terms of a logical relation, are not pure products of the mind. For example, in the proposition *A body is that which is wholly bounded by surface*, *body* represents something real, and so does *what is wholly bounded by surface*, although the relation between them is furnished by the reason and therefore *body* as subject and defined, and *that which is wholly bounded by surface* as predicate and definition. Also, *Nothing wholly bounded by surface is infinite* is certain and real, though it does not itself imply a relation of principle with respect to the conclusion, and therefore its status of principle is furnished by the reason. We can see, then, that a subject of dialectic, considered in itself, is real. Only when considered formally as the subject of a probable conclusion does it become a second intention provided by the mind. We can rightly say, therefore, that dialectic reasons about things.²⁴

In this sense, reasoning is called dialectical because it proceeds from what the mind brings to reality, yet with some reference to what is real. It seems that a more precise way of formulating

exception [to the conclusion that the common reasons of dialectic are proper and essential to no one particular subject], however, must be made for the second intentions, because of their particular condition of being extrinsic to the nature of all real beings and yet in a certain way connected with them all. Whatever concerns a second intention is, of course, proper to logic, but to no science of reality and to no entitative subject. Yet the second intention is common to all things, and not essentially and entitatively as a nature is common, but as a common, extrinsic condition. What accrues to a being inasmuch as it is known, then, can be classed among the common things which form the basis of dialectical reasoning.”

23. St. Thomas, *Exp. Po. An.*, lib. I, lect. 20, n. 5: “Pars autem logicae, quae demonstrativa est, etsi circa communes intentiones versetur docendo, tamen usu demonstrativae scientiae non est in procedendo ex his communibus intentionibus ad aliquid ostendendum de rebus, quae sunt subiecta aliarum scientiarum. Sed hoc dialectica facit, quia ex communibus intentionibus procedit arguendo dialecticus ad ea quae sunt aliarum scientiarum, sive sint propria sive communia, maxime tamen ad communia. Sicut argumentatur quod odium est in concupiscibili, in qua est amor, ex hoc quod contraria sunt circa idem. Est ergo dialectica de communibus non solum quia pertractat intentiones communes rationis, quod est commune toti logicae, sed etiam quia circa communia rerum argumentatur. Quaecunque autem scientia argumentatur circa communia rerum, oportet quod argumentetur circa principia communia, quia veritas principiorum communium est manifesta ex cognitione terminorum communium, ut entis et non entis, totius et partis, et similium.”

24. O’Flynn, “The First Two Meanings of ‘Rational Process’,” 89–90.

O’Flynn’s conclusion is that, in the example conclusion about body, the inference is only warranted by the assumption of those premises as if they met the requirements demanded by the second intentions involved in demonstration, viz., the status of real principles. If one does not have evidence (immediate or otherwise) that body is that which is wholly bounded by surface, then the argument proposed merely takes this as if it were the definition through conceiving it in the mode of the second intention which it would have were it the real definition.

We now have three specific senses of dialectical reasoning. Reasoning is called dialectical if it proceeds from premises that are merely probable; e.g., a universal *ut nunc* or a commonly accepted opinion. Reasoning is also dialectical if it proceeds from what is true about a common genus; e.g., in the argument for squaring the circle. Lastly, reasoning is dialectical if it proceeds from propositions constructed by relying on second intentions to supply missing evidence. Now, this last sense is most formal to dialectic because the evidence provided based upon second intentions taken as proxies for proper evidence is both common (because it is extrinsic to the proper nature of the subject without being alien to it) and probable (because one lacks understanding of the proper principles).

17.3 *The dialectic between sciences*

It will be helpful to note briefly how De Koninck understands these senses of “dialectical reasoning.” The second sense of dialectical reasoning can characterize the relationship between general natural philosophy and specific sciences. De Koninck observes:

Is [to return more and more to experience] not in conformity with the necessity to go as far as possible, even to the elements, and never to define without sensible matter? Isn’t it for that reason that definitions by form alone, such as “the desire for revenge” as definition of “anger,” are purely dialectical, because they remain common and distant from the proper matter? Only experience can give us the natural definition. The knowledge that we acquire in the earlier treatises [in

natural philosophy], although it is quite determinate to the subject of the common as such, when it is considered in relation to the species, remains dialectical.

It is by an ever deepening experience that the mind emerges little by little from this dialectical condition. In this respect, the treatises nowadays designated as properly constituting the philosophy of nature are at bottom only an introduction to knowledge of nature properly speaking.²⁵

The core of De Koninck's point is that the knowledge acquired in the more general studies (e.g., in the *Physics* or *De Anima*), even as scientific conclusions, can only be applied dialectically to specific subjects. The reason given is that the genus is common and "remains distant from the proper matter" of the specific subject.

Now, in a similar sense, the considerations of the first mobile body in Chapters 3 and 4 are dialectical when the mind attempts to relate them as such to the more determinate nature of the first mobile. In Chapter 3, the first mobile was considered only as a physical continuum, abstracting from its determinate species; in this sense, anticipations of its complete account, apart from this peculiar type of "abstraction," would be dialectical. In Chapter 4, since the first mobile was conceived generically as a secondary and instrumental agent, in this fashion it relates to more determinate and specific considerations as genus to species, such a case is not precisely the same as considering only the form without the matter (as in the case of anger). However, the consideration is still from what is remote and common.

The anticipations of certain properties of the first mobile body from Chapter 2 also parallel this case of anger. Arguing that the *primum mobile* would be the cosmic plenum, basis for cosmic time, and foundation for cosmic place is dialectical in this sense. Such arguments look only to some formal property and argue that its subject must exist. How this subject is one in number and its substance such as to possess all these properties is not yet known from proper principles. In all of these cases, the third sense of dialectical reasoning is found insofar as the generic arguments are used as anticipatory of the actual nature of the

25. De Koninck, *Writings*, Vol. 1, 449. The passages to which De Koninck alludes in this argument are *De Anima*, I.1, 402b25–403a2, 403a29–33.

first mobile body. Without sufficient evidence, the mind must supply the notion of a specific nature which would possess these characteristics.

17.4 *The dialectic within science*

Dialectical reasoning can also be found within the consideration of the subject of a science. In this sense, the discovery of the principles of change, the definitions of nature, motion, place, and time belong to natural philosophy, i.e., as part of a process of dialectical reasoning.²⁶

What this implies is that prior to settled insight into the real definitions of terms belonging to a scientific genus, the meaning of such terms would be provisional. The conclusions drawn from them would therefore be dialectical in the first sense determined above, i.e., merely probable. This is the sense in which, as St. Thomas noted above, that the dialectical is opposed to the demonstrative mode of proceeding within a science.²⁷ De Koninck comments in the following text:

By *episteme* Aristotle meant knowledge about a universal subject, acquired by demonstration from first, self-evident, and proper principles. Even to him there was not much of it outside of logic and mathematics. But if it be knowledge of the physical world that we seek, we will soon be launched on a sea of provisional generalizations, universals *ut nunc*, i.e., for the time being, and of hypotheses to be improved upon by further hypotheses. Though we move on in great strides, nothing final can ever come into sight.²⁸

The state of such a dialectical “rest,” in De Koninck’s view, characterizes much of the procedure of the modern sciences. This does not derogate from their practical applicability but only from their speculative adequacy:

26. For example, the way to the three principles of change required Aristotle to begin from what second intentions provide to our experience of change: a subject and contrary or privative predicates. These, as dialectical terms, prepare the way for seeing the necessity of form, matter, and privation as real principles of change. This insight is not itself obtained by an inferential step, even though it is motivated by dialectical reasoning.

27. St. Thomas, *SBdT*, q. 6, a. 1a, c.: “Et sic rationabilis processus dividitur contra demonstrativum. Et hoc modo rationabiliter procedi potest in qualibet scientia, ut ex probabilibus paretur via ad necessarias probationes.” (Leon.50.159:149–53)

28. De Koninck, “The Unity and Diversity of Natural Science,” 14.

We are sometimes told that this precarious, provisional character of even the most exact branch of natural science, mathematical physics, must not be overstressed. And the reason offered is that we achieve undeniable results. The results may be indeed most practical, but does this require that the theoretical knowledge which led to their success be speculatively true? We can launch artificial satellites on the basis of Newtonian physics, but does this prove that such physical theory is true? Practical success is always a sign that we are on the right track towards speculative truth, but to move towards a term and to have reached it are not quite the same thing. Dalton's atoms, conceived as billiard balls, only much smaller, served their purpose and were nearer the truth than those of Democritus; but they were not the last word on the subject, nor are the atoms of today. Just because we can set down the word "atom" does not mean that there are atoms in the way that there are apples. Atoms are not atoms in the way apples are apples.²⁹

Thus, the practical applicability of the provisional terms provided by more determinate researches is only a sign of what they are. This means they belong to a dialectical mode of reasoning; the mind substitutes them into the account of the essence of the thing, giving them *ut nunc* universality. In contrast to the mode of conception by which the general natural philosopher draws his concepts and terms from fundamental and primary experience, more determinate researches begin to require more and more provisional conceptions or definitions of their terms.

This gives a more determinate subject of investigation the character of provisionality. Its terms are not mere fictions, but they are not stabilized. This instability can be contrasted with cases when the terms in question are stable.

Now, all this faces us no doubt with a deep enough cleavage between diverse modes of knowing the things of nature. But does this cleavage restrict natural philosophy to our initial gropings among vague generalities, and hold experimental science to mere concrete investigation? What we are agreeing to call philosophy of nature is experimental too, though not quite after the manner of mathematical physics nor even of advanced biology. I pointed out long ago that in the study of nature we must distinguish between strictly scientific knowledge (in Aristotle's sense) and that which is called dialectical, as providing no more

29. De Koninck, "The Unity and Diversity of Natural Science," 14–15.

than opinion. Now, opinions are still enunciated in words, and are in fact true or false if it be speculative knowledge that we mean to express. Notice, however, that an opinion is not a fiction in the strict sense of this term. It is, at bottom, an inquisitive proposition. The opinion that “the world is eternal” still leaves open the question whether the world really is or has to be eternal. We can unfold what we mean by “world” and by “eternal,” but can we in truth say the latter of the former? The notions of “world” and “eternal,” though vague, have a relatively stable meaning. What we are questioning is not their meaning, of course, but their connection in a proposition. Is such a proposition necessary? Is the eternity of the world a fact?

But in mathematical physics, when words are used to describe, not how things are in fact, but merely how a certain symbolic construction has been laid down, e.g., that of the atom, we must be aware that, unlike the terms used in a statement about nature, the symbols, the construction, and the names we choose to employ for the purpose of communication do not have a stable meaning. The only stable meaning the word “atom” ever had was that of “indivisible.” In other words, we are now entitled to question not merely the connection of the terms, but the very terms themselves. At any rate, these are utterly provisional, whereas what “world” or “eternal” stand for are not.³⁰

In the first case, the connection between terms with stable meaning is put into question. To provide another example, after the general inquiry into the soul, one could ask if all dogs are of one *infima species*. In the second case, the terms themselves may be called into question, and not just their connection. For example, the question whether all dogs are of one biological species would be of such a type prior to an adequate definition of biological species (e.g., just after the advent of evolutionary theory).

In this second case De Koninck speaks in particular of the modes of expression used by mathematical physics, which involve systems of measurement and symbolic expression. While this will be examined in more detail in Chapter 6, for the present it suffices to note De Koninck’s claim concerning why a dialectical character accrues to the terms in mathematical physics, viz., because of the system of measurement and symbolic conceptualization

30. De Koninck, “The Unity and Diversity of Natural Science,” 15–16. See also “Mental Construction and the Test of Experience,” in De Koninck, *The Hollow Universe*, 72–73, for a similar discussion of the provisional character of “atom” as a term.

employed.³¹ It is this method of arriving at the definition of terms in mathematical physics that provides a new but closely related way in which one proceeds dialectically in a science.

It should now be plain that our study of nature can proceed on three different levels: that of science, that of opinion, and that of terms that are themselves provisional—whose meanings are accordingly unstable. There is no doubt that in point of certitude there are radical distinctions between these various modes of investigating nature: between vague knowledge that is certain and definitive, such as knowledge of what the word “man” stands for; knowledge that is tentative, of the kind we have in dialectical propositions; and knowledge that is both tentative and known to be provisional, provisional even as to the very terms we use to express it. The latter kind is nothing short of paradoxical, since greater exactness is paid for by increasing instability.³²

Thus, the first way of proceeding is the demonstrative mode. The second way of proceeding is dialectical in the senses discussed above. The third mode is dialectical not only as to the propositions involved but also the terms in those propositions. Thus, insofar as the modern sciences use such terms—and evidently this is connected to their use of measurement and symbolic constructs—they are dialectical.³³

This new sense of dialectical process is closely related to the third classical sense noted above, i.e., where the mind uses second intentions to substitute for a like of evidence at a first intentional level. That is, if symbols are in some fashion beings of reason, then their employment in the practice of science will be dialectical in a way that is similar to this third sense. A more complete explanation must be left for Chapter 6.

17.5 *The dialectical modes of the following inquiry*

Based on the above, it follows that there are several ways in which the following inquiry (§§18–20) will be dialectical. First, it will be dialectical by making use of probable reasons

31. See De Koninck, “The Unity and Diversity of Natural Science,” 12–14.

32. *Ibid.*, 16.

33. Bernard Mullahy, “Subalternation and Mathematical Physics,” *Laval théologique et philosophique* 2, no. 2 (1946): 100, a doctoral student of De Koninck’s, uses the term “dialectical subalternation” to describe the type of subalternation in modern mathematical physics that most closely relates to this third sense.

and looking for such reasons based on signs. We will take as *endoxa* what modern scientists say about the cosmos and from these propose conclusions about the first mobile body. Since these are taken up as opinions, and thus indeterminately known, the conclusions can only be probable, or dialectical. Unlike Aristotle's use of *endoxa* taken from other philosophers or experts, this chapter will not resolve conflict or disagreement at the level proper to which a demonstrative conclusion would be made.

Second, since we are proceeding from a more common study to a more particular one, the conclusions we possess about the *primum mobile* based on general natural philosophy, while certain at their own proper level of generality, are dialectical when taken as principles within more determinate researches. This is because such conclusions are remote from the proper matter required to define and explain the first mobile body.

Third, because the terms which the modern sciences use are provisional in the two ways discussed just above (the connections between the terms as well as the terms themselves are provisional), what modern theories propose about the nature and properties of the first mobile being will be dialectical or provisional. Insofar as these terms make use of a symbolic mode of expression, the inquiry into the specific nature of the first mobile body will also be dialectical in the sense that the evidence of beings of reason somehow substitute for what is lacking in first intentions.

§18 PROPOSALS ABOUT THE SPECIFIC NATURE OF THE FIRST MOBILE BODY REQUIRE MORE DETERMINATE OBSERVATIONS AND THEORIES WHICH REPLACE THE PRIMITIVE EXPERIENCES UPON WHICH ANCIENT, MEDIEVAL, AND NEWTONIAN COSMOLOGY RELIED; MODERN COSMOLOGY IS IN THE POSITION TO PERFORM THIS TASK.

It is a striking thought that ten years of radio astronomy have taught humanity more about the creation and organization of the universe than thousands of years of religion and philosophy.

P. C. W. DAVIES

Space and Time in the Modern Universe

Philosophical choices necessarily underly cosmological theory.

G. F. R. ELLIS

“Issues in the Philosophy of Cosmology”

The observational and theoretical bases from which I will principally draw the materials of the following three sections are from fields of research far less than a century old and which continue to exhibit rapid change and development. These fields of research ground the newest version of an ancient science: cosmology.³⁴ Proposals about the specific nature of the first mobile body require more determinate observations and theories—a self-consistent cosmology—to replace ancient-medieval and Newtonian cosmology. In this section, I will sketch the development of cosmology through three stages as preparation for arguments about the first mobile in §19.

34. Andrew Liddle and Jon Loveday, *The Oxford Companion to Cosmology*, 1st ed. (Oxford/New York: Oxford University Press, USA, 2009), 1: “Cosmology is amongst both the oldest and youngest of sciences. . . . In its modern form, however, cosmology is quite a young science. At the beginning of the 20th century, essentially none of our current understanding was in place.” I will use the term “cosmology,” to mean the modern practice of cosmology as a part of astronomy, generally conceived. (For instance, it would therefore include the nuclear chemistry and stellar dynamics.) It seems that Aristotle’s *De Caelo* is a “cosmology” that would contain the practice of astronomy as a part.

18.1 *Three stages of cosmology*

The development of cosmology can be approximately divided into three stages: the closed world, the infinite universe, and the expanding universe.³⁵ The three stages are distinguished pragmatically by two significant advances: the invention of the telescope and then the invention of instruments allowing more detailed and more expansive access to the electromagnetic spectrum (e.g., the spectroscope, radio telescopes, as well as satellites and space telescopes). With each stage, the advance in observational power allowed for advances in theory; still, *theory* is required just to interpret the observations. That is, previous knowledge about how to interpret observations is required to have data in the first place. For instance, a theory of geological timescales, sedimentation, and carbon decay are necessary to construct the fossil record. This link between observations leading theory and theory leading observations is one of the difficulties encountered in cosmology as a practiced science.³⁶ This symbiosis between observation and theory also divides cosmology, broadly speaking, into two parts: observational and physical (or theoretical).³⁷

35. I borrow the first two designations from Alexandre Koyré, *From the Closed World to the Infinite Universe* (New York: Harper & Brothers, 1958). The order of presentation in this section is also greatly aided by ideas from Carol Day, “Time, Space, and the Expanding Universe (unpublished paper)” (Society of Aristotelian Studies, Thomas Aquinas College, 2011); Dr. Day provided me with an unpublished version of her paper.

36. See George F. R. Ellis, “Cosmology and Verifiability,” in *Modern Cosmology & Philosophy*, ed. John Leslie (Amherst, N.Y.: Prometheus Books, 1999), 119–126; George F. R. Ellis, “Issues in the Philosophy of Cosmology,” in *Philosophy of Physics (Handbook of the Philosophy of Science)*, ed. Jeremy Butterfield and John Earman (Amsterdam/Oxford: North Holland, 2007), 1222.

37. See *ibid.*, 1183; Liddle and Loveday, *The Oxford Companion to Cosmology*, 70–71, 81–82. Indeed, the demands of modern cosmology require that the universe’s history be an essential part of the study, not just because it seeks to determine the origin of the universe but also, and more importantly, because any observations of the *distant* universe of necessity look at the universe in the past, due to the finite speed of light. Edward Harrison, *Cosmology: The Science of the Universe*, 2nd ed. (Cambridge: Cambridge University Press, 2000), 74, quotes Agnes Clerke, who writes “Our view of sidereal objects is not simultaneous. Communication with them by means of light takes time, and postdates the sensible impressions . . . of their whereabouts in direct proportion of their distances. We see the stars not where they are—not even where they were at any one instant, but on a sliding scale of instants.”

18.2 *The finite, static cosmos of the ancients & medievals*

The cosmos of the ancient and medieval astronomers—*pace* the Stoics and Epicureans—was finite, hemmed in by the *primum mobile* and the sphere of the fixed stars, “quite simply and finally, the largest object in existence.”³⁸ Because of the inability to measure stellar parallax, an accurate scale of cosmic distances could not be devised.³⁹ As a consequence, knowledge of the finitude of the cosmos had to rely upon arguments from natural philosophy or metaphysics. However, the medieval cosmologists could not resolve the dispute between the physically consistent homocentric theories and the mathematically effective but physically inconsistent heterocentric theories (see §11.2). Furthermore, the motor causality principle could not be instantiated in the cosmos as a whole given the observational basis of geocentric astronomy (see §11.3). As these deficiencies and others have already been discussed in Chapters 3 and 4, I pass on to the next stage.

18.3 *The unstable non-universe of the Newtonian theory*

The rupture of the celestial spheres of the Aristotelian cosmos required an advance in observational data indicating the true distance to the stars and comets, and a celestial dynamics explaining their independence from celestial spheres. As for the observations, measurements of stellar parallax were not made until centuries after Ptolemy. Yet even before such computations were available of the distance to the stars, the key breakthrough for the next stage

38. C.S. Lewis, *The Discarded Image: An Introduction to Medieval and Renaissance Literature* (Cambridge: Cambridge University Press, 1964), 99. Ptolemy was able to use parallax measurements made by the naked eye (aided by a parallactic instrument called a *triquetrum*) to determine the height of the moon; see Ptolemy, *Ptolemy's Almagest*, 244–51. Estimates of the size of the cosmos had to be based on measurements of the diameter of the earth and assumed ratios between the earth and the other spheres of the planets; the altitude and magnitude of the *primum mobile*, being without stars, could not be estimated. Lewis, *The Discarded Image*, 98–99, poetically describes how the medieval man would use a concept of height—his night sky is “vertiginous” in a qualitative way that is lost in modern measurements.

39. Ptolemy, *Ptolemy's Almagest*, 243: “Hence for those bodies with no perceptible parallax, namely, those to [the distance of] which the earth bears the ratio of a point, it is, obviously, impossible to find the ratio of the distance.”

in cosmological theory had to be made: the telescope. This brought to the point of realizability Kepler's dream of a physical theory of astronomy with a mathematical model more accurate than Copernicus', advancing beyond the unhappy marriage of Aristotelian celestial causality and Ptolemaic mathematical phenomena-saving.⁴⁰ It spurred the development of a more accurate celestial dynamics. The availability of data on the revolution of the celestial bodies in the solar system (the periods of Jupiter and Saturn's moons) was indispensable in Newton's argument for universal gravitation.⁴¹ His paradigm became the mode for explaining the "system of the world" in the large and small: from the interaction of the stars to the kinetic theory of matter.⁴²

However, a clear answer to the question "What is the universe?" does not fall out directly from Newtonian physics. Indeed, a strictly speaking Newtonian cosmology is impossible. On the one hand, Jaki notes that Newton maintained the universe to be a materially finite amount of matter in an infinite extent of space.⁴³ On the other hand, Newton at other times

40. See Copernicus, *On the Revolutions of the Heavenly Spheres*, 507–508, in Claudius Ptolemy, Nicholas Copernicus, and Johannes Kepler, *Ptolemy, Copernicus, Kepler* (Chicago: Encyclopedia Britannica, Inc, 1989); Kepler, *Astronomia Nova*, 4ff.

41. Newton, *Principia*, Book III, "Phenomena," 797–803.

42. The Newtonian paradigm, an anachronistic name but accurate enough to the style of thinking Newton inaugurated, is defined by Roberto Mangabeira Unger and Lee Smolin, *The Singular Universe and the Reality of Time: A Proposal in Natural Philosophy* (Cambridge University Press, 2014), 373, to be where "the system to be studied is always a subsystem of the universe, idealized as an isolated system." It relies principally upon the notion of a configuration space, a logical simulacrum of nature. See also Einstein and Infeld, *Evolution of Physics*, 3–67: "The great results of classical mechanics suggest that the mechanical view can be consistently applied to all branches of physics, that all phenomena can be explained by the action of forces representing either attraction or repulsion, depending only upon distance and acting between unchangeable particles. In the kinetic theory of matter we see how this view, arising from mechanical problems, embraces the phenomena of heat and how it leads to a successful picture of the structure of matter" (67). While Newton was not a "mechanical philosopher" of the likes of Descartes, Hobbes, or Boyle, his outlook readily lent itself to the mechanical reductionism of motions that followed in the history of physics and the instruction of physics. Newton himself was not a mechanist, as De Gandt argues, *Force and Geometry in Newton's Principia* (Princeton, NJ: Princeton University Press, 1995), 268–70, and the reductionism carried out in the name of his physics is unwarranted (see Hassing's "Wholes, Parts, and Laws of Motion" and "Animals versus the Laws of Inertia"). Indeed, the kinetic theory ultimately failed as an explanation of the structure of matter, which requires quantum physics.

43. Stanley L. Jaki, *Cosmos in Transition: Studies in the History of Cosmology*, Pachart history of astronomy series v. 5 (Tucson: Pachart, 1990), 201–203. See *De Gravitatione* in Isaac Newton, *Isaac Newton: Philosophical Writings*, ed. Andrew Janiak (Cambridge: Cambridge University Press, 2004), 41.

postulated a universe infinite in extent with a statistically homogeneous distribution of mass in order to explain the existence and stability of the universe's structure. That is, Newton wavered between a Stoic conception of the universe (with a static, finite amount of matter in a void space of infinite extent) and an Epicurean one (with a static, infinite amount of matter in void space of infinite extent).⁴⁴

The importance of deciding between these options lies in the fact that paradoxes result from the Epicurean universe: the gravity paradox and the darkness paradox (or, Olber's paradox).⁴⁵ The paradox due to gravity was recognized by Newton himself. The Stoic universe (of finite matter in infinite space) is subject to collapse given a universe of sufficient age.⁴⁶ Newton suggests in his first letter to Bentley that this can be avoided by supposing the material universe to be homogeneously distributed through an infinite space.⁴⁷ As noted, this solution—shifting to the Epicurean universe—is problematic. The basic argument that this infinite universe is impossible is based upon considerations of mass density in a sphere.⁴⁸

44. Edward Harrison, "Newton and the Infinite Universe," *Physics Today* 39, no. 2 (February 1986): 27, gives the two options these names after their philosophical forebears. See also Edward Harrison, *Darkness at Night: A Riddle of the Universe* (Harvard University Press, January 1989), 68–80; Harrison notes (70) that in Newton's published work there is precious little that reveals his thoughts about the starry universe.

45. See "The Gravitational Paradox of an Infinite Universe," in Jaki, *Cosmos in Transition*, 189–212; also, Harrison, *Cosmology*, 323–26.

46. Harrison, "Newton and the Infinite Universe," 27–28, 29, argues that Newton could have easily performed the calculations concerning how long the collapse of such systems would take, which depends upon the density of the sidereal system and not its volume, and suggests Newton would have arrived at a figure of approximately 100 million years.

47. Isaac Newton, *Correspondence of Isaac Newton, Volume III: 1688-1694*, ed. H. W. Turnbull (Cambridge: Cambridge University Press, 1961), 233.

48. See Alan Guth, *The Inflationary Universe: The Quest for a New Theory of Cosmic Origins* (Reading, Mass.: Addison-Wesley, 1997), 295–97, who shows that such a universe would collapse just as quickly as any spherical universe of finite size. Harrison, "Newton and the Infinite Universe," 27 uses a similar argument from Lord Kelvin to support his reconstruction of a Newtonian argument of the collapse of a finite universe in infinite space; see Lord William Thomson Kelvin, *Baltimore Lectures on Molecular Dynamics and the Wave Theory of Light* (London: C.J. Clay & Sons, 1904), 537–39. Einstein takes this same Epicurean-Newtonian universe and argues that it is impossible, but based upon an expanding series of spheres—i.e., the result would be universe with an infinite gravitational force: Einstein, *Relativity*, 119–21. This is also noted by Harrison, "Newton and the Infinite Universe," 29: "In a fixed element of solid angle the number of stars increases as the square of the radial distance, whereas each star exerts a pull inversely as the square of its distance. Hence in an infinite universe uniformly populated with stars the integrated gravitational force in any direction becomes infinitely great." Jaki, in *Cosmos in Transition*, 191–92, after taking Einstein's historical insensitivity to task, shows *ibid.*, 195, that Einstein's argument was anticipated by Lord Kelvin,

Therefore, the collapse of a finite island of stars in infinite space and the collapse or infinite gravitational intensity of an infinite universe are two sides of the same mathematical-physical coin: the result of the mass density of a sphere.

The puzzle of Olbers' paradox illustrates similar theoretical difficulties with an infinite, static Newtonian universe.⁴⁹ Essentially, one can qualitatively grasp the argument of Olbers' paradox in a two-dimensional plane by imagining oneself in a forest: "In a large forest of evenly spaced trees, every line of sight must eventually end up at a tree."⁵⁰ Analogously, in an infinite space homogeneously filled with stars that have been burning forever a dark night sky could never exist.⁵¹ Consequently, in such a world, life on Earth would be unsupportable due to the high equilibrium temperature of such a universe.⁵²

Why do these paradoxes arise? It is because Newtonian principles do not lead *intrinsically* to an explanation of the whole universe. The Newtonian universe is too simple and partial: space is static (an unchanging substantial void), stars can shine indefinitely (energy is not conserved), and there has been an indefinite time available for them to shine. The simplistic cosmos generated by Newtonian mathematical physics and philosophical assumptions about space and time is only applicable in abstraction from and not adequate to the observable cosmos.

The simple, monadic principles of Newtonian mathematical physics stand in contrast to Aristotle's ontological hierarchies founded upon substance: its changes, its causal relationships, and the parasitic nature of place and time. The finitude of space and time and

drawing on Green's theory of potentials developed in 1828.

49. See Stanley L. Jaki, *The Paradox of Olbers' Paradox: A Case History of Scientific Thought* (Pinckney, Mich.: Herder / Herder, 1969), especially 133–46, as well as Harrison, *Darkness at Night*, 91–101.

50. James M. Overduin and Paul S. Wesson, *The Light/Dark Universe: Light From Galaxies, Dark Matter And Dark Energy* (New Jersey: World Scientific, 2008), 2.

51. Jaki notes that both paradoxes (Olbers' paradox and the gravity paradox) reduce to the same principles, viz., the inverse square law, which governs both gravitational and electromagnetic propagation; see Jaki, *Cosmos in Transition*, 197.

52. These points are made by George F. R. Ellis, "Emerging Questions and Uncertainties," in *Modern Cosmology & Philosophy*, ed. John Leslie (Amherst, N.Y.: Prometheus Books, 1999), 280.

causal connections, in Aristotelian terms, are determined by asking about the principles of substance. Newtonian physics does not have such resources. Some extrinsic source must set the initial condition to decide whether or not the extent of matter or time is finite or infinite in a finite or infinite space, and this leaves apart altogether the force laws which relate these masses—for the force laws are only intelligible upon supposing mass, space, and time as independent objects.

Consequently, from the intrinsic character of the principles of Newtonian physics and thus apart from the pragmatic *stipulation* of initial conditions, it is impossible to conclude whether the universe is a universe: a totality of causally interacting substances in a stable and intelligible order. The Stoic model of the universe would lead to eventual collapse whether or not the system is rotating or not.⁵³ It can only be saved by extrinsic, *ad hoc* assumptions. The Epicurean model of the universe will also either collapse (if one allows that a spherical universe of infinite radius can “collapse” at all) or result in a singularity, an infinite gravitational force. If one wishes to theorize the cosmos as a whole—e.g., recognizing that the darkness of the night sky is a necessary condition for the existence of life—a cosmology of an entirely different order is required.⁵⁴

18.4 *The standard model of modern cosmology*

In §19 I will propose a candidate for the *primum mobile* which meets the parameters for such a being as determined by general natural philosophical arguments. In preparation for this,

53. Harrison, “Newton and the Infinite Universe,” 27–28, notes that Newton’s Stoic universe could have been given more (if temporary) stability by rotation (a group of bodies orbiting a center of gravity). However, as Harrison notes, even this system would eventually collapse.

54. Newton only offers brief discussions on the origins of cosmic order, God’s causality, and the role of the laws of nature in *Principia*, “General Scholium,” 940, as well as *Opticks: Or a Treatise of the Reflections, Refractions, Inflections & Colours of Light-Based on the Fourth Edition London, 1730*, ed. I. Bernard Cohen (New York: Dover Publications, 1979), Book III, Query 31, 400–402. See also Paul Davies, “What Caused the Big Bang?,” 229–30, in *Modern Cosmology & Philosophy*, who notes that the assumptions must state that the universe must be finite in space or the age of matter in it (or time itself) sufficiently young, or both. As one example, Lord Kelvin in Kelvin, *Baltimore Lectures*, 540, could only guess at the initial state of a universe several million years old.

some familiarity with modern, physico-mathematical cosmology is required. This preparation will allow us to see in what sense the standard model of modern cosmology is dialectical. I will consider (1) its basic mathematical theory, (2) its principal supporting observations, and (3) its most recent modifications.

(1) *Basic mathematical foundations of modern cosmology*

The mathematical theory used by the standard model of modern cosmology is that of general relativity (GR). GR is the basis for the standard model because gravity is the only known force whose effects take a cosmic scale. The large scale structure of the universe and its history—up to a point—can be effectively accounted for using only this theory. This requires that the cosmologist assume that the laws of local physics of Einsteinian gravity can apply to the whole without exception, a paradigm which still echoes the classical, Newtonian project of understanding the whole in terms of laws applicable to the parts.⁵⁵ Thus it, too, is partial and not fully adequate to the whole.⁵⁶ Yet its failure when attempting to comprehend the universe as totality is not as immediate as the Newtonian theory's.

55. The necessity of using GR for cosmology at present is noted by Ellis, "Issues in the Philosophy of Cosmology," 1185. Unger and Smolin, *The Singular Universe and the Reality of Time*, 17–22, 124, call the Newtonian paradigm the "first cosmological fallacy," as part of their program for an alternative cosmology. This fallacy leads them (22, 124) to reinterpret singularities. Near the temporal origin of the universe, the Big Bang, the equations of general relativity yield "singularities," i.e., infinite quantities, which some theorists note means the theory is really breaking down and not predicting an actually infinite density or mass. Indeed, the notion of the regularity of time under such conditions is tenuous at best.

The practice that Hassing, "History of Physics and the Thought of Jacob Klein," 239–46, describes as "physico-mathematical secularism" regards the difference between physical quantities and mathematical quantities as inconsequential and disputable (private, philosophical) matters when it comes to the important and indisputable (public, scientific) practice of mathematical physics. This requires that key philosophical difficulties are passed over without notice. Perhaps this is in part responsible for the ease with which singularities in mathematical theory lead to impassés when trying to understand nature. See, e.g., Joseph Ford, "How Random Is A Coin Toss?," *Physics Today* 36, no. 4 (April 1983): 46: "Newtonian dynamics has, over the centuries, twice foundered on the assumption that something was infinite when in fact it was not: the speed of light, c , and the reciprocal of Planck's constant, $1/h$. Reformulations omitting these infinities led first to special relativity and then to quantum mechanics. Complexity theory now reveals a third tacitly assumed infinity in classical dynamics, namely the assumption of infinite computational and observational precision."

56. The synthesis of GR and quantum physics (hence chemistry) remains, arguably, the fundamental desideratum of physics.

An outgrowth of Einstein's special theory of relativity (SR), GR applies the principle of relativity to gravitating systems, the aspect in which SR was constructed as incomplete. Consequently, SR is applicable to the world in restricted domains, viz., when gravitational effects can be neglected for the problems at hand (e.g., when calculating special-relativistic effects on particles in particle accelerators).⁵⁷

A key to generalizing SR is the equivalence of inertial and gravitational mass, which equivalence was taken to be coincidental in Newtonian physics. Einstein's thought experiment of the experience of an observer in "a room in deep space" is designed to illustrate the underdetermination of the observer with respect to these two types of inertia. The observer inside the room makes the same measurements whether the room is accelerating upward or in a gravitational field of equal effect directed downward.⁵⁸ The space-time geometry of GR, built upon a generalized principle of relativity and Einstein's equivalence principle, provides a geometric theory of gravitational or accelerated as well as inertial frames of reference.⁵⁹

The curved space-time which is so central to the theory of GR is unlike the flat, gravitational-field-free Minkowski space-time of SR.⁶⁰ The rods and clocks used to measure distance and time in GR require a description by a non-Euclidean geometry of intrinsic curvature; the space-time of GR must be described mathematically as a Riemannian manifold.⁶¹ Yet does this make a physical difference? Einstein observes that "space-time does not claim exis-

57. Torretti, *The Philosophy of Physics*, 249, fn. 1: "SR can hold in a world governed by GR only if that world is completely lacking in gravitational sources. Still, in a world like ours, GR agrees excellently with SR in a small, freely falling lab, over short periods of time. It is therefore not altogether unjustified to describe SR as a special version and GR as a general version of the same theory. On the other hand, this description conceals the drastic change of meaning and scope that SR suffers when embedded in GR." For overviews of the genesis of GR after SR, see Einstein, *Relativity*, 67–82; Torretti, *The Philosophy of Physics*, 289–90; John Frederick Hawley and Katherine A. Holcomb, *Foundations of Modern Cosmology* (Oxford: Oxford University Press, 2005), 213–22.

58. See Einstein, *Relativity*, 71–79, 172–73.

59. Torretti, *The Philosophy of Physics*, 290: "The Equivalence Principle suggests that inertia is just a limiting case of gravity, in agreement with Mach's idea . . . that inertial phenomena—for example, the deformation of the liquid surface in Newton's rotating bucket—reflect the presence of distant matter."

60. Einstein, *Relativity*, 175–76.

61. *Ibid.*, 88–111. See 176, where Einstein notes that this makes the space-time of SR a "special case" of the space-time of GR, namely, a space-time of zero curvature.

tence on its own, but only as a structural quality of the field,”⁶² viz., the gravitational field. Philosophical interpretation is necessary here—the mathematics does not explain its own claims upon material reality; it does not interpret itself. For instance, is space-time merely an abstract geometrical object (a mental instrument) that best predicts the phenomena, or does some “underlying” belong to space-time, so as to explain why the presence of matter and energy demand that a Riemannian metric be used to understand the phenomena? This question will be considered in §19.2.

Experimental confirmation of GR includes three predicted observations provided by Einstein himself.⁶³ First, the perihelion of Mercury is more accurately predicted by GR than by Newtonian physics. Second, the bending of light in a gravitational field (gravitational “lensing”) is predicted by GR. It was first observed in 1919 by Sir Arthur Eddington during a solar eclipse. Radio telescopes have since allowed for similar tests on radio waves to be carried out without the need to catch a solar eclipse. Finally, GR also predicts the redshift of light escaping from a gravitational source, e.g., stars and galaxies.⁶⁴

62. See Einstein, *Relativity*, 121.

63. Ibid., 84–85, 141–51, and Harrison, *Cosmology*, 233–36.

64. Concerning the redshift of distant sources of radiation, see Hawley and Holcomb, *Foundations of Modern Cosmology*, 278–80, 287–95, Harrison, *Cosmology*, 270–75, and 302–314. The phenomenon of redshift observed in celestial objects has several components, not just the celestial analog to mundane Doppler effects such as the shift in pitch of moving sources of sound. Gravitational redshift must be distinguished from cosmological redshift (an important element in the argument for the existence of Λ , see below, p. 300).

Redshifts allow one to infer that, due to some cause, the sources are moving relative to the observer. Edwin Hubble discovered in the 1920’s that these recessional velocities of the galaxies possess a roughly linear relationship with distance: the further the galaxy the greater its recessional velocity. Since a random distribution of galactic velocities (due to their own peculiar motions) would be expected to produce a corresponding random range of spectral shifts, the natural explanation was to assign a common underlying change to account for this uniform linearity. Hubble expressed this in what is now called the Hubble law or the redshift–distance law, $zc = Hl$, where z is the redshift, c the speed of light, l the independently measured distance to the source, and H the “constant” or Hubble term.

GR could plausibly account for the observed velocity–redshift relationship by appealing to a change in the scale factor of space that behaves, in the presence of matter and energy, in a homogeneous and isotropic fashion. That is, spatial expansion explains the observed redshift of distant objects by attributing the lengthened (redshifted) wavelength to an increase in the scale factor of space occurring between the point of emission and the point of reception. This seems to require that space possess physical causality (see below, fn.104).

This rate of expansion would require that parts of the universe recede from each other with velocities in excess of the speed of light. This striking, deduced behavior of the universe as a whole calls out for some explanation: what causes this change? It requires us to conclude, according to the principles of GR, that

Einstein realized that GR could provide the basis for mathematical models of the universe as a whole.⁶⁵ Einstein's original solution for his field equations describing the gravitational behavior of the universe included an *ad hoc* "cosmological constant," a repulsive force that counteracted the effect of gravity and thus maintained the universe in a static state. Non-static solutions for GR's field equations were first proposed in the 1920's, but were not

the expansion of space is not a local motion or a causal connection in the usual senses allowed by GR and prompts inquiry into a causal power of space itself. See Tamara M. Davis and Charles H. Lineweaver, "Expanding Confusion: Common Misconceptions of Cosmological Horizons and the Superluminal Expansion of the Universe," *Publications of the Astronomical Society of Australia* 21, no. 1 (January 2004): 98–99: "In the Λ CDM concordance model all objects with redshift greater than $z \sim 1.46$ are receding faster than the speed of light. This does not contradict SR because the motion is not in any observer's inertial frame. No observer ever overtakes a light beam and all observers measure light locally to be traveling at c The general relativistic interpretation of the expansion interprets cosmological redshifts as an indication of velocity since the proper distance between comoving objects increases. However, the velocity is due to the rate of expansion of space, not movement through space, and therefore cannot be calculated with the special relativistic Doppler shift formula." See also Ellis, "Issues in the Philosophy of Cosmology," 1215.

The Hubble term H allows us to define other basic theoretical parameters of the universe, viz., the Hubble time and the Hubble length; see Hawley and Holcomb, *Foundations of Modern Cosmology*, 303–305; Harrison, *Cosmology*, 287–89, 443–44. The Hubble length is the distance that a light signal can travel during the Hubble time. The Hubble time gives us the approximate, extrapolated age of universe based upon the Hubble constant. Thus, the Hubble time, when calculated assuming that the Hubble term is a true constant, yields an estimate of the age of the universe. Thus, if the current value of the Hubble term (H_0) is measured and yields an age that is less than the ages of certain members of the universe, this defeater requires remeasuring the Hubble term or finding a reason for why the expansion of the universe is changing (accelerating). Historically, this was the case in the early days of modern cosmology, when H yielded an overall age of the universe less than the age of the Earth according to geology. Thus, since H_0 is not a constant in most models, the Hubble length (or Hubble sphere, in three dimensional space) is not the same as the horizon of the observable universe. Such an "age problem" motivates, in part, the recent reintroduction of the cosmological constant Λ ; see below, p. 300.

65. This "universe" conceived through the mathematical formulas of GR is not a whole structured by natural kinds (a cosmos) but a whole that describes the spatiotemporal manifold of mass-energy in "the whole." Stanley L. Jaki, *Is There a Universe? The Forwood Lectures for 1992* (Liverpool: Liverpool University Press, 1993), 10–11, contends that the ability to relate the "strict totality of things" to "the total mass of gravitationally interacting things" grounds the "birth of a new science, a genuinely scientific cosmology." GR allows for this because it offers a "contradiction-free scientific discourse about a totality of things subject to the inverse square law of gravitation as manifesting a central field of force." (12) The usefulness of GR to conceive "the whole" is also noted by Ellis, "Issues in the Philosophy of Cosmology," 1185: "The dominant role of gravity [in cosmological theory] . . . arises from the fact that it is the only known force acting effectively on astronomical scales Consequently, cosmological theory describing all but the very earliest times is based on the classical relativistic theory of gravitation . . . , with the matter present determining the space-time curvature and hence the evolution of the universe." (My emphasis.) De Koninck contends that even Aristotelian cosmology, because of its mode of conception, could focus only on certain formal parts of the universe; see below, §23.4, p. 391, and also above, §11.1. As a consequence, even a non-mathematical cosmology would require completion by another inquiry in order to study all of the natural kinds in the cosmos—most conspicuously it would need biology.

applicable to the universe as a whole until the discovery of cosmological red-shift, and hence recession, of distant galaxies. The original model of the cosmos Einstein provided also maintained that the universe is a finite, unbounded spherical space. However, the current dynamic versions within the “standard model” in cosmology make use of flat, curved, and hyperbolic spaces.⁶⁶

These models are based on the Einstein field equation (EFE) of GR. Essentially, the EFE relates space-time curvature to matter and energy: “Matter [mass-energy] tells space how to curve, space tells matter [mass-energy] how to move.”⁶⁷ Thus, qualitatively, the EFE shows how space-time curvature and mass-energy influence each other.⁶⁸ This mutual influence is seen in the three original observational confirmations of GR, mentioned above and the following three, more recent discoveries.⁶⁹

(2) *Basic empirical foundations of contemporary cosmology*

The dynamic relation between space-time curvature and mass-energy distribution is supported by three categories of phenomena discovered after Einstein: the cosmic background radiation (CBR), the amount of lighter elements due to Big Bang nucleosynthesis, and the age of observed parts of the universe.

66. See Albert Einstein, “Cosmological Considerations in the General Theory of Relativity,” in *The Collected Papers of Albert Einstein*, trans. Alfred Engel, vol. 6 (English Translation Supplement) (Princeton, NJ: Princeton University Press, 1997), 421–432; also, Einstein, *Relativity*, 122–29. Guth, *The Inflationary Universe*, 36–46, provides a helpful summary of this development. Einstein noted the later modification in Appendix 4, Einstein, *Relativity*, 152–54. The most current observations indicate that the universe has a flat geometry; see G. Hinshaw et al., “Nine-year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Cosmological Parameter Results,” *The Astrophysical Journal Supplement Series* 208, no. 2 (October 2013): 15–16.

67. Liddle and Loveday, *The Oxford Companion to Cosmology*, 112.

68. Harrison, *Cosmology*, 229; Liddle and Loveday, *The Oxford Companion to Cosmology*, 111–12.

69. I thank Carol Day for her “Time, Space, and the Expanding Universe (unpublished paper),” which establishes the basics of these four points, from which I directed my own research and further exposition below.

Cosmic background radiation (CBR)

A crucial phenomenon that supports the theory of the expanding universe of the hot big bang theory, and not explicable by Newtonian physics, is the cosmic background radiation (CBR).⁷⁰ Derivable as a natural result of the hot big bang models and first observed in 1965 by Arno Penzias and Robert Wilson, CBR is low temperature (approximately 2.725 degrees Kelvin) microwave radiation that fits a blackbody curve with high precision. It possesses a very high redshift ($z \geq 1000$) and is extremely isotropic.⁷¹ By combining theories of atomic formation from particle physics with the temperatures expected to exist in the early universe, the hot big bang models were able to predict conditions under which the CBR would form and in what manner it would be detectable today.⁷²

The high temperature and density of the early universe prevented by energetic collisions the formation of stable elements. As the temperature of the universe dropped (due to expan-

70. For further details, see Guth, *The Inflationary Universe*, 57–83; Steven Weinberg, *The First Three Minutes: A Modern View of the Origin of the Universe* (Basic Books, 1993), 44–100; Harrison, *Cosmology*, 394–96; Hawley and Holcomb, *Foundations of Modern Cosmology*, 407–430; Liddle and Loveday, *The Oxford Companion to Cosmology*, 56–66, 95–96, 186, and 249–50. The most high-precision measurements of the CBR have only recently been performed by satellite observatories like NASA’s COBE (COsmic Background Explorer) in the early 1990’s, NASA’s WMAP (Wilkinson Microwave Anisotropy Probe, 2001–2010), and the ESA’s Planck mission (2009–2013); see Hinshaw et al., “Nine-year Wilkinson Microwave Anisotropy Probe (WMAP) Observations,” and Planck Collaboration Team, “Planck 2015 results. I. Overview of products and scientific results,” *arXiv:1502.01582 [astro-ph]*, February 2015, accessed July 30, 2015.

71. A blackbody is an ideal object that neither absorbs nor reflects radiation, but only emits radiation thermally. A blackbody at various temperatures possesses a characteristic curve relating the frequency (or wavelength) of the emitted radiation to its energy density. Statistical mechanics of heat shows that any body in thermal equilibrium produces this blackbody spectrum.

72. Weinberg notes in *The First Three Minutes*, 51–52, that such background radiation was predicted by various theorists in conjunction with the development of the theory of nucleosynthesis, but this theoretical work did not lead to “a search for the cosmic microwave background.” The famous pair of publications for the discovery matched theoretical expectations—given in R. H. Dicke et al., “Cosmic Black-Body Radiation,” *The Astrophysical Journal* 142 (July 1965): 414–419—as interpreting aberrant microwave temperature readings: A. A. Penzias and R. W. Wilson, “A Measurement of Excess Antenna Temperature at 4080 Mc/s,” *The Astrophysical Journal* 142 (July 1965): 419–421. Penzias and Wilson won the Nobel Prize for their discovery. (The difficulty of claiming a discovery without interpretation is noted by Helge Kragh, *Cosmology and Controversy: The Historical Development of Two Theories of the Universe* (Princeton University Press, 1997), 353–54.) The hot big bang model involved the development of the theory of big bang nucleosynthesis, which will be discussed just below; see Victor S. Alpher, “Ralph A. Alpher, Robert C. Herman, and the Cosmic Microwave Background Radiation,” *Physics in Perspective* 14, no. 3 (August 2012): 300–334, for the history of particular individuals in this area of theoretical development.

sion), the lighter elements were able to form at conditions around 3000 K. Such conditions resulted in two further types of events, recombination and decoupling, by which the universe became transparent to radiation.⁷³ Under such conditions, the CBR radiation originates as from a blackbody from a “surface of last scattering” (this is the effective limit prior to which no electromagnetic signal is able to penetrate through the dense plasma of the early universe as observed with respect to our lookback time). The surface of last scattering formed approximately 10^{13} seconds (about 300,000 years) after the big bang. If any of this radiation remains today, it would preserve its characteristic blackbody radiation spectrum.

Newtonian physics cannot explain the presence of and characteristics belonging to the CBR. Under the standard model, however, the expansion of space preserves this primal radiation as an “echo” observable from the last scattering surface. Indeed, the expansion of space, just as it produces redshifts in wave phenomena, also affects in proportion the wavelength and consequently the temperature of this primal radiation escaping at the time of decoupling and recombination. This produces the observed blackbody spectrum of the CBR.⁷⁴

Big Bang nucleosynthesis

A second phenomenon which supports the theory of the expanding universe is the observed abundances of certain light elements throughout the universe. As noted above, this big bang nucleosynthesis was developed as part of the hot big bang theory in 1948, and predicted the

73. Recombination refers to the formation of atomic nuclei and free electrons “recombining” with them. Decoupling, in this case, refers to photon decoupling, when photons no longer freely interact with (the recently) recombined electrons. See Liddle and Loveday, *The Oxford Companion to Cosmology*, 95–96 and 249–50. Liddle and Loveday as well as Weinberg, *The First Three Minutes*, 64, note that “recombination” is a misnomer because the electrons were not previously combined with atomic nuclei.

74. Here we should note that certain types of CBR observations support the inclusion of a cosmological constant, Λ , in the basic equations (see above, p. 290). These observations are of slight anisotropies or variations in the CBR’s temperature paired with redshift data from Type Ia supernova support the inference that the expansion of the universe is currently accelerating; Hawley and Holcomb, *Foundations of Modern Cosmology*, 401; see also P. J. E. Peebles and Bharat Ratra, “The Cosmological Constant and Dark Energy,” *Reviews of Modern Physics* 75, no. 2 (April 2003): 560–61. These will be mentioned below when discussing current modifications to the standard model of cosmology.

CBR as a residual sign of this stage of the universe's history.⁷⁵ In short, the combination of extrapolating the standard models of cosmology with the nuclear physics involved in a hot big bang model demands the formation of atomic nuclei beginning early in the history of the universe (on the order of tenths of a second to several minutes) as the expanding universe cooled (from about thirty to ten billion degrees Kelvin). The theory of nuclei formation, or nucleosynthesis, in these conditions (especially the possible ranges of the ratio of available protons to neutrons), yields predictions of the relative abundance of various isotopes of the lightest elements (hydrogen, helium, and lithium) in the universe, and observations match these predictions. These elements then provide the fuel for stars, which burn them by nuclear fusion into all the higher chemical elements, a process called stellar nucleosynthesis, in contrast to the earlier big bang nucleosynthesis.

Three items should be noted. First, prior theories about the state of the universe before this earliest "nucleosynthesis epoch" are required to explain the presence of available matter. This is provided by particle physics' "grand unified theories" (GUT's) and incorporated by the modifications inflationary theory makes to the hot big bang theory.⁷⁶

Second, the observations of the abundance of these light elements lead to the result that the density of matter in the form of protons and neutrons (the baryon density) is far below the critical density needed for the universe to be globally flat.⁷⁷ Now, observational efforts

75. The intricacies of the development of the hot big bang theory are detailed by Kragh, *Cosmology and Controversy*, 80–141; see also Weinberg, *The First Three Minutes*, 122–32 for a briefer historical account. The initial development of the theory in 1948 began with the so-called " $\alpha\beta\gamma$ " paper, R. A. Alpher, H. Bethe, and G. Gamow, "The Origin of Chemical Elements," *Physical Review* 73, no. 7 (April 1948): 803–804, and successor papers, on which see P. J. E. Peebles, "Discovery of the Hot Big Bang: What Happened in 1948," *The European Physical Journal H* 39, no. 2 (April 2014): 205–223. Fabio Iocco et al., "Primordial nucleosynthesis: From precision cosmology to fundamental physics," *Physics Reports* 472, nos. 1–6 (March 2009): 1–76, is a relatively recent, technical, comprehensive review. See also Harrison, *Cosmology*, 392–94, 418–19; Hawley and Holcomb, *Foundations of Modern Cosmology*, 339–42, 362–68; and Guth, *The Inflationary Universe*, 85–104.

76. The term for the process by which higher-energy particle interactions produce the baryonic matter for the requisite ratio of neutrons and protons, baryogenesis, is described by *ibid.*, 105–13, and Hawley and Holcomb, *Foundations of Modern Cosmology*, 356–58. Baryons are a family of elemental particles that include protons and neutrons.

77. Studies of the CBR as early as 1998 (NASA's COBE satellite) and more recently by the WMAP and the

to measure the total mass of observable matter in the universe yield a result of less than unity; the current estimate for this density of gravitating matter, Ω_M , is about a quarter of unity.⁷⁸ The matter density resulting from big bang nucleosynthesis, the baryonic matter density Ω_b , is a fraction of this component. This “shortfall” in ordinary, observable matter is the basis for asserting the existence of “dark matter.” Since the total matter density of gravitating matter, Ω_M , is less than unity and there is reason to believe that the value of Ω is unity (from evidence that the overall spatial geometry is flat), this has further motivated cosmologists to conclude that Ω is subdivided into gravitating (ordinary plus dark-matter) and non-gravitating components. This non-gravitating (in fact anti-gravitating) component is Ω_Λ , the repulsive energy density provided by the cosmological constant Λ or dark energy.

Finally, it should be noted that the initial conditions responsible for the first generation of any hydrogen and helium is, by the same token, responsible for the existence of stars, which must burn hydrogen and helium. Since the nucleosynthesis of heavier elements, including those needed for life, occurs mainly in stars, the causes of these initial conditions (within the universe’s first second) are a necessary condition for the emergence of life billions of years after the big bang event. The disposition of this process towards the existence of life (and thus the lives of human cosmologists) is enunciated by the anthropic principle.⁷⁹

ESA’s Planck Satellite have showed that, although space is locally curved in accordance with GR, it is flat globally. In terms of the theory, if Ω scales the total density of the universe, then for a flat universe, $\Omega = 1$. The matter density parameter is usually formulated such that $\Omega_M + \Omega_\Lambda + \Omega_k = 1$, where Ω_k is the contribution from the curvature of space itself. Measurements of the angular size of small perturbations in the CBR caused by *gravitational* redshifting and blueshifting (the Sachs–Wolfe effect) can independently yield measurements of Ω_k . Thus, Ω_Λ can be inferred; see Hawley and Holcomb, *Foundations of Modern Cosmology*, 390–91, 422–30, and Hinshaw et al., “Nine-year Wilkinson Microwave Anisotropy Probe (WMAP) Observations,” 15–16.

78. Hawley and Holcomb, *Foundations of Modern Cosmology*, 392–99; Hinshaw et al., “Nine-year Wilkinson Microwave Anisotropy Probe (WMAP) Observations,” 8.

79. This requires, at the very least, the “weak” anthropic principle, viz., that the conditions of the universe be compatible with the presence of observers; John D. Barrow, Frank J. Tipler, and John A. Wheeler, *The Anthropic Cosmological Principle*, 1st (New York: Oxford University Press, USA, August 1988), 16. While this will soon provide dialectical support for the instrumental causality of physical space insofar as it is subject to expansion, as demanded by GR, a full assessment and incorporation of the anthropic principle and its versions must be relegated to another project.

Consistent ages of objects in the universe

A final point to consider is the harmony between predictions made by the standard cosmological model of the age of the universe and the measured age of stars, star clusters, and even geological formations. The age of the universe is estimated from the standard model by measuring H and then computing the Hubble time, $1/H$.⁸⁰ The values of H measured in the early days of big bang theory were large and grossly underestimated the age of the universe, predicting ages of the universe billions of years shy of the age of the Earth given by geologists.⁸¹ Age problems continued to persist even after the discovery of the CBR.⁸²

Today, this age constraint motivates the plausibility of the cosmological constant, Λ , and the presence of Ω_Λ in the universal density parameter.⁸³ (This is corroborated by the estimates for Ω_M , as mentioned above.) The presence of Λ in the basic equations of contemporary cosmology would be analogous to an additional, outward (repulsive) force at work in the universe. Consequently, if the expansion rate of the universe is presently accelerating, then the value of H originally extrapolated as a constant into the past to calculate the Hubble time would lead us underestimate the total age of the universe. Given the correction using Λ , the age of the contents of the universe (e.g., the Earth, the Sun, and certain types of star clusters) is in harmony with the theory.

80. See fn. 64.

81. George Gamow, "Modern Cosmology," 60, in *Modern Cosmology & Philosophy*. (This article by Gamow originally appeared in 1954.) See also Arthur Eddington, *The Expanding Universe: Astronomy's 'Great Debate', 1900-1931*, Reprint (1987), Cambridge Science Classics (Cambridge University Press, 1933), 14, 86–87.

82. Jayant V. Narlikar, "Was There a Big Bang?," in *Modern Cosmology & Philosophy*, ed. John Leslie (Amherst, N.Y.: Prometheus Books, 1999), 92–93. (Originally published in 1981.)

83. Peebles and Ratra, "The Cosmological Constant and Dark Energy," 569, as well as Harrison, *Cosmology*, 392, and Hawley and Holcomb, *Foundations of Modern Cosmology*, 387–89.

(3) *Recent modifications, the cosmological constant Λ*

The observations and data from the three areas outlined above support the theory that the universe is expanding, from a singular event, the very origin of time and space. In the earliest moment, before the Planck time of 10^{-43} seconds, the temperature and density of the universe were exceedingly great. This is commonly termed the hot big bang theory. Now that the basics of this theory and its empirical support have been set out, I introduce one of its most recent modifications.⁸⁴ This is the empirical motivation cosmologists have for introducing a positive Λ or cosmological constant—sometimes termed “dark energy.”

Certain observations lead cosmologists to conclude that the universal density parameter Ω ,—see below, equation (5)—contains a majority contribution from an unknown energy component, the “dark energy” or “quintessence” represented by the cosmological constant, Λ . The observations of a positive Λ partially vindicate GR but also lead to other problems that are currently unresolved and provide evidence that GR is ultimately inadequate as a model for the cosmos as a whole.

The modern models of the cosmos consider the large-scale evolution of the universe through cosmic time (the rate of change of the characteristic size of the universe as a function of time, \dot{R}) as solutions to Einstein’s field equations. One such solution, commonly used, is the Friedmann equation

$$\dot{R}^2 = \frac{8}{3}\pi G\rho R^2 - kc^2, \quad (1)$$

which expresses the total matter density of the universe in the $(8/3)\pi G\rho R^2$ term, and where k is the global curvature from GR. When the universe has a spatially flat geometry ($k = 0$),

84. For reasons of space I pass over theories of “inflation” which attempt to solve difficulties which arise in matching the conditions in the current epoch of the universe with initial conditions in the very early universe (at scales far less than a billionth of a second).

the matter density parameter or Ω is $8\pi G\rho_0/3H_0^2$ as a result.⁸⁵ Now, this density includes both non-relativistic and relativistic matter (radiation) and even the curvature of space. In the original form of his field equations, Einstein introduced a constant, the cosmological constant, to the geometric side of his equation to counteract the gravitational force of the mass-energy density term (because he thought the universe to be static, not expanding). However, this *ad hoc* addition proved unnecessary with the development of the standard model, and eventually it was realized that the cosmological constant, instead of representing an arbitrary feature of the geometry of the universe, could represent a contribution to the mass-energy contents of the universe, a type of repulsive gravitational pressure.⁸⁶

How do we know that this constant, i.e., dark energy, is actually present in the universe? Cosmologists subdivide the density parameter into various components:

$$\Omega_{M0} + \Omega_{R0} + \Omega_{\Lambda0} + \Omega_{K0} = 1. \quad (5)$$

85. Equation (1) can be modified to include the Hubble constant and scale factor at the current time—denoted by “naught” subscripts H_0 and R_0 —and rearranged to show the relation between curvature and measurable terms:

$$\frac{kc^2}{R^2} = H_0^2 \left(\frac{8\pi G\rho_0}{3H_0^2} - 1 \right). \quad (2)$$

This not only provides a way to determine the curvature and thus the geometry of the universe as a whole (because the Hubble constant and the matter density can be measured), but leads to what cosmologists term the “critical density” of the universe (Hawley and Holcomb, *Foundations of Modern Cosmology*, 322–23). As noted above, this is the density at which the universe as a whole possesses flat geometry. This is obtained by supposing that $k = 0$, in which case equation (2) becomes:

$$\frac{8\pi G\rho_0}{3H_0^2} = 1 = \Omega. \quad (3)$$

This defines Ω , the matter density parameter. Consequently, the density of a spatially flat universe, or the *critical density* ρ_c , follows from equation (3) by isolating the density term by itself:

$$\rho_c = \frac{3H_0^2}{8\pi G}. \quad (4)$$

Consequently, “the density of the universe directly determines the geometry of space-time in the standard models.” (ibid., 323). Matter (mass-energy) “tells” space how to curve. If the actual density of the universe is less than the critical density, space-time will possess a hyperbolic geometry; if it is greater than the critical density, a spherical geometry. By definition, a universe possessing the critical density would also possess a flat geometry.

86. For an accessible derivation, see ibid., 327–28.

The “naught” subscripts all denote that the terms express these mean density values at the present “now” of cosmic time. Here, Ω_{M0} is the mean mass density of nonrelativistic matter, Ω_{R0} that of relativistic matter, Ω_{K0} is the contribution made by the curvature of space, and $\Omega_{\Lambda 0}$ is the cosmological constant.⁸⁷

The cosmological constant Λ or “dark energy” has several claims for being a non-zero contribution to equation (5). First, it solves the age problem.⁸⁸ Second, estimates of the total gravitating mass (Ω_{M0}) of the universe provide a result far below unity required to make Ω match the critical density, i.e., for equation (5) to sum to unity.⁸⁹ Finally, observations of slight anisotropies or variations in the CBR’s temperature paired with redshift data from Type Ia supernova support the inference that the expansion of the universe is currently accelerating. The supernovae redshift-magnitude observations provide “the most direct evidence” for the presence of a non-zero value for Ω_{Λ} .⁹⁰ The measurement of CBR anisotropies that constrain the value of $\Omega_{\Lambda 0}$ to near three-quarters of unity, taken together with independent the dynamical estimates for Ω_{M0} being about one-quarter of unity, provide a “check” to supplement the central evidence.⁹¹

It is also the case that the same redshift-magnitude relationship of distant Type IA supernovae provides the basis for an argument that the spacetime of GR is responsible for cosmological redshift.⁹² Consequently, given the physical geometry of space in GR and the

87. Peebles and Ratra, “The Cosmological Constant and Dark Energy,” 560. In the present matter-dominated state of the universe, Ω_{R0} is mostly the contribution which the CBR makes to Ω . What cosmologists call “dark matter” was discussed above, see p. 295.

88. This was noted above, see p. 297.

89. Also noted above, p. 295.

90. Hawley and Holcomb, *Foundations of Modern Cosmology*, 401; see above, fn. 74.

91. See also Peebles and Ratra, “The Cosmological Constant and Dark Energy,” 560–61: “The most direct evidence for detection of dark energy comes from observations of supernovae of a type whose intrinsic luminosities are close to uniform The observed brightness as a function of the wavelength shift of the radiation probes the geometry of spacetime, in what has come to be called the redshift-magnitude relation. The measurements agree with the relativistic cosmological model with $\Omega_{K0} = 0$ meaning no space curvature, and $\Omega_{\Lambda 0} \sim 0.7$, meaning nonzero Λ .”

92. This problem was mentioned above, fn. 64. Davis and Lineweaver, “Expanding Confusion,” 102–104, argue that high- z supernovae recently discovered establish the expanding (as opposed to static) character of space based upon the duration-redshift relation. These observations discriminate that GR and not SR is the

concordance of observation and theory indicating the existence of Λ , one could interpret Λ physically as a principle of expansion which not only explains the observed redshift of distant celestial objects but also the current acceleration of that expansion. Therefore, that Λ exists is highly probable. Yet what Λ is and what it means for it to be a physical principle are not clear. It makes some sense that if space in GR is not a sheer void (and how could void possess curvature or bend light?) but an “aether” of sorts, then it would have natural characteristics and causal properties of its own. It would possess a natural motion or activity.

However, cosmologists soon realized that explaining what Λ is in terms of known physical theories led to disastrous results. This is known as the “cosmological constant problem.”⁹³ This problem arose when cosmologists realized that vacuum energy (from quantum physics) would act like a cosmological constant.⁹⁴ However, the total vacuum energy predicted in the universe is about 10^{120} greater than what is actually observed. Thus, not only is it a difficulty that Λ has a value at all, it also perplexes cosmologists why it has such a well-behaved value, viz., on the same order as matter’s contribution to the overall density of the universe.⁹⁵

theory required to explain the observed redshift of distant objects (cosmological redshift).

93. This problem was outlined in 1968 by Zeldovich, see “The Cosmological Constant and the Theory of Elementary Particles (Republication),” *General Relativity and Gravitation* 40, no. 7 (March 2008): 1557–1591; see also Steven Weinberg, “The Cosmological Constant Problem,” *Reviews of Modern Physics* 61, no. 1 (January 1989): 1–23.

94. The energy of the quantum vacuum is an established feature of quantum theory. Even in a “ground state” where no massive particles or photons are present, the Heisenberg uncertainty principle demands that “a quantum system possesses fluctuations and an associated zero-point energy.” See D. W. Sciama, “The Physical Significance of the Vacuum State of a Quantum Field,” in *The Philosophy of Vacuum*, ed. Simon Saunders and Harvey R. Brown (Oxford: Clarendon Press, 1991), 137. See also Decaen, “The Existence of Aether,” 235 fn. 67: “A free (i.e., non-interacting) quantum field is a sum of an infinite number of ‘modes,’ and these modes are excited when there are particles present. The vacuum state, then, is where none of the modes of the field are excited, and therefore, no particles are present.” That is, apparently empty space possesses measurable energy properties—it is not a sheer void but possesses “aether-like” qualities. The effect of this quantum aether can be measured, and is responsible for experimentally verified phenomena, e.g., the Casimir effect and the Lamb shift. This is documented by Decaen, *ibid.*, 235–42; see also his “Aristotle’s Aether and Contemporary Science,” 416–20, in particular 418: “The so-called vacuum is full—it is filled by the irremovable zero-point energy—so its name will be a contradiction in terms unless it is a vacuum only relatively or loosely speaking, that is, unless it is empty only of a certain genus of things, while it may remain full of something of another genus.”

95. Steven Weinberg, “The Cosmological Constant Problems (Talk given at Dark Matter 2000, February, 2000),” *arXiv:astro-ph/0005265*, May 2000, 1, accessed August 1, 2015.

Indeed, the cosmological constant *must* have some small, positive value such that conditions obtain for the existence of life.⁹⁶

Thus, on the one hand, some unknown factor restrains the vacuum energy of the universe (from reaching the predicted value that is 10^{120} greater than observed) yet is not enough to eliminate this cosmological constant. On the other hand, this constant must be present. This dialectical conflict is currently pressuring physicists towards a new theory beyond quantum physics and general relativity. The cosmological constant is “a most stimulating though enigmatic clue to the physics yet to be discovered.”⁹⁷ We await a new—and doubtless very different—Anaxagoras.⁹⁸

96. Peebles and Ratra, “The Cosmological Constant and Dark Energy,” 570, fn. 17: “If Λ were negative and the magnitude too large there would not be enough time for the emergence of life such as ours. If Λ were positive and too large the universe would expand too rapidly to allow galaxy formation. Our existence, which requires something resembling the Milky Way galaxy to contain and recycle heavy elements, thus provides an upper bound on the value of Λ .”

97. Ibid., 561–62, where the entire context is instructive: “Unless there is some serious and quite unexpected flaw in our understanding of the principles of physics we can be sure the zero-point energy of the electromagnetic field at laboratory wavelengths is real and measurable, as in the [Casimir effect]. Like all energy, this zero-point energy has to contribute to the source term in Einstein’s gravitational field equation. If, as seems likely, the zero-point energy of the electromagnetic field is close to homogeneous and independent of the velocity of the observer, it manifests itself as a positive contribution to Einstein’s Λ , or dark energy. . . . The value of the sum suggested by dimensional analysis is much larger than what is allowed by the relativistic cosmological model. The only other natural value is $\Lambda = 0$. If Λ really is tiny but not zero, this introduces a most stimulating though enigmatic clue to the physics yet to be discovered. . . . General relativity and quantum mechanics are extremely successful over a considerable range of length scales, provided we agree not to use the rules of quantum mechanics to count the zero-point energy density in the vacuum, even though we know we have to count the zero-point energies in all other situations. . . . Perhaps a new energy component spontaneously cancels the vacuum energy density or the new component varies slowly with position and here and there happens to cancel the vacuum energy density well enough to allow observers like us to exist. Whatever the nature of the more perfect theory, it must reproduce the successes of general relativity and quantum mechanics.” Further, see *ibid.*, 580: “One sobering detail is that in standard cosmology the two dominant contributions to the stress-energy tensor—dark energy and dark matter—are hypothetical, introduced to make the theories fit the observations.” Consider also the tentative affirmative case for a Kuhnian “paradigm shift” provided by Jorge E. Horvath, “Dark Matter, Dark Energy, and Modern Cosmology: The Case for a Kuhnian Paradigm Shift,” *Cosmos and History: The Journal of Natural and Social Philosophy* 5, no. 2 (2009): 287–303. In a recent review article, Joshua A. Frieman, Michael S. Turner, and Dragan Huterer, “Dark Energy and the Accelerating Universe,” *Annual Review of Astronomy and Astrophysics* 46, no. 1 (2008): 425–26, observe that “Because of its multiple close connections to important problems in both physics and astronomy, cosmic acceleration may be the most profound mystery in science.”

98. Aristotle, *Metaphysics*, I.3, 984b15–19.

18.5 *The dialectical status of the standard model*

Modern cosmology does make various philosophical assumptions, statements which cannot be justified within the parameters of the theory. Most essentially, it assumes that the universe is not anthropocentric but still “anthropometric.”⁹⁹ The assumed homogeneous and isotropic character of the cosmos (the cosmological principle) is what permits homogeneous and isotropic geometries like those used in GR to model the cosmos. Indeed, mathematically, general relativity can model the cosmos only on this simplifying assumption, viz., that the universe behaves as a “fluid” and the mathematical model approximates this behavior where stars and galaxies are members of that continuum.

By applying this idealized mathematical model, modern cosmology also applies a theory tested only under local observations to the universe as a single whole. However, certain simple local laws such as the conservation of energy have not yet been successfully applied to the cosmos as a whole. The resulting asymmetry through time seems significant, and we return to it below.

Modern cosmology also makes assumptions about the constancy and universality of observed local laws. Take two examples. First, it assumes the constancy of natures in all parts of space. In order to measure the redshift of a star, astronomers must assume that the spectral lines are produced by elements of the same properties as those observed on earth, against whose locally measured spectral lines they measure for any shift. Thus, the assumption is that the behavior of the elements at the time of emission was the same as the current behavior of elements. Second, modern cosmology assumes the constancy of natures even across time. For instance, the experimentally verified behavior of atomic particles is assumed to be operative even in the early universe. Modern cosmology also depends upon the lack of systematic errors in accuracy (to be distinguished from precision) when it comes to astronomical

99. Harrison, *Cosmology*, 20.

observations relying on standard candles and standard clocks, which measure distance and time in the heavens.¹⁰⁰

From these presuppositions and the exposition of the standard model, we can see that cosmology is in a dialectical state. The third sense given in §17.5 maintains that an inquiry is dialectical when the meaning of its terms are fluctuating and when it makes use of symbolic, intention-constructing modes of expression for the sake of making certain realities more intelligible. All of these conditions are met by the standard model outlined above, in both its general relativistic modeling and the measurements which provide a reference for confirming or disconfirming the basic equations.

100. These are to be distinguished from the general paucity and statistical “filling in” that undergird astronomical data; see Peebles and Ratra, “The Cosmological Constant and Dark Energy,” 560.

§19 A CANDIDATE FOR THE FIRST MOVED MOVER IS DRAWN FROM INDICATIONS PROVIDED BY MODERN COSMOLOGY; “PHYSICAL SPACE” IS THE FIRST MOVED MOVER IN THE COSMOS.

CRITIAS: We thought that because Timaeus is our expert in astronomy and has made it his main business to know the nature of the universe, he should speak first, beginning with the origin of the universe

SOCRATES: Why don't you make an invocation to the gods, as we customarily do?

TIMAEUS: That I will, Socrates. Surely anyone with any sense at all will always call upon a god before setting out on any venture, whatever its importance. In our case, we are about to make speeches about the universe—whether it has an origin or even if it does not—and so if we're not to go completely astray we have no choice but to call upon the gods and goddesses, and pray that they above all will approve of all we have to say, and that in consequence we will, too. Let this, then, be our appeal to the gods.

PLATO, *Timaeus*, 27c–d

In this section, I make dialectical proposals for the nature of the *primum mobile*. First, (§19.1), I discuss the nature of the arguments which I am making. In the remaining subsections I draw upon four lines of argument from general natural philosophy to propose the specific nature of the *primum mobile* as determinable from modern theory.

19.1 *The nature of the following arguments*

Is modern science searching for the lost *primum mobile* of the ancient cosmologists? Not in such terms. The modern mathematical sciences approach nature in an ontologically neutral fashion. Yet modern cosmology's equations, before and after their use, rely upon an experience of the natural order that, however proper or specialized it may be, essentially involves a non-mathematical aspect and therefore requires natural-philosophical interpretation. Transposing the equations of the standard model and their supporting observations to

the key of ontological claims is of this order. (In what follows, I therefore distinguish between “cosmology” as a putative, yet lost, Aristotelian science and modern physico-mathematical cosmology.)

The transposition will have the following logical structure. In prior chapters, conclusions were established concerning the general nature of the *primum mobile*. Since this is the general conception of a principle upon which the study of cosmology rests, cosmology takes it up as an assumption and seeks to know more about it through the methods proper to cosmology. (The procedure is complicated in the case of modern cosmology since its methods are physico-mathematical.) An analogous instance is Aristotle’s study of the soul. When defining the soul in *De Anima*, Book II, Aristotle takes up as known the various meanings of “substance” (form, matter, and composite), before arguing that the soul is a form. But the knowledge of form, matter, and composite in general is already manifested by the *Physics* as a prior part of natural philosophy. The procedure for the study of the soul is then to manifest the soul as a form via effect-to-cause arguments: we analyze the objects of the powers of the soul, which informs us about its activities, which tells us about the powers of the soul—viz., more about how it is form.¹⁰¹

Analogously, since the first moved mover is discovered by another science, cosmology assumes it as a principle of its subject (the universe), and its scientific work will be *a posteriori*: its arguments will reveal things about this first principle using details about the effects that it principles. Only at the end of its inquiry, therefore, will cosmology know the principle of its subject as such. The study of the soul is analogous in this respect also: the reason that the organism manifests various modes of life is because the soul is form, but we know the soul in detail as form only after an investigation of the various modes of life.¹⁰² It seems reasonable, therefore, that the details of modern cosmology can be used to inform us

101. See Aristotle, *De Anima*, II.4, 415a14–22.

102. Ibid.

in more detail about the fundamental cosmic body which it takes up only vaguely at first, on the basis of general natural philosophy.

However, this analogy to the study of the soul is not perfect. Since the soul is an intrinsic principle of a living composite, it is defined correlatively to matter and we learn more about it from the objects naturally related to the soul as an *intrinsic* principle of *internal* activities of the living composite. However, the *primum mobile* is not the form of a composite, so we cannot learn about it in exactly the same way. The arguments will still be *a posteriori*, but will proceed from effect to cause *extrinsically*, where “something is proven of one thing through another thing [that is] wholly extrinsic.”¹⁰³ However—as I hope to manifest—there is still a significant sense in which the *primum mobile* is a first, intrinsic principle to the cosmos as a unity of order.

A first difficulty with this procedure has to do with the middle term, and this in two ways. First, the conception of the *primum mobile* attained by general natural philosophy compares to what cosmology is able to attain as indeterminate to determinate. Thus, the arguments proposed below are not to be taken as *propter quid* demonstrations, but a manifestation of how one level of determination is found within another level; the arguments are concerned with establishing an identity. We will return to the idea of this order of determination (as opposed to demonstration) below in §22.2. The connections in this section are not demonstrations from one genus to another but point out the order of determination from general natural philosophy to cosmology. In the arguments below, the first premise will be the more determinate conception of the *primum mobile* in cosmology, and the second premise will provide the connection to what was discovered in general natural philosophy.

A second aspect of this difficulty is that the middle term is subject to equivocation. What guarantees that modern physico-mathematical cosmology provides a candidate “of such and such a character” under the notions intended by general natural philosophy? Yet

103. St. Thomas, *Sbdt*, q. 6, a. 1a, c. This mode of reasoning belongs most of all to natural philosophy.

this is always the weakness of a middle science. Since the middle term of this argument is constituted by mathematical physics, its univocity is subject to the limitations of such notions in the middle sciences. This characterizes the following arguments' dialectical character in the second sense of "dialectical," defined above, in §17.5, namely, from what is common instead of what is proper.

Another difficulty with this procedure is that the meaning of the subject term provided by modern cosmology will also be dialectical. As the mathematical theory which is used to predict and interpret observations changes and as the observations require tweaks to an established mathematical model, the *ratio* of the subject that modern cosmology contributes likewise shifts. The move from Newtonian physics to general relativity, for instance, is what first permitted meaningful (non-contradictory) dynamical models of the universe to be constructed. As noted in §18.5, this gives the subject term of this argument a dialectical character in the third sense defined in §17.5, which involves the use of second intentions and symbolic mathematics.

I will now present a series of arguments to specify the nature of the first mobile body. §19.2 gives an argument based on local motion, §19.3 an argument based on place, §19.4 and argument based on time, and §19.5 an argument based on causal conditions for elemental generation and corruption. These four lines of argument join in §19.6 with an overall proposal about the relationship between energy, entropy, time, and anti-reductionism in cosmology.

19.2 Proposal based on the cosmic conditions for local motion

In this section I defend the following argument:

1. Physical space is the fundamental condition for all cosmic local motion.
2. The fundamental condition for all cosmic local motion is the *primum mobile*.
3. Therefore, physical space is the *primum mobile*.

The second (major) premise was established in §10 through an argument based on the physical continuum as well as under the deeper notion of act and potency in §14.2. The first premise I support as follows.

According to one interpretation of general relativity, space is not a void but is itself qualified by a gravitational field. Einstein argues:

In accordance with classical mechanics and according to the special theory of relativity, space (space-time) has an existence independent of matter or field. In order to be able to describe at all that which fills up space and is dependent on the coordinates, space-time or the inertial system with its metrical properties must be thought of at once as existing, for otherwise the description of ‘that which fills up space’ would have no meaning. On the basis of general theory of relativity, on the other hand, space as opposed to ‘what fills space,’ which is dependent on the co-ordinates, has no separate existence. Thus a pure gravitational field might have been described in terms of the g_{ik} (as functions of the coordinates), by solution of the gravitational equations. If we imagine the gravitational field, i.e. the functions g_{ik} , to be removed, there does not remain a space of [the Minkowskian type], but absolutely *nothing*, and also no “topological space.” For the functions g_{ik} describe not only the field, but at the same time also the topological and metrical structural properties of the manifold. . . . There is no such thing as an empty space, i.e. a space without field. Space-time does not claim existence on its own, but only as a structural quality of the field.¹⁰⁴

104. Einstein, *Relativity*, 175–76. Generally, the debate over the nature of space-time falls into two camps: substantivalism and relationalism, and has as its forebear the controversy in early modern physics between Descartes and Newton and Leibniz and Clarke regarding the absolute (or “true”) as opposed to relative nature of motion. Given the predisposition towards relative motion from the Machian background of GR, the debate between substantivalism and relationalism in GR takes on a much finer grain than that between Descartes and Newton (see Newton’s thought experiments with the bucket and two balls in space: Newton, *Principia*, 412–15). What are the terms of the debate in the wake of Einstein? Notes Oliver Pooley, “Substantivalist and Relationalist Approaches to Spacetime,” in *The Oxford Handbook of Philosophy of Physics*, ed. Robert W. Batterman, Oxford Handbooks (New York: Oxford University Press, 2013), 522: “Substantivalists maintain that a complete catalog of the fundamental objects in the universe lists, in addition to the elementary constituents of material entities, the basic parts of spacetime. Relationalists maintain that spacetime does not enjoy a basic, nonderivative existence. According to the relationalist, claims apparently about spacetime itself are ultimately to be understood as claims about material entities and the possible patterns of spatiotemporal relations that they can instantiate.” For the substantivalist, specifying what is to be included as a “basic part” of spacetime (as opposed to an accident of the mathematics used to implement the theory) is crucial. Tim Maudlin, “Substances and Space-Time: What Aristotle Would Have Said to Einstein,” *Studies in History and Philosophy of Science* 21, no. 4 (1990): 541, argues that “a failure to distinguish between the ontology of the mathematical representation and that of the thing represented has led to [confusion].”

An interpretation of space-time in GR more in line with Aristotelian-Thomistic ideas of an underlying is implicit in Christopher A. Decaen, “The Existence of Aether and the Refutation of Void in Aristotle: A

Thus, the space of general relativity cannot be a Democritean void insofar as this qualitative modification is in some way real. Decaen adds:

The gravitational field, which extends out from massive bodies according to an inverse-square law, and now being understood as space-time curvature, implies that all apparent voids are ‘curved’ to some degree. Hence, these ‘voids’ are qualified in some way, and therefore are not truly void; rather, they must be filled by some substance that is subject of this quality, the metric field of gravitational ‘force’ (a quality without a subject being a contradiction).¹⁰⁵

The quality of the gravitational field (as well as dark energy in its accelerative effect) expressed by the spacetime metric (its curvature) requires a *prior* continuum as a substratum—what I will call “physical space.”¹⁰⁶ It is not a mass-possessing dynamic entity like a Cartesian plenum, nor a sheer backdrop like Newtonian space, nor the mechanical ether of pre-

Critical Evaluation of the Arguments” (Ph.D. Diss., Catholic University of America, 1998), see *ibid.*, 224 and fn. 34. The support for this substantivalism comes from the notion that space behaves in a fashion such that non-Euclidean geometry can be used to predict the motion of massive bodies in space. To this end, Decaen quotes Einstein’s remarks (see Albert Einstein, “Ether and the Theory of Relativity,” in *The Genesis of General Relativity: Sources and Interpretations*, ed. Jürgen Renn et al., vol. 3, Boston Studies in the Philosophy of Science 250 (Dordrecht: Springer, 2007), 617–18, 619): “Mach’s idea finds its full development in the ether of the general theory of relativity. According to this theory the metrical qualities of the continuum of space-time differ in the environment of different points of space-time, and are partly conditioned by the matter existing outside of the territory under consideration. This space-time variability of the reciprocal relations of the standards of space and time, or, perhaps, the recognition of the fact that ‘empty space’ in its physical relation is neither homogeneous nor isotropic, compelling us to describe its state by ten functions (the gravitation potentials $g_{\mu\nu}$), has, I think, finally disposed of the view that space is physically empty. But therewith the conception of the ether has again acquired an intelligible content although this content differs widely from that of the ether of the mechanical undulatory theory of light. The ether of the general theory of relativity is a medium which is itself devoid of all mechanical and kinematical qualities, but helps to determine mechanical (and electromagnetic) events. . . . According to the general theory of relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense.”

105. Decaen, “The Existence of Aether,” 227. Decaen further notes, *ibid.*, fn. 43, that the possibility of the local movement of massive bodies through any space, thus affecting the space-time curvature of that space, requires that a void is impossible in principle, not merely that void does not exist in proximity to massive bodies. That is, physical space of its nature is in every place ready to interact with massive bodies, not to mention light.

106. Ludwik Kostro, *Einstein and the Ether* (Montreal: Apeiron, 2000), 183–85, notes that, while “physical space,” “ether,” and “field” were all used by Einstein in near-synonymous ways; “ether” was favored at first, “physical space” later on, and “total field” near the end of his career. Contrast Einstein in 1934, “Physical space and the ether are different terms for the same thing; fields are physical states of space,” with 1955: “Space does not enter here as something existentially independent but as a continuous field of four dimensions.”

Michelson-Morley electromagnetism. This physical space (designated indirectly by the formalism of general relativity) is the fundamental condition for bodies in gravitational motion in the cosmos on local and cosmic scales since, in absence of this subject which the gravitational field qualifies, bodies would not possess such motion. It is especially the cosmic scale which is important. The quality expressed by the metric is applied to the universe *as a whole* by the mathematical models and then claimed to be meaningful. It is this note which essentially grounds the middle term in this first argument about the *primum mobile*.

Here one could object that mere geometry in general relativity cannot provide any causal explanations. Why does the mathematics necessitate some substrate any more than do Ptolemaic epicycles? Consider:

The basic tenet of relativity is the equivalence of mass and energy, $E = mc^2$. In this equivalence there is no theoretical basis for distinguishing body and the surrounding field. What actually results is a geometric continuity of various curvatures, representing a continuous “field” of various intensities. But here “field” is taken in a new sense—as seen through the eyes of geometry. Many popularizers of relativity are perplexed by these difficulties. Bodies and the surrounding environment are obviously distinct realities, yet in relativity theory they are one. There are obviously distinct realities in the universe, yet relativity considers all as a single continuum. There must be some cause of movement, but relativity can offer no cause. The solution of these difficulties lies in the fact that the theory of relativity is not a philosophical theory, but a mathematical theory of nature.¹⁰⁷

Following Weisheipl’s lead, it is important to see that the mathematical abstractions of general relativity cannot be the last word when interpreting the actual physical causality at work—yet neither are they no word at all.¹⁰⁸ The formal quantitative differences described

107. James A. Weisheipl, “Space and Gravitation,” *The New Scholasticism* 29, no. 2 (1955): 218–19.

108. See Decaen, “The Existence of Aether,” 226, fn. 40 and 229, fn. 48. Einstein himself, in “On the Ether,” in *The Philosophy of Vacuum*, ed. Simon Saunders and Harvey R. Brown (Oxford: Clarendon Press, 1991), 13, 18, notes that, in the absence of a complete field theory of matter, general relativity still contains a “dualism” between matter and fields. It is interesting that Aristotle’s own argument in *Physics* VII.1 assumes, as a contrary-to-fact premise, that the cosmos is one continuum—however, this conception of the continuum is a type of abstraction and not adequate to the being of physical space—whatever type of being it has. Even a complete field theory, in the modern sense, would still have to contend with the objection that what its formulas describe are not, in fact, specific physical continua but only their representations. Decaen, “The

by the mathematics are applied to matter and energy in space-time. Thus, unless matter is nothing other than a mode of space curvature, instead of affecting that curvature in some way (a hyper-realism of mathematical entities which is objectionable based upon arguments in *Physics* II.2, see §3.3), it is meaningful to speak of space as a type of physical agency. This is because the differences in curvature would have to be attributed to some underlying other than the contained bodies and since the behavior of massive bodies and radiation are *determined* in some way by their surroundings, which the mathematics describes. It seems more plausible to assume that whatever form is indirectly ascribed to physical space by general relativity also indirectly describes some type of agent causality. That is, it is more plausible to say that space curvature has some physical reality akin to the physical things of our experience than to say that matter is merely a “mode” of space curvature.

Indeed, “physical space” must be an agent if it causes redshift. General relativity is currently the best explanation for the redshift of distant objects. They cannot be solely kinematic Doppler effects due to the peculiar motion of the source or receiver nor special relativistic ones. Thus, the medium of the electromagnetic wave itself must be responsible, and this is the physical space described by general relativity.

Further, Einstein argues that the physical space of general relativity is not just a cause for gravitation but also a causal factor for inertial motion.¹⁰⁹ This denial of action at a distance

Impossibility of Action at a Distance,” 198, argues that since the mathematical physicist abstracts from the matter of substances (and hence from both the good and from agency), and considers only relations, the imagination can easily lead the physicist to erroneous judgments of the material nature of substances.

109. Einstein, “Ether and the Theory of Relativity,” 617: “It is true that Mach tried to avoid having to accept as real something which is not observable by endeavouring to substitute in mechanics a mean acceleration with reference to the totality of masses in the universe in place of an acceleration with reference to absolute space. But inertial resistance opposed to relative acceleration of distant masses presupposes action at a distance; and as the modern physicist does not believe that he may accept this action at a distance, he comes back once more, if he follows Mach, to the ether, which has to serve as medium for the effects of inertia. But this conception of the ether to which we are led by Mach’s way of thinking differs essentially from the ether as conceived by Newton, by Fresnel, and by Lorentz. Mach’s ether not only *conditions* the behavior of inert masses, but *is also conditioned* in its state by them.” Emphases in original. In a passage making similar comments (see Einstein, “On the Ether,” 15), Einstein cautions against making this Machian ether of general relativity behave like ponderable matter or the mechanical ether sought in vain by the Michelson-Morley experiments. See also Decaen, “Aristotle’s Aether and Contemporary Science,” 410–11.

puts Einstein in agreement with Newton.¹¹⁰ Indeed, the causal contact thesis seems to be a first principle in natural philosophy that can be manifested only by induction. Its defense by metaphysics relies upon the following argument: an agent acts precisely in virtue of its actuality, viz., its form. However, as a thing exists, so it operates: those agents whose forms are received in some underlying are proportionately agents of that sort. In physical substances, then, this mode of action therefore follows upon the localized mode of the agent.¹¹¹ If one uses this to interpret the point of view of general relativity, therefore, one has the mathematical means to claim that physical space is a medium for gravitational and inertial motion.

However, cosmology requires not only gravitational and inertial motion, but a cosmic-scale change of the scale factor of physical space itself. Why isn't this expansion of space a hypostatization of a mathematical object, as objected against earlier, only in this case one reifies the geometry of the scale factor?¹¹² Building on the above defense of the necessity

110. See Coughlin, *Physics*, "Appendix 11: A Note on the Contact between the Mover and the Moved," 278–79, where the pertinent excerpt of Newton's letter to Bentley is quoted. See also Einstein, "On the Ether," 20: "The general theory of relativity, whose basic points of view physicists surely will always maintain, excludes direct distant action." For a tentative response to the spectre of problems involving quantum non-locality, see Decaen, "The Impossibility of Action at a Distance," 198–99, and n. 11 and n. 71. These problems—even if they do not pose a problem for the general principle of natural philosophy that there is no action at a distance—do pose foundational problems for relativity; see also Tim Maudlin, *Quantum Non-Localilty and Relativity: Metaphysical Intimations of Modern Physics*, 3rd ed. (West Sussex: Wiley-Blackwell, 2011).

111. In regard to understanding this axiom in philosophy of nature and metaphysics, Decaen's "The Impossibility of Action at a Distance," in *Wisdom's Apprentice: Thomistic Essays in Honor of Lawrence Dewan, O.P.*, ed. Peter A. Kwasniewski (Washington, D.C: Catholic University of America Press, 2007), 190–94, is indispensable. Its centerpiece is a close reading of St. Thomas, *ST*, Ia, q. 115, a. 1, where the argument just given can be found. As St. Thomas states, "Oportet enim omne agens coniungi ei in quod immediate agit, et sua virtute illud contingere, unde in VII *Physic.* probatur quod motum et movens oportet esse simul," and shortly thereafter, "Nullius agentis, quantumcumque virtuosi, actio procedit ad aliquid distans, nisi in quantum in illud per media agit." (St. Thomas, *ST*, Ia, q. 8, a. 1, c. and ad 3 (Leon.4.82). See Elders, *The Philosophy of Nature of St. Thomas Aquinas*, 103, fn. 16.)

112. Graham Nerlich, "Why Spacetime is Not a Hidden Cause: A Realist Story," in *Space, Time, and Spacetime: Physical and Philosophical Implications of Minkowski's Unification of Space and Time*, ed. Vesselin Petkov (Dordrecht: Springer, 2010), 181–82, argues that the formalism of general relativity is no more than statements about the identities between the metric and what is "in" the metric of spacetime; for instance, he notes *ibid.*, 187: "Curvature does not *cause* the deviation because it *is* the deviation" (in regard to the deviation from the expected straight paths of starlight in the gravitational lensing experiments). This position merely assumes ontological neutrality as a conclusion rather than as a working method—it takes the command to feign no physical hypotheses as a categorical imperative. For the case of expansion, Matthew J.

of a substratum, and combining this with the current conclusion of modern cosmology that the spacetime of general relativity is required to explain redshift (i.e., the change of space between objects in space), I can answer no. Physical space is the substrate of what is mathematically modeled by the scale factor; its natural change or operation seems to be expressed mathematically by the change of the scale factor (observable as the Hubble flow), and (given the recent strong consensus that the expansion of space is accelerating) is thus related to dark energy, signified (in some way) by the symbol Λ .

Physical space is, then, a unique type of affected agent cause. It “not only *conditions* the behavior of inert masses, but *is also conditioned* in its state by them.”¹¹³ Thus, taking physical space to be that substratum required by the mathematics of general relativity, we have a causal condition of local motion that determines the motion of bodies without itself exerting a physical force (as a massive object) or being reacted upon by a physical force.¹¹⁴ This physical space must be fundamentally prior in the order of local motion, for it can be devoid of ponderable matter and radiation, but not vice versa. Thus, its “change” or deformation is not such as to possess spatio-temporal predicates in the same sense as the matter it locates.¹¹⁵ Thus, “physical space” is that substratum of the gravitational field and

Francis et al., “Expanding Space: The Root of All Evil?,” *Publications of the Astronomical Society of Australia* 24, no. 2 (2007): 95, 98, decry the “balloon,” “rubber sheet,” and “raisins in rising dough” analogies for expanding space for their crudity. The expansion of space can be a purely metric feature of the model, that is, 101: “a consistent description of cosmological dynamics emerges from the idea that the expansion of space is neither more nor less than the increase over time of the distance between observers at rest with respect to the cosmic fluid.” As with Nerlich’s position, this merely refocuses the attention of the mathematics by relegating “the cosmic fluid” to the background, which was the point at issue. How do they explain the cause of expansion redshift? Ibid.: “The key is to make it clear that cosmological redshift is not, as is often implied, a gradual process caused by the stretching of the space a photon is traveling through. Rather cosmological redshift is caused by the photon being observed in a different frame to that from which it is emitted. In this way it is not as dissimilar to a Doppler shift as is often implied. The difference between frames relates to a changing background metric rather than a differing velocity.” Here again, the “changing background metric” is meaningful as a piece of mathematics, but begs the question.

113. Einstein, “Ether and the Theory of Relativity,” 617.

114. Decaen, “Aristotle’s Aether and Contemporary Science,” 411.

115. Ibid., 412, fn. 123: “Einstein frequently reiterates that his aether is devoid of all predicates pertaining to motion, place, and time, but he implicitly admits that such predicates may apply to it in an extended sense. What Einstein is saying most precisely is that aether lacks a determinate and mathematically expressible velocity, or state of motion or rest, or a trackable temporal history at any point within it Relativistic

Hubble flow, definable by general relativity, by which ponderable matter and radiation are given the necessary but not sufficient determinations of local motion.¹¹⁶

To some degree, this proposal regarding physical space resolves the difficulties of the motor-causality principle discussed in §10.4. This seems likely insofar as the classical problems which the motor causality principle and the causal contact thesis faced—the natural motion of the elements, projectile motion, and the motion of celestial bodies—are resolved through an appeal to physical space as a principle.¹¹⁷ The unity of the motor causality principle is obtained by seeing how the causal contact thesis is found in such disparate motions. Indeed, what physical space adds to the Einsteinian synthesis is the reinstatement of a causal contact condition to all local motions.

This first stage of this series of dialectical proposals raises further questions about the nature of this “physical space.”¹¹⁸ Is it a substance? Akin to the case of Aristotle’s aether, one must answer yes, but it is not a substance like the ordinary living and non-living corrupt-

aether is nevertheless ubiquitous and has points and spatio-temporal coordinates within it, each possessing its own distinct curvature, and which change with time—all of which are spatial and temporal predicates that must have some (perhaps non-mathematical) sense to them. Likewise, by surrounding bodies, the relativistic aether locates them or gives them place, and it is the substratum of space-time; therefore, it bears an intrinsic relation to space and time as a principle of them. Thus, distinguishing analogical (i.e., rationally equivocal) from univocal predication, and following Aristotle’s account, we may rightly say that even Einstein’s aether both has and does not have place, motion, and time.”

116. In view of ensouled beings, one must add “not sufficient.” See St. Thomas, *ST*, q. 115, a. 4, c: “Ponere igitur caelestia corpora esse causam humanorum actuum, est proprium illorum qui dicunt intellectum non differre a sensu. Unde quidam eorum dicebant quod *talis est voluntas in hominibus, qualem in diem inducit pater virorum deorumque*. [*Odyssey*, XVIII.135] Quia ergo constat intellectum et voluntatem non esse actus organorum corporeorum, impossibile est quod corpora caelestia sint causa humanorum actuum.” (Leon.5.544) See also *ibid.*, a. 6, and in particular obj. 1 and ad 1.

117. See Weisheipl, “The Principle *Omne quod movetur ab alio movetur* in Medieval Physics,” 30: “In medieval physics there were three highly controversial problems which involved the principle *Omne quod movetur ab alio movetur*. These were the problem of the natural fall of heavy bodies, the problem of projectile motion, and the problem of celestial motion.” Also, Moreno, “The Law of Inertia and the Principle *Quidquid Movetur Ab Alio Movetur*,” 325: “We must emphasize that the three different kinds of local motions considered by the Greeks, namely, natural, celestial, and violent, necessarily require three different kinds of interpretations of the principle *Quidquid movetur ab alio movetur*. It has to be so, because the concrete interpretation of this principle depends upon the physical theory which accounts for the specific kind of local motion. In all these cases, however, the principle is considered always valid.”

118. Some of these questions I draw from Day, “Time, Space, and the Expanding Universe (unpublished paper).”

ible substances of our experience. If space is expanding, and we take from general natural philosophy that the universe cannot be infinite, then space cannot be expanding “into” anything.¹¹⁹ Yet, since it changes (conditioning bodies and being conditioned by them, as well as expanding) it would possess a nature of some sort. Its change would be neither a local motion (since it is not in place) nor the usual type of growth (since it does not assimilate anything from “outside”). Since the existence of any qualitatively distinct field of energy would seem to be posterior to the continuum required for the field to exist, the expansion of space would seem to be growth in quantity “from within” that is *sui generis* as a quantitative mutation. At the very least, this would require that we modify the Aristotelian arguments defending the priority that local motion has to all other types of motion.¹²⁰ This first mobile would possess a first motion that is irreducibly its own.¹²¹

19.3 Proposal based on conclusions about place

In this section I defend the following argument:

1. Physical space is the principle of place for bodies in the cosmos.
2. The principle of place for bodies in the cosmos is the *primum mobile*.
3. Thus, physical space is the *primum mobile*.

119. Many cosmology textbooks note this pedagogically, but professional reviews do also; for the latter, see Ellis, “Issues in the Philosophy of Cosmology,” 1214–15.

120. See Aristotle, *Physics*, VIII.7, 260a26–261a26.

121. In this conjunction, note that St. Thomas also makes the nature of the first motion—even as a local motion—of an entirely unique type. This is in response to the well known difficulty that, on Aristotle’s definition of place, the outermost sphere would not have a containing body to be its place, and yet it still undergoes motion in place. For discussions of this difficulty historically, see Duhem, *Medieval Cosmology*, 139ff, Jammer, *Concepts of Space*, 72–73, and Grant, *Planets, Stars, and Orbs*, 122–35. St. Thomas, *In Phys.*, lib. IV, lect. 7, discusses various solutions to this problem, and sides with Themistius, n. 7: “Et ideo magis approbo sententiam Themistii, qui dixit quod ultima sphaera est in loco per suas partes.” This means that, in reply to the objection that act is prior to potency, and thus the motion of the first body should not be through parts merely existing in potency, n. 9: “dicendum est ergo quod hoc optime congruit primo motui. Necessesse est enim quod gradatim ab uno immobili descendatur ad diversitatem quae est in mobilibus. Minor est autem variatio quae est secundum partes existentes in loco in potentia, quam quae est secundum tota existentia in loco in actu. Unde primus motus, qui est circularis, minus habet de difformitate, et plus retinet de uniformitate, propinquior existens substantiis immobilibus.” (Leon.2.168)

The second (major) premise of this argument relies on determinations made in §6 and §10. Place, in Aristotle's sense, is the innermost, immobile surface of the containing body; the immobility of this surface is formal immobility with respect to an order of position possessed by the cosmos as a whole. This order to the first principle of place is "a-mobile" and thus preserves the formal immobility of the containing surfaces as subjects of the predicamental reality of place.

Building upon §19.2, I claim that physical space is a principle of the order of bodies that it contains. Consequently, it is a principle of any order of position of containing surfaces (whether of some bodies by other bodies or by a body contained by physical space alone). This can be seen by first noting that the GR-based models provide the cosmologist with a geometry structured by "comoving coordinates." These space-time coordinates remain by definition at rest (a-mobile) with respect to the geometrically ideal Hubble flow or change of the scale factor. The distance between intervening points changes according to the scale factor R , or $R(t)x$. These comoving coordinates do not move with respect to some further "background"—the comoving coordinates are "coordinates fixed with respect to the overall Hubble flow of the universe, so that they do not change as the universe expands."¹²²

Yet are these comoving coordinates anything more than a merely mathematical structure and not a physical one? Indeed, Einstein—in a passage describing the differences between the various "ethers" of physical theories—notes that "the fact that the general theory of relativity has no preferred space-time coordinates which stand in a determinate relation to the metric is more a characteristic of the mathematical form of the theory than of its physical content."¹²³ Physical space is no longer "handed" or organically articulated (as Aristotle thought, maintaining that Europeans live on the hemisphere of the earth looking "up" at the underside of the heavens).¹²⁴ However, it seems from the above (§19.2) that physical space

122. Hawley and Holcomb, *Foundations of Modern Cosmology*, 522.

123. Einstein, "On the Ether," 18.

124. See Aristotle, *De Caelo*, II.2, 285a27–286a1; his reasoning is functional: the principle of motion in

is a principle of location. Can these comoving coordinates “exist” in some way?

Recall that the Friedmann equation (above, equation (1), p. 298) is applied to the universe as a whole. In order to do so, it is assumed as a first principle by cosmologists that the cosmos as a whole is homogeneous and isotropic, and this can be confirmed or disconfirmed observationally. Ludvigsen clarifies this further:

The universe, as we have seen, appears to be homogeneous and isotropic on a sufficiently large scale. These properties lead us to make an assumption about the model universe we shall be studying, called the cosmological principle. According to this principle the universe is homogeneous everywhere and isotropic about every point in it. This assumption is very important, and it is remarkable that the universe seems to obey it. The universe is thus not a random collection of galaxies, but *a single unified entity*. As we stated above, the cosmological principle is not true for all observers, but only for those who are, *in a sense*, at rest with respect with the universe as a whole. We shall refer to such observers as being comoving.¹²⁵

The comoving “observers,” if they existed as more than conceptual entities, would possess the property of sharing a rest frame with the universe as “a single unified entity.” Those observers who are “in a sense” at rest in this frame would have a privileged view of the evolution of the universe. Therefore, if physical space is the substrate for the metric of the expansion of space, then these positions of order of that substrate grounding “cosmic rest frames” for comoving observers would not be a mere idealization.

Now, one implication of the cosmic background radiation (CBR) is that it could allow human observers to *discover* such a cosmic rest frame. That is, whether the CBR *is* a unique

animals is in the right; yet the origination of motion in the heavens is from the east—or to one’s left in the northern hemisphere. See St. Thomas, *In De Caelo*, lib. II, lect. 3, n. 12: “Et hoc sic apparet. Imaginemur enim hominem cuius caput sit in polo Arctico et pedes in polo Antartico: manus eius dextra erit in occidente et manus sinistra in oriente; si tamen facies eius sit versus hemisphaerium superius, quod est nobis apparens. Cum ergo motus caeli sit ab oriente in occidentem, sequetur quod sit a sinistro in dextrum. Sed si ponamus e converso quod caput hominis sit in polo Antartico et pedes in polo Arctico, eadem dispositione faciei manente, manus dextra erit in oriente et sinistra in occidente: et sic motus incipiet a dextra, secundum quod convenit. Et ita manifestum est quod sursum caeli est polus immanifestus.” (Leon.3.132)

125. Malcolm Ludvigsen, *General Relativity: A Geometric Approach* (Cambridge: Cambridge University Press, 1999), 7; my emphases. See also Hawley and Holcomb, *Foundations of Modern Cosmology*, 420–21.

reference frame for the cosmos is testable. Such a result comports with physical space as a locative agency—expressed via the geometry of space-time—of the distribution of mass-energy throughout the universe. At present, data are consistent with the assertion that the CBR’s frame of reference coincides with the overall Hubble flow of the cosmos, but results are not definitive.¹²⁶ The difficulty with testing the CBR as a rest frame is that it is ultimately dependent upon the accuracy of measurements in such tests. I note that this measurement difficulty of “locating” the first immobile principle of place would still have existed for pre-modern cosmology due to the precession of the celestial pole. The mere difficulty of an empirical measurement does not negate the being of what is being measured.¹²⁷

While the latest observations suggest that space possesses a flat geometry, observations cannot determine whether or not the universe is infinite in extent. The mathematical physicist may, of course, *assume* an indefinite character for the sake of his calculations.¹²⁸ However, while a mathematical space conceived of using symbolic notation can countenance the expansive alteration of an infinite space, a physical space with a natural aptitude for change

126. Hawley and Holcomb, *Foundations of Modern Cosmology*, 422.

127. However, the difficulty is magnified exponentially today due to the fact that the last scattering surface eliminates the possibility of observing the totality of the universe. Finding the resting frame of the CBR and matching it with the pure (theoretical) Hubble flow requires the elimination of all peculiar motions (of the Earth, the Solar System, the Milky Way, the local galactic cluster, etc.); *ibid.*, note: “At some point all galaxy motions should blend into a background Hubble flow, but until we can determine the peculiar motion of our and other galaxies, it is not so easy to extract the pure Hubble flow. We can plot velocity–redshift diagrams for distant galaxies located in all directions, and attempt to shift the data until the scatter of the points is minimized; but so far this approach is not really definitive. For the present we shall simply state that the data are consistent with the coincidence of the CBR frame and the frame of the Hubble flow. Work in this area continues.”

George F. R. Ellis, Roy Maartens, and Malcolm A. H. MacCallum, *Relativistic Cosmology* (Cambridge University Press, 2012), 20–21, also describe the limiting margin between theory and observation in this case: “*Observationally*, the 4-velocity of such a family [of fundamental or comoving observers] can be determined either (a) by measuring the motion of matter in an averaging volume (e.g., a local cluster of galaxies) and determining a suitable average of those motions, or (b) from the CMB [cosmic microwave background] anisotropy measurements. There is a preferred frame of motion in the real universe such that the radiation background is (approximately) isotropic; this is a classic case of a *broken symmetry* (the solution breaks the symmetry of the equations). (One cannot observe this velocity from within an isolated box, e.g. if closed off in a laboratory with no windows; thus this does not violate the principle of special relativity.) We move with almost that preferred velocity, which can be dynamically related to that of the matter present in the universe Our usual assumption is that the matter and CMB velocities agree.” My emphases.

128. Aristotle, *Physics*, III.7, 207b27–34.

cannot.¹²⁹ Furthermore, the presence of a positive cosmological constant in the GR-based equations is not incompatible with a closed geometry (an “infinite” but bounded universe), as in Lemaître’s original model.¹³⁰ Thus, if finite physical space is best modeled on the cosmic scale with a flat geometry, one could suggest that the cosmos is currently large enough such that observations cannot invalidate the cosmological principle in such a space (recall that this principle is a philosophical assumption of physico-mathematical cosmology and not one of its conclusions). If physical space is best modeled on the whole with a spherical geometry, while there would be no “center” to space, a rest frame for the cosmos would still be possible.

To summarize: Physical space is the foundation or principle of place in the cosmos. From modern cosmology, I have proposed that this corresponds to the order of position in physical space of “comoving observers,” which is determinable in principle according to the standard model. This further determination supplements the indeterminate status of conclusions reached in the general philosophy of nature.

19.4 Proposal based on conclusions about time & simultaneity

In this section I defend the following argument:

1. Physical space insofar as it is the principle of expansion is the principle of cosmic time.
2. The principle of cosmic time is the *primum mobile*.
3. Therefore, physical space is the *primum mobile*.

129. The Aristotelian “radius argument” against an infinite, rotating heavens would apply here, only in a radial direction; see Aristotle, *De Caelo*, I.5, 272b29–273a1. The reasoning is based upon the impossibility of an infinite distance being traversed in a finite time; see *Physics*, VI.7, 238a32–b15. See also St. Thomas, *ST*, Ia, q. 7, a. 3, c.

130. “Infinite” in this case would be said only by metaphor, it seems; see Aristotle, *Physics*, III.6, 207a1–9.

The second premise was defended above in §7. The first premise in this argument has been suggested by others.¹³¹ In a passage critiquing Maritain, Thomas McLaughlin also defends this premise:

Astronomers speak of the age of the universe and date it based on its expansion. The expansion of the universe is the motion of the whole that has replaced the revolution of the outermost celestial sphere as the basis of a universal time. The hierarchy of the universe, contrary to Maritain's view, has not been reversed, but unlike the ancient view in which one revolution of the outermost celestial sphere is just like any other, the expanding universe changes as a whole over time.¹³²

Other philosophers of science outside the Aristotelian-Thomistic tradition also suggest a similar premise. Noting the limitations of special and general relativity as local models, Whitrow writes:

Once the existence of a world-wide distribution of matter, albeit of extremely low mean density, becomes an essential feature of the problem under investigation, then certain frames of reference and observers must be specially distinguished, namely those which move with the mean velocity of matter in their neighbourhood. In the cosmological models which we have discussed . . . , the local times of all these 'privileged' observers fit together into one world-wide time. Does it therefore follow that, despite the successes of relativity theory on the local scale, we must revert to the traditional idea of an objective universal time on the cosmic scale?¹³³

Similar observations are made by other philosophers of science.¹³⁴ The most comprehensive new case for a unified cosmic time is made by Unger and Smolin.

131. Coughlin suggests it as a "guess" (dialectical proposal) in a text quoted at the end of §7.3; see also Coughlin, "The Ground and Properties of Time," 76–77. Day, "Time, Space, and the Expanding Universe (unpublished paper)," also defends this premise.

132. Thomas J. McLaughlin, "Astronomy: Queen of the Specific Sciences," *Angelicum* 87 (2010): 1039. McLaughlin refers to Jacques Maritain, *Philosophy of Nature* (New York: Philosophical Library, 1951), 154: "[Our world's] hierarchy has been reversed: the atomic world and not the celestial spheres is now the basis of time." Since the subject of McLaughlin's illuminating essay is closely tied with the material of Chapter 7, I will only note here that by "physics" McLaughlin means modern mathematical physics; he distinguishes, *ibid.*, 1015, between modern physics and the general philosophy of nature. The manner in which he defines astronomy would include cosmology, as I am using it here, as a part.

133. G. J. Whitrow, *The Natural Philosophy of Time* (Oxford: Clarendon Press, 1980), 257.

134. Swinburne, "Verificationism and Theories of Space-Time," 73–74, whose account is refined by Peter Forrest, "Relativity, the Passage of Time, and the Cosmic Clock," in *The Ontology of Spacetime II*, ed. Dennis Dieks, *Philosophy and Foundations of Physics* 4 (Amsterdam: Elsevier, 2008), 250–52.

The assertion that what is real is real in a moment conflicts with the relativity of simultaneity according to which the definition of simultaneous but distant events depends on the motion of an observer. Unless we want to retreat to a kind of event or observer solipsism in which what is real is relative to observers or events, we need a real and global notion of the present. . . .

A global preferred time would have to be relational, in that it would be determined by the dynamics and state of the universe as a whole. It would thus not be determinable in terms of information local to an observer. Such a relational local time could then be consistent with the relativity of simultaneity holding locally in regions of spacetime.¹³⁵

There is significant precedent, therefore, for this second premise, ranging from Thomists to cosmologists involved in active research.

The Friedman equation discussed above—equation (1)—demands *ex hypothesi* that space expands homogeneously and isotropically. From the discussion of comoving observers, above, one can draw the corollary that such a set of observers all keep cosmic time insofar as they are at rest with respect to the whole universe—if they had started their clocks at the big bang, their clocks would now give the precise age of the universe.¹³⁶

Insofar as physical space contains a principle of expansion (which seems to be tied to “dark energy” signified by cosmologists as Λ) and is the fundamental condition for local motion in the cosmos, its motion would be the first motion of the cosmos. Its change would therefore “keep” cosmic time. As a causal condition for local motion, it is present to (“together with”) all bodies in the cosmos. So it is a universal cause of time, just as it is a universal cause of mobility. Physical space also shows how the causal argument for simultaneity and the dimensional argument for simultaneity are connected, because physical space

135. Unger and Smolin, *The Singular Universe and the Reality of Time*, 418, 420. This quote is taken from the second half of the book, written by Lee Smolin. He references a mathematical formalism—“shape dynamics”—which shows how the local invariances of general relativity are compatible with a global time. See also 139.

136. The actual isotropic expansion of the universe seems to be contingent upon the initial conditions present in the early universe, and thus only on the basis of a hypothesis such as the inflationary modification to the hot big bang model could one preserve isotropy of expansion, and thus the theoretical possibility of matching local clocks to a cosmic clock, viz., since the universe would be expanding uniformly everywhere. See Forrest, “Relativity, the Passage of Time, and the Cosmic Clock,” 249, 251.

possesses dimension as an attribute and it is a cause.¹³⁷ Is physical space one substance? The most popular mathematical models assume that the expansion of space is homogeneous and isotropic: it behaves in a unified way. Thus, if it does undergo a single change that is natural to it, then it is reasonable to conclude that it is one being, if the identity of a being can be inferred from the identity of a motion. (Alternately, a set of numerically different, interacting, fundamental physical spaces would require coordination by a first mover.)

A difficulty for this account, however, is that (at least according to relativity theory on the local scale), local irregularities in the uniformity of time arise.¹³⁸ The interaction of physical space and mass-energy cause irregular local times within one cosmic time. This would seem to require that cosmic time, if it is one through the whole cosmos, “runs” at various rates on local scales and is thus not one. Perhaps the contradiction is only apparent. If time is a derivative feature of the before and after in motion, and the before and after in motion is grounded in the realized actualities of the natural potencies of the mobile, perhaps a subject-less *Newtonian* time would find this irregularity difficult (since Newtonian time flows equably apart from any moving subject). Modern philosophical cosmology must provide a different account. Just as physical space as a substratum of its own expansion (perhaps its first accident) is not in place strictly speaking and would possess location only in an analogous sense to contained bodies in the universe, so also it would possess time only in an analogous way compared to bodies in local time frames. That is, its “duration” and the durations of substances at local levels would be analogous, since they have different modes of being. This does not prevent the duration of physical space from being the principle of time for bodies in the cosmos—it only means that physical space must be an equivocal cause as the cosmic, ontological measure of time.¹³⁹ These bodies, after all, have their own natural

137. Coughlin, “The Ground and Properties of Time,” 77. In addition, perhaps its dimensionality (a quantitative attribute), is an instrument for the gravitational and inertial effects it allows.

138. This is “many-fingered” time; Lee Smolin, *Time Reborn: From the Crisis in Physics to the Future of the Universe* (New York: Houghton Mifflin Harcourt, 2013), 66.

139. St. Thomas uses “duration” as an analogous notion between physical substances, angelic substances,

aptitudes for change—dependent as they are for the before’s and after’s in their local motions upon the before’s and after’s grounded in physical space—and so a local system could possess time more “intensely” than the whole time that measures it.

19.5 Proposal based on the cosmic conditions for the elements

In this section I defend the following argument:

1. Physical space is the first intracosmic, instrumental cause of the generation and corruption of the elements.
2. The first intracosmic, instrumental cause of the generation and corruption of the elements is the *primum mobile*.
3. Physical space is the *primum mobile*.

The second premise was defended in §14 and §15. Contemporary cosmology argues that matter throughout the whole cosmos is subject to generation and corruption (not just a limited terrestrial region). Thus, it seems that the whole cosmos requires dispositive causality for such changes. However, these conditions and changes taken as a sum total have a very indeterminate and accidental relationship to each other. (They would only be given a unity conceptually, say through the notion of entropy; more on this in §19.6.) Having expanded the region where generation and corruption occur, modern astronomy thus expands the influence of indeterminacy in any putative primary causal influences for substantial changes;

and God’s eternity. Indeed, if physical space is a moved mover, as it seems it must be if it undergoes a change, God’s eternity would measure its duration. See also De Koninck’s *Cosmos, Writings, Vol. 1*, 293–94, 298–300, where he distinguishes the homogeneous time of mathematical physics (“experimental time”) from the heterogeneous, ontological time that exists in a cosmos of more and less perfect substances. My proposal is that physical space demands a type of duration that is similarly analogous to the durations proper to various substances, although, as De Koninck notes, experimental time is still effective because it measures these heterogeneities based upon their common generic aspect, viz., sharing in the genus of corporeity. Thus, the perfect uniformity of time may exist in the mathematizing, measuring mind but not perfectly such in things themselves; see Coughlin, “The Ground and Properties of Time,” 57–58, who argues: “Thus, that time is uniform is a *per se notum* proposition because measure or number is in the definition of time. Since time is a measure because the mind uses one motion to measure another motion, the uniformity of time follows from this act of the mind and not simply from the external reality of time.” That is, the uniformity of time is a formal property found most perfectly in the mind, and not in things. This comports with my guess about the comparison of global to local time in this paragraph.

however, it would not eliminate the *per se* requirement that any substantial change have proper conditions.

Modern cosmology therefore contends that there are chance occurrences in the heavens, contrary to what the ancients and medievals thought.¹⁴⁰ The existence of chance events in the heavens, however, does not prevent there from being natural agency in the heavens—indeed, the nature of chance requires that there be *per se* agency. Thus, we should speculate (as general natural philosophers) that the existence of this fundamental instrumental cause is still necessary as a *per se* condition of generation and corruption even if its nature gives a wide berth to indeterminate chance occurrences. This *per se* causality is thus ordered to a *per se* end that uses *per accidens* causes.

To defend the second premise of the argument above, I can appeal both to nucleosynthesis and to the order which many (including De Koninck) argue exists between the aptitude of fitting conditions in the cosmos and the existence of human life. Recall that the originators of the hot big bang theory were led to it via their research into the existence of the various elements. The high temperatures predicted in the early universe provided the proper conditions for the formation of the light elemental nuclei.¹⁴¹ Since the requirement for the existence of life is not only the existence of stars (because heavier elements are only thought possible as the results of stellar fusion) but also, in view of that end, the existence of enough space for stable star systems to form, the expansion of space is required as an instrument to realize those conditions.

140. Recall that the reason why they thought the contrary was the case was due to the nature of the aether which composed the heavenly bodies: since generation, corruption, alteration, and growth are not possible in such a matter, but only determinate local motions, there would be no room for the material indeterminacy requisite for chance occurrences.

141. The inflationary hypothesis, motivated by other problems, contributes at least theoretically to the formation of these conditions because the predicted rise in temperature after the phase transition which ends the inflationary epoch, leaving behind a hot “soup” of elementary particles, provides the requisite material conditions for the hot big bang model. Thus, one could suppose, first, that if the “inflaton” field of the inflationary epoch is identified, it is some mode of physical space as the first mobile, as seems plausible since the inflationary theory relies upon the energy density of a “vacuum” state.

Note, first, that some cosmologists disparage the notion of “fine tuning” and even seem to use it as a sign that further inquiry is needed. I sketched De Koninck’s early commitment to a version of the “strong” anthropic principle above, in §14.3. Since it is outside the scope of this project to evaluate the notion of the anthropic principle in modern science, it will suffice to note that cosmologists nonetheless must use a “weak” anthropic principle as a regulative concept. If a proposed model of the universe makes the formation of life impossible, then it cannot be explanatory of the current universe. Indeed, if physico-mathematical cosmology is an inquiry that is ordered by a higher philosophical discipline, then the practicing cosmologist could take the anthropic principle as a useful tool of his inquiry, and not concern himself, *qua* cosmologist, with its meaning in a higher sphere.

Second, since the expansion of space is homogeneous and isotropic, its *per se* causality would subsume the chance positioning of matter in such formations (the accidental arrangements or events in the early universe, called “seed perturbations”) to the *per se* end of the formation of large-scale structure in the older universe. While the conditions that lead to these formations are indeterminate, the processes that regulate them (*viz.*, the motion of expansion and nucleosynthesis) are not, insofar as these processes are principled by the natures of the substances in question. Furthermore, these “seed perturbations” could succeed or fail to attain the naturally envisioned end—the name is apt, even if unintentionally so.

Applying an argument like De Koninck’s to the case at hand (see §14.3), the general notions of a fundamental cosmic instrument ordered to generation and corruption of the elements is made more precise and determinate by cosmology through its proposals concerning nucleosynthesis and large-structure formation. Specifically, physical space as the subject of expansion is the first intracosmic cause of the conditions of generation and corruption ordered to the formation of higher forms, whether substantial (elements and compounds) or accidental (structure or position). If we follow De Koninck, we can see in physical space both secondary and instrumental causality—secondary because physical space is a moved mover,

and instrumental because it is ordered to the achievement of an end (the human form) which exceeds its own natural capacity to produce.

19.6 Proposal based on energy, entropy, and time's cosmic arrow

But change, by nature, displaces all things. For all things come to be and are destroyed in time.

ARISTOTLE
Physics, 222b16–17

This final argument will bring to bear the dialectical conclusions from the above sections on the temporal asymmetry of nature, or the “arrow of time.”¹⁴² The vast majority of equations in physics are symmetric under time reversal: “Mathematically, final conditions are just as good as initial ones for determining the evolution of a system.”¹⁴³ Now, this is a sign that mathematical physics is fundamentally inadequate as an explanation of the natural order, if one grants that the reality of time and its directionality are fundamental and non-illusory experiences.

Typically, one sees appeals to the second law of thermodynamics (entropy) as a way to understand (if not go so far as to explain) the asymmetric character of time.¹⁴⁴ The

142. In this section, I draw part of the argument from Day, “Time, Space, and the Expanding Universe (unpublished paper),” and part of the argument from a problem in cosmology identified by Edward R. Harrison, “Mining Energy in an Expanding Universe,” *The Astrophysical Journal* 446 (1995): 63–66, a problem which Ellis, “Emerging Questions and Uncertainties,” 281–83, also mentions. His two proposed resolutions (indicating the dialectical status of this question), exhibit that he is still attempting to solve the problem *within* the language of mathematics: “The direction of the arrow of time may be related directly to the expansion of the Universe (which would be experienced as a contraction if time ran the other way). . . . The arrow of time may be determined by specific boundary conditions for local physical laws at the beginning and end of the universe, restricting the physically realized solutions from all possible ones to those that conform to the one consistent time direction.” Penrose argues against such positions; see below, p. 330.

143. Roger Penrose, *The Road to Reality: A Complete Guide to the Laws of the Universe* (New York: Alfred A. Knopf, 2005), 687.

144. See *ibid.*, 686–92, 696–98. De Koninck also makes this correlation, see *The Cosmos*, in *Writings*, Vol. 1, 241: “It is the irreversible direction taken by this progressive denouement [of energy] which gives time its arrow, its unique direction. The measure of the disorder of the growing chance which leads to the utilization of energy is called *entropy*. It is entropy that allows us to discern the flow of the universe. . . . A constant relation exists between the law of degradation and the expansion of the universe: the entropy of the universe is proportional to its volume.” See also “Reflections on the Problem of Indeterminism,” *ibid.*, 431.

second law essentially states that heat flows from a hot body to a cold body; the reverse is impossible. This exchange of heat between systems results in an increased measure of disorder, since *more* order is required of the microscopic parts of the hot and the cold body to exhibit (macroscopically) those diverse temperatures, while *less* order is required to exhibit thermal equilibrium. Thus, the entropy, or the measure of disorder in a system, increases with time. A system of low entropy is organized and contains energy in a more usable form (a log, ready to be used for fuel), and progresses over time to a higher entropy (there is now only ash in the firepit). (Living beings, then, must locally reverse the trend of entropy by increasing entropy elsewhere.¹⁴⁵) Writes De Koninck:

If time really advances, if there is a unique direction, there could not be perfect symmetry [between the coordinates of space and the coordinates of time]. Not only is the witness of our consciousness opposed to this indifference of direction, but the unique direction of time is experimentally defined in the degradation of energy. But it is to be noticed that if we remove from the second law of thermodynamics its statistical character, we also take from time its arrow, and entropy no longer has any objective meaning.¹⁴⁶

To give an objective meaning to time, in the Aristotelian cosmos, requires that one take as a premise the reality of motion. Since a mobile undergoing some motion possesses the actuality of some potency as such, time is irreversible because potency is ordered to act. Time possesses an arrow precisely because nature is a principle that acts for the sake of something. Therefore, a mode of conception which abstracts from sensible matter (and hence from the good) leaves one with a conception of time denuded of direction. However, an appeal to potency to explain the direction of time should not be directly equated with “potential energy” that is “lost” in a system measured by physics—the equations preserve this loss within other forms by the conservation of energy. The increase of a system’s entropy, as a measure of these other forms

145. Ibid., 242–43, 244–45. In his classic essay, Erwin Schrodinger, *What is Life?* (Cambridge University Press, 2012), 71, says of this negative entropy: “What an organism feeds upon is negative entropy. Or, to put it less paradoxically, the essential thing in metabolism is that the organism succeeds in freeing itself from all the entropy it cannot help producing while alive.”

146. De Koninck, “The Problem of Indeterminism,” in *Writings*, Vol. 1, 365.

of energy as part of the disorder of a system (the light and heat of the log as it reduces to ash) is a correlation to time's arrow, but not an explanation of it.

Now, it is the probable opinion of some cosmologists that the conservation of energy might be a local law and not one that is applicable to the cosmos as a whole.¹⁴⁷ For instance, the energy lost after decoupling is not conserved.¹⁴⁸ After this event, the universe expands and the radiation on the last scattering surface cools with the expansion to form what we observe as the cosmic background radiation. The claimed non-conservation of energy can be seen by analogy to an expanding container of gas that cools as the container expands. In the case of a container filled with hot gas, the energy lost as the gas cools is converted into other forms, viz., work on the walls of the container. In the case of the universe, however, the radiation is not *itself* causing the expansion of the universe so as to conserve energy in the form of work, nor can an exchange with gravitational potential energy explain this loss (since this merely presupposes a change in a local gravitational field in space, unconnected to the expansion redshift).¹⁴⁹ Since cosmologists presume that the universe is a closed system, and there is no “external agent in the cosmos, nor is there a boundary against which the photons push,”¹⁵⁰ the universe is a system whose energy decreases even as its entropy increases.

Now, the idea of the “increase of entropy” of the whole universe and the idea of its conser-

147. Harrison, “Mining Energy in an Expanding Universe,” 65, 66: “In an expanding, homogeneous, unbounded universe, all large-scale comoving regions are alike in content, and each, by detailed balancing, may be regarded as a closed system having no external world to which the lost energy $-PdV$ can be transferred. We may imagine the whole universe partitioned into macroscopic cells, each of the comoving volume V , and all having contents in identical states. The $-PdV$ energy lost from any one cell cannot reappear in neighboring cells because all cells experience identical losses. The usual idea of an expanding cell performing work on its surroundings cannot apply in this case. . . . The tentative conclusion of this discussion is that energy in recognizable forms (kinetic, potential, and internal) in an expanding, spatially unbounded, homogeneous universe is not conserved.”

148. Protons and electrons can bind into neutral atoms (of hydrogen or helium) and thus “decouple” from an ambient electromagnetic field (photons) previously coupled to unbound (charged) protons and electrons. See also above., p. 293.

149. See also Harrison, *Cosmology*, 348–49, as well as Hawley and Holcomb, *Foundations of Modern Cosmology*, 414–15. The finitude of energy is also Harrison’s solution to Olbers’ paradox (*Darkness at Night*, 195–204); therefore, as Olbers’ paradox arises when extrapolations from local physical principles are made, the context of his solution seems significant.

150. Hawley and Holcomb, *Foundations of Modern Cosmology*, 414.

vation of energy must be more closely examined. Clausius concluded that the energy of the universe is constant and that the entropy of the universe tends to a maximum.¹⁵¹ However, the sub-title of Clausius' work might lead one to wonder whether the steam-engine is an adequate model for the cosmos.¹⁵² Indeed, Harrison's arguments concerning non-conservation of energy lead to the suspicion that the problem arises because we are considering systems in mathematical physics. Now, let us say that in such a context the law holds: every closed system in mathematical physics conserves energy. However, taking Harrison's position up as a dialectical premise, I claim that the cosmos as a whole does not conserve energy. Thus, the cosmos is not a closed system in mathematical physics.

Furthermore, as the context of Harrison's argument makes clear, it is the expansion of the universe as to its parts that results in the non-conservation of energy. Now I can draw upon the various claims made above: the *primum mobile*, physical space, is the cause of the expansion of the universe as to its parts. (That is, physical space is that which undergoes expansion as its proper change, with a consequent effect upon the universe of parts—e.g., stars and galaxies—that is distinct from this expansion.) Thus, the *primum mobile* causes a non-conservation of energy in the cosmos.

As a corollary, if one considers these two arguments together on the basis of what mathematical physics provides, the *primum mobile* or physical space must possess an aspect of its being that is outside the "universe" of mathematical physics. For the remainder of this section, then, let "universe" designate that object which is contemplated through the formalism of mathematical cosmology, and "cosmos" that object which, by this corollary, must be prior to and outside of that consideration.

What, then, to make of the entropy of the expanding universe? Here, correlation does not

151. Rudolf Clausius, *The Mechanical Theory of Heat: With Its Applications to the Steam-Engine and to the Physical Properties of Bodies* (London: J. Van Voorst, 1867), 365.

152. In the context of discussing the problem of non-conservation of energy at the level of the universe, Harrison, *Cosmology*, 349, observes: "The universe is not in the least like a steam engine and we must never jump to the conclusion that pressure is the cause of [the universe's] expansion."

equal causation: “A constant *relation* exists between the law of degradation and the expansion of the universe: the entropy of the universe is *proportional to its volume*.”¹⁵³ Without due caution, however, one might conclude that the increase of entropy in the cosmos is due *per se* to the expansion of the universe. It is usually claimed by physicists that the entropy of the universe tends to a maximum, because the universe is a closed system. Indeed, the universe is a closed system in mathematical physics. However, even mathematical physics can see that the *entropy* of the universe as a closed system does not increase *merely* due to the expansion of space. Roger Penrose argues that:

There is a common view that the entropy increase in the second law is somehow just a necessary consequence of the expansion of the universe. . . . This opinion seems to be based on the misunderstanding that there are comparatively few degrees of freedom available to the universe when it is ‘small,’ providing some kind of low ‘ceiling’ to possible entropy values, and more available degrees of freedom when the universe gets larger, giving a higher ‘ceiling,’ thereby allowing higher entropies. As the universe expands, this allowable maximum would increase, so the actual entropy of the universe could increase also.¹⁵⁴

The notion of “ceiling” here is appropriate. The available degrees of freedom (possible states of disorder) in a room for one’s collection of books and papers increases in a bigger room. (But the cosmos is not a room!) Penrose first argues by *reductio*:

There are many ways to see that this viewpoint cannot be correct. It implies for example that, in those universe models where there is a collapsing phase, the entropy necessarily starts to decrease, in violation of the second law.¹⁵⁵

That is, from the perspective of mathematical physics, one cannot simply appeal to the expansion of space (the change of the scale factor) as affecting the available range of entropy in the universe, because this change of scale factor is (mathematically) symmetric and thus

153. De Koninck, *Writings, Vol. 1*, 241. My emphases.

154. Penrose, *The Road to Reality: A Complete Guide to the Laws of the Universe*, 701.

155. *Ibid.*

leads to the violation of the second law of thermodynamics.¹⁵⁶ Additionally, Penrose argues that the available degrees of freedom for entropy do not increase in an expanding universe because this “phase space” includes in advance this increase or decrease of the scale factor.¹⁵⁷ (Analogously, the possibilities for spreading out the books and papers in one’s room does not change if one is given in advance “all possible space” and somehow your room keeps getting bigger.)

What this implies is that the universe—conceived of as including the expansion of space—is not the subject of the entropy in it.¹⁵⁸ Rather, the “sum total” entropy that the universe possesses belongs to its parts.¹⁵⁹ Thus, the entropy of the universe does increase to a maximum, but this is not the feature of a *per se* unity or whole. To be sure, entropy is a *per se* whole in the conception of the mathematical physicist. His conception looks only to the parts and unifies what he measures only in that conception. However, the change in this conception does not belong to a *per se* mobile, and thus to the natural philosopher “the total entropy of the universe” is a unity only *per accidens*.

Here we can work towards a second corollary: what is fundamental to the *cosmos* must explain entropy. The entropy of the universe is only a *per se* whole in mathematical physics, it is *per accidens* in the natural order. However, what is *per accidens* must be led back to what is *per se*. So the entropy of the *universe* is contained as a *per accidens* effect within an order that is *per se*. The corollary above noted that the *primum mobile* or physical space is a fundamental cause outside the universe of mathematical physics. How to connect this corollary with what we have seen about the *per accidens* whole of entropy?

156. Penrose argues that the scenarios where the universe does end in a “Big Crunch” will still be a maximum state of entropy, due to the formation of entropy-high black holes; Penrose, *The Road to Reality: A Complete Guide to the Laws of the Universe*, 714–15, 728.

157. *Ibid.*, 701.

158. I acknowledge Day, “Time, Space, and the Expanding Universe (unpublished paper),” for clarifying the central point of this paragraph.

159. See the discussion of Penrose, *The Road to Reality: A Complete Guide to the Laws of the Universe*, 699–700, 727–29, where he derives as estimate of the order of magnitude of the universe’s entropy based upon its baryon number, viz., the number of its fundamental, massive *parts*.

Here I again must use as a premise a combination of what was argued in the previous sections: the *primum mobile*, the fundamental condition for cosmic motion, location, time, and the conditions for elemental development, is an instrument. However, an instrument of its nature realizes some end, and the realization of an end is what structures time. Yet the structure of time and the structure of entropy are *correlated* with each other. The natural activity of the *primum mobile*, by causing motion and hence time *per se*, causes entropy *per accidens*. As a second corollary, then, we can conclude that the entropy of the *universe* is a *per accidens* unity within the *cosmos*, a natural, *per se* unity of order of which the *primum mobile* is the fundamental member.

I make three final observations. First, the above arguments allow us to see how the mathematical universe is a closed system. However, even if this universe is a closed system, it is radically incomplete. The universe as conceived by physico-mathematical cosmology bears a complementarity relationship to the conception of the cosmos in the mind of the natural philosopher. Niels Bohr once suggested that such a complementarity relationship exists (not only in quantum physics) but even in our knowledge of living organisms.¹⁶⁰ Richard Hassing argues that the causal neutrality of Newtonian physics (its parallelogram rule for the composition of forces and the calculation of motion paths from given initial conditions) allows, in an analogous fashion, for “the logical possibility of a principle of complementarity

Specifically, in the case of the organism, the parallelogram rule for composition of elementary forces cannot be applied. For the force we perceive exerted on the whole as such, and the elementary forces we reveal by our experimental intervention do not act simultaneously and cannot be compared. Knowledge of the compound *as one whole* and knowledge of *parts acting according to simple*

160. See Hassing, “Wholes, Parts, and Laws of Motion,” 206. Regarding quantum mechanics and complementarity, consider also Wolfgang Smith, *The Wisdom of Ancient Cosmology: Contemporary Science in Light of Tradition*, 1st (Oakton, VA: Foundation for Traditional Studies, 2009), 79, and also Wolfgang Smith, *Cosmos and Transcendence: Breaking Through the Barrier of Scientistic Belief* (Peru, IL: Sophia Perennis, 2008), 20–21.

force laws are ‘complementary.’ Knowledge of the one precludes knowledge of the other.¹⁶¹

This “complementarity” of Newtonian physics leaves room for soul, but does not solve for it. It merely modifies the interaction problem between mathematically conceivable particles and forces and a non-mathematizable principle of motion by excluding the latter from its universe of discourse.

Analogously, physico-mathematical cosmology possesses a complementarity “from within.” Its mode of conception analyses the parts of a system which it cannot contemplate as a whole “from the outside.” This “containment riddle” captures the difference between the reality studied and the models used to study it, akin to an object *quod* and an object *quo*.¹⁶² Here De Koninck’s remark—commenting on Eddington’s defense of the object of physics as a mathematical science—is appreciated: “From within physics, a beyond physics makes no sense.”¹⁶³

Does this mean that using physico-mathematical cosmology as a tool is useless? If we seek adequate knowledge, yes; but not a dialectical progression towards complete knowledge. This complementarity leaves the mind in a dialectical state, a notion which will be crucial for our understanding of De Koninck’s philosophy of nature and science in Part II of this project.

161. Hassing, “Wholes, Parts, and Laws of Motion,” 206. See also Hassing, “Animals versus the Laws of Inertia,” 51–52, 56.

162. Harrison, *Cosmology*, 161–62: “The cosmologist constructs a world picture that contains his physical body and physical brain but not his mind that constructs the picture. If his mind is not excluded, or if he thinks of himself as only a physical brain, he also encounters the absurdity of an infinite regression: the universe contains the cosmologist studying a universe, which in turn contains the cosmologist studying a universe, and so on, indefinitely. Where then is the cosmologist studying the universe? Can an image contain the image maker? The physical universe, consisting of multitudes of facts woven together in a web of ideas, apparently does not contain the thing that shapes the facts and spins the ideas. Those persons who cannot agree and claim that life and mind are no more than a collective dance of atoms must answer the containment riddle. Generally, those who think that life and mind are fully contained in the physical universe confuse the physical universe with the unknown Universe and mistake the mask for the face. . . . The answer to the containment riddle is that we, who create the universes, occupy the unknown Universe.” See also 20.

163. De Koninck, “The Philosophy of Science of Sir Arthur Eddington,” in *Writings, Vol. 1*, 130. Ellis, “Issues in the Philosophy of Cosmology,” 1273–74, concludes his treatment of the current state of affairs in cosmology with just such a “complementarity” principle.

The second observation is closely related. We must recall that the “interaction problem” between soul and body in Aristotelian psychology is avoided by insight into a new type causal contact: the soul is “in” the body as a whole “in power,” not as one body in another; as a natural principle it “somehow” moves the organic whole.¹⁶⁴ The *primum mobile* is, likewise, “somehow” a cause of the cosmic whole. It is known in an indeterminate fashion by general natural philosophy and by ever more determinate approaches within physico-mathematical cosmology. Just as the Newtonian mechanics of a body are a closed but incomplete system with respect to the soul and a living body, so also the general relativistic mechanics of the universe represents a closed but incomplete system with respect to the cosmos and its fundamental principles: the first moved mover and the spiritual “pressure” from without which naturally opens the cosmos to a higher order; the cosmos is not a system closed in on itself.¹⁶⁵

Third, this cosmic complementarity principle opens up the logical space, from the perspective of one “turning around” from mathematical physics, for teleology within the cosmos. Where this path leads out of the cave of mathematical symbolism cannot be decided in advance by the mathematical physicist; it requires a new type of investigation. Perhaps the instrumentality of the *primum mobile* is being used for an end higher than it of its own nature is capable of realizing. For instance, if we follow De Koninck’s strong anthropic line of reasoning, we must “say that a multitude of human individuals, numerically definite, is the final end of the cosmic universe.”¹⁶⁶

164. Aristotle, *Metaphysics*, V.4, 1015a17–18: “And nature in this sense is the source of the movement of natural objects, being present in them somehow, either potentially or actually.” See also St. Thomas, *ST*, Ia, q. 75, a. 1, ad 1, and also ad 3: “Est duplex contactus, quantitatis et virtutis. Primo modo, corpus non tangitur nisi a corpore. Secundo modo, corpus potest tangi a re incorporea quae movet corpus.” (Leon.5.195)

165. See the text from De Koninck, quoted above at the end of §14.2.

166. De Koninck, *The Cosmos*, in *Writings*, Vol. 1, 267. I note that De Koninck maintains this without straying towards a personalistic interpretation of the created order, since “cosmic universe” is not a pleonasm. It denotes the physical—as opposed to the spiritual parts of—the whole of the created universe, man being famously, by St. Thomas’ phrase, *in confinio* between the two; see *ibid.*, 256, 264, and St. Thomas, *ScG*, II.80: “Anima humana, ut supra ostensum est, in confinio corporum et incorporearum substantiarum, quasi in horizonte existens aeternitatis et temporis, recedens ab infimo, appropinquat ad summum.” (Leon.13.506) What De Koninck applies to the evolutionary cosmos was maintained analogously concerning the Thomistic

§20 AN ARISTOTELIAN SCIENTIFIC COSMOLOGY IS POSSIBLE, BUT A FINAL ACCOUNT CONCERNING THE FORMAL PARTS OF THE UNIVERSE, REQUIRED BY SUCH A COSMOLOGY, HAS NOT BEEN ATTAINED; CONTINUED PROGRESS IN THE STUDY OF THE COSMOS REQUIRES THE PHILOSOPHY OF NATURE.

It is appropriate to approach the problems of cosmology with feelings of respect for their importance, of awe for their vastness, and of exultation for the temerity of the human mind in attempting to solve them. They must be treated, however, by the detailed, critical, and dispassionate methods of the scientist.

R. C. TOLMAN

Relativity, Thermodynamics, & Cosmology,
(1932)

However, cosmology is different from all other disciplines; in the end an unavoidable choice must be made that is essentially philosophical and not subject to experimental test. We should use broad criteria that take into account the whole range of human experience, and not just that part which can be scientifically described (though that, of course, must be included as a central feature).

G. F. R. ELLIS

“Emerging Questions & Uncertainties” (1993)

In this final section, two points will be outlined. First, cosmology as a specific part of the philosophy of nature does exist. Second, and correlatively, it follows that modern cosmology, as a physico-mathematical discipline, requires the philosophy of nature.

static cosmos. St. Thomas argues, however, from the advantage of a theological perspective, *De Pot.*, q. 5, a. 5, c.: “Ponimus enim quod motus caeli est propter implendum numerum electorum. Anima namque rationalis quolibet corpore nobilior est, et ipso caelo. Unde nullum est inconveniens, si ponatur finis motus caeli multiplicatio rationalium animarum: non autem in infinitum, quia hoc per motum caeli provenire non posset; et sic moveretur ad aliquid quod consequi non potest; unde relinquitur quod determinata multitudo animarum rationalium sit finis motus caeli. Unde ea habita motus caeli cessabit.”

20.1 *Is cosmology as a science in the Aristotelian sense possible?*

The question which must be answered if an Aristotelian science of cosmology is possible is this: “What is the universe?” An Aristotelian science requires a subject that exists and is defined. The tradition of cosmology, inchoate in Plato’s *Timaeus* and carried on by Aristotle’s *De Caelo*, took this object to be the totality of natural substances as a causally connected and ordered whole—a cosmos. A cosmic order is even implied in the order of study followed in the *Timaeus* and the Aristotelian natural philosophical corpus, which proceeds from the heavens to the elements to living beings.¹⁶⁷ How is the subject of this science established beforehand (somehow) and what is the argument for why it is studied before other parts of natural philosophy?

These twin questions—about grounds for the subject of cosmology and its order with respect to the other specific parts of natural philosophy—are implicitly asked by St. Thomas in his *prooemium* to the *De Caelo* commentary. That the *De Caelo* is the logical successor to the general natural philosophy of the *Physics* is due to the orders of concretion (from whole to part, from simple to composed, and from primary to secondary).¹⁶⁸ However, that “the universe” itself is the subject of the book was a matter of dispute among commentators.¹⁶⁹ By “universe” St. Thomas means something more than just what we mean by “all material being.” As Stanley Jaki notes, St. Thomas distinguishes between the “universe as a mere name and as a thing.”¹⁷⁰ Thus, cogent answers must be given for why the universe is a thing susceptible of study (i.e., a reason or reasons why there is a universe or a strict totality of things), and why it is the first to be studied after general natural philosophy, and why it

167. See Andrea Falcon, *Aristotle and the Science of Nature: Unity Without Uniformity* (Cambridge/New York: Cambridge University Press, 2005), 2–13.

168. See St. Thomas, *In De Caelo*, prooem., nn. 2–3 (Leon.3:1–2), and also above, §11.1.

169. *Ibid.*, nn. 4–5, (Leon.3:2–3).

170. Jaki, *Is There a Universe?*, 565. See St. Thomas, *In I Sent.*, d. 44, q. 1, a. 2, ad 2: “Ad secundum dicendum, quod non loquimur de universo quantum ad hoc nomen, sed quantum ad hanc rem, quae modo universum dicitur: in quo quamvis omne quod actu bonum est, contineatur, non tamen omne bonum quod Deus potest facere.”

differs from the other specific parts of natural science (in Aristotle's sense).

While this answer cannot be given in full here, it is worth repeating that Newtonian physics of its own intrinsic principles cannot account for the universe as a unified whole.¹⁷¹ By contrast, Aristotelian natural philosophy could provide an answer. Indeed, Jaki notes that such an argument for the existence of a universe is "hinted at" in the Five Ways.¹⁷² This is because the arguments address the possibility of an intra-cosmic infinite regress of causality. In the preceding chapters (Chapters 2, 3, and 4) proofs were presented that some first, intracosmic principle of place, time, and causality must exist, and this first principle must itself be principled by an extracosmic cause. Thus, under the light of these ideas, the numerical finitude and formal unity of the cosmos can be grasped. The observed multiplicity of mobile beings is a finite totality unified according to orders of place, time, and causality. But such a finite, unified totality is a universe. Now, while this is not the most detailed notion that one could supply of the universe, it is the one which can be presented from general natural philosophy.¹⁷³ If this is true, then we can say that general natural philosophy presents the Aristotelian cosmologist with the grounds by which he can maintain that his science studies the universe: a finite totality of mobile beings ordered according to *situs* (this order is implicated by the orders of bodies in place, time, and causality). In this respect, general natural philosophy is indispensable for cosmology.

20.2 Aristotelian cosmology as incomplete; its dialectical status

Physico-mathematical cosmology is like a builder seeking to complete a house who finds that he has only many possible, and very detailed, blueprints, but not enough materials. By its very abstraction from matter it removes itself from the possibility of giving an adequate

171. See above, §18.3.

172. See Jaki, *Is There a Universe?*, 92–93.

173. St. Thomas notes in other works that the universe can be considered under higher lights, as possessing the good of a unity of order, with God as its separate, common good, *In Meta.*, lib. XII, lect. 12, nn. 2629–37.

account of the whole. This intrinsic limitation has been sketched above, in §11.1, and I return to this theme in Part II.

Consequently, progress towards the goal of cosmology as a science in the Aristotelian sense is still underway. The “formal parts” of the universe and the universal causality of these formal parts is not sufficiently known. What is more, cosmology possesses a pragmatically essential incompleteness from the Aristotelian perspective. St. Thomas’ observation is as relevant as ever: comprehending the universe requires a basis in experience that many lifetimes cannot adequately provide.¹⁷⁴

Dialectical progression towards an Aristotelian cosmology as a limit is an insight De Koninck defends. I have anticipated this aspect of his philosophy of science in the exposition of the arguments of §19. There we noted that the arguments were dialectical in three ways: first, due to the method of listening to experts; second, due to the attempt to integrate premises proved in a higher science with those supplied by a lower science; third, due to the use of terms in that lower science that are subject to fluctuation.

The terms of modern physico-mathematical cosmology are fluctuating or unstable in two principal ways. First, their observations (dependent upon prior theories) are subject to reinterpretation given clearer evidence to the contrary. However, using the first mode of dialectic, we can observe that most of the experts are convinced about the basic interpretation of their observational basis.¹⁷⁵ Second, the mathematical theory through which the observations are interpreted at large scales—general relativity—is currently being pressed to

174. See above, Ch. 3, fn. 161. See also De Koninck, “Are the Experimental Sciences Distinct from the Philosophy of Nature,” in De Koninck, *Writings*, Vol. 1, 450.

175. The principle proponents of alternative interpretations of the principal observational bases of modern cosmology (extragalactic redshift, the cosmic background radiation, and the proportion of light elements in the universe) are the quasi-steady state theorists. See F. Hoyle, G. Burbidge, and J. V. Narlikar, *A Different Approach to Cosmology: From a Static Universe through the Big Bang towards Reality* (Cambridge, UK ; New York: Cambridge University Press, 2005), 197–228; Halton Arp, *Seeing Red: Redshifts, Cosmology and Academic Science* (Montreal: Apeiron, 1998), 1–34, and 225: “If redshifts are not caused by velocity of recession, what are they? The answer to this question goes back to the roots of modern cosmology and opens up the possibility of a whole new understanding of the universe.” The principal points of this alternative standpoint are reviewed by Smith, *The Wisdom of Ancient Cosmology*, 130–34.

its limits. Perhaps by some other mode of mathematical physics, currently unknown, further insight is possible.¹⁷⁶ From these two points, we can see how the dialectical status of modern physico-mathematical cosmology exemplifies what St. Thomas means when he says that a dialectical argument is a process of reasoning that completely turns the mind towards one side of two contradictory positions but without sufficient insight such that a certain “dread” of the other being true is still present.¹⁷⁷

Yet just as the mobile requires the immobile as its principle, so also a dialectical problem must be framed in terms which are certain—at the very least better known and more certain to us. The prior philosophical bases of cosmology are even acknowledged by some modern scientists.¹⁷⁸ Consequently, insofar as we depend upon the “natural road” when thinking about nature, cosmology is posterior to general natural philosophy as science in the Aristotelian sense. The implications of the “natural road” are considered in the remaining two chapters of this project.

176. St. Thomas, *In De Caelo*, lib. II, lect. 17, n. 2: “Forte secundum aliquem alium modum, nondum ab hominibus comprehensum, apparentia circa stellas salvantur.” (Leon.3.186–87)

177. St. Thomas, *Exp. Po. An.*, lib. I, lect. 1, n. 7: “Per huiusmodi enim processum, quandoque quidem, etsi non fiat scientia, fit tamen fides vel opinio propter probabilitatem propositionum, ex quibus proceditur: quia ratio totaliter declinat in unam partem contradictionis, licet cum formidine alterius, et ad hoc ordinatur topica sive dialectica.”

178. See Ellis, “Issues in the Philosophy of Cosmology,” 1242, as well as Unger and Smolin, *The Singular Universe and the Reality of Time*, xvii–xviii; in 75–89, Unger sets out the various revisionist and directive functions of natural philosophy.

CONCLUSIONS AND OBSERVATIONS FROM CHAPTER 5

So we should accept the likely tale on these matters. It behooves us not to look for anything beyond this.

PLATO
Timaeus, 29d

When any one shall succeed in finding proofs of greater precision, gratitude will be due to him for the discovery, but at present we must be content with what seems to be the case.

ARISTOTLE
De Caelo, II.5

But the principal use we should derive from cosmology is to elevate us with the help of the general laws of nature to its author, whose wisdom has established those laws, allowed us to see those which are necessary for us to know for our utility or for our amusement, and has hidden the rest from us to teach us to doubt.

D'ALEMBERT
Encyclopédie, "Cosmologie"

Ultimate uncertainty is a key aspect of cosmology.

G. F. R. ELLIS
"Issues in the Philosophy of Cosmology"

Plato has his astronomer remark that "In every subject it is of utmost importance to begin at the natural beginning."¹⁷⁹ This has been the method of the foregoing five chapters. Starting at the natural beginning within the philosophy of nature, what is first with respect to us, the inquiry established the first principles of the order of nature but remained at a generality of conception about these principles. Further dialectical determinations were provided to the limit of what modern cosmology has been able to discern.

179. Plato, *Timaeus*, 29b.

Following three ways in which a discourse can be dialectical, I have proposed conclusions based upon the opinions of the experts in cosmology, attempted to specify a conclusion from a more generic set of principles, and relied upon modes of conception that cause the discourse to rest in the intentions or concepts the mind uses as tools to discuss the natural order. The central dialectical conclusion about the more determinate nature of the *primum mobile* was that it is “physical space,” as a substratum with a certain nature, with a certain natural operation (both local gravitational effects and a cosmic-scale expansion), ordered to being a necessary condition of cosmic local motion, a principle of place in the cosmos, the ground of cosmic time, an instrument in primordial elemental generation and corruption, and perhaps for higher ends within the cosmos. This conclusion is limited by its dependency upon physico-mathematical cosmology; no fully determinate account of the formal parts of the cosmos is at hand.

Several indications have been discovered that general natural philosophy possesses an architectonic relationship with cosmology. The first is that the object of cosmology can only be provided by general natural philosophy because of the generality of the latter’s consideration. Second, the project of investigating the principle of cosmic-scale change in cosmology is ordered by general natural philosophy, which also, third, provides reasons to exclude certain options in cosmology (e.g., an infinite universe) and preserve the unity of cosmology with other disciplines (e.g., those that depend upon more manifest teleology). Thus, being a principle of more universal conception, order, and unity, general philosophy of nature has certain earmarks of being a sapiential type of knowledge.¹⁸⁰

180. McLaughlin, “Astronomy: Queen of the Specific Sciences,” 1015–16, notes similar features of astronomy with respect to the particular parts of natural science. I consider McLaughlin’s position in Chapter 7.

PART II

On Natural Philosophy as Architectonic

INTRODUCTION TO PART II

A man inherited a field in which was an accumulation of old stone, part of an older hall. Of the old stone some had already been used in building the house in which he actually lived, not far from the old house of his fathers. Of the rest he took some and built a tower. But his friends coming perceived at once (without troubling to climb the steps) that these stones had formerly belonged to a more ancient building. So they pushed the tower over, with no little labour, and in order to look for hidden carvings and inscriptions, or to discover whence the man's distant forefathers had obtained their building material. Some suspecting a deposit of coal under the soil began to dig for it, and forgot even the stones. They all said: "This tower is most interesting." But they also said (after pushing it over): "What a muddle it is in!" And even the man's own descendants, who might have been expected to consider what he had been about, were heard to murmur: "He is such an odd fellow! Imagine using these old stones just to build a nonsensical tower! Why did not he restore the old house? He had no sense of proportion." But from the top of that tower the man had been able to look out upon the sea.

J. R. R. TOLKEIN
"Beowulf: The Monsters and the Critics"

The central aim of this project is to defend the sapiential character of a type of human knowledge. Now, what is by nature is opposed to various other principles, e.g., what comes about by custom, art, or violence. There is a danger of mistaking what is natural for what is actually the customary or the artificial. The very notion of this "natural path" is found in one tradition of inquiry—that of Aristotelian or Thomistic philosophy. What prevents one from misusing pre-cut stone from the ancient house in a disproportionate way?

CHAPTER 6

**The Natural Path of the Human Mind
& Charles De Koninck's Philosophy of Nature**

INTRODUCTORY NOTE TO CHAPTER 6

To wish to comprise nature in science would be to want to put the whole into the part.

HENRI POINCARÉ,
The Value of Science

De Koninck argues that the fundamental source of philosophy is not the customary or artificial, but what is natural. This natural source is how “the common” about which Heraclitus speaks should be understood. This common or fundamental experience of reality is prior to any human response or method. Within the human mind receptive of this common source there consequently arises a natural way to proceed that shapes all future investigations. This is what Aristotle calls the “natural path.”

Previously, in Chapter 1, an extensive commentary was provided concerning this natural path, which Aristotle introduces in *Physics* I.1. In the present chapter, we will reexamine its existence, character, properties, and the implications it bears for the relationship between natural philosophy and the modern sciences. This will allow the inquiry to reach its goal in Chapter 7, viz., a defense of the sapiential character of general natural philosophy. In what follows, §21 will examine De Koninck's early views concerning the relationship of natural philosophy and the modern sciences. In §22, the existence, nature, and characteristics of the natural path in our knowledge will be defended: the natural path is maximally conformal

to the human mind as a knowing power. Based upon this character, we can see the features which allow natural philosophy to reach perennial conclusions (§23), why De Koninck's later view maintains that natural philosophy is formally unified with the modern sciences, which are its dialectical extensions (§24), and how this formally unified type of knowledge makes use of different methods, involving symbolic constructs and dialectical processes of thought.

§21 DE KONINCK'S EARLY THESES ON THE RELATIONSHIP BETWEEN NATURAL PHILOSOPHY AND THE SCIENCES ARE TO BE CONTRASTED WITH HIS LATER POSITION.

In this section, I present the framework of Charles De Koninck's ideas about the relationship between natural philosophy and the sciences as well as the sapiential character of natural philosophy. Early in his career, De Koninck held a position close to that of Jacques Maritain: natural philosophy and the modern sciences are formally distinct. Following ideas of Maritain, he also defended the idea that natural philosophy possesses a sapiential office. However, he later changed his mind about the former thesis and defended the continuity of the old and the new physics. The major writings where De Koninck explains the architectonic office of natural philosophy appear only before he switched positions.¹ It will require some discussion in §27.1 to see that the latter thesis is not affected by this switch.²

21.1 *De Koninck's early position: formally separate*

Early in his career, De Koninck maintained along with thinkers like Jacques Maritain that natural philosophy and the experimental sciences are irreducibly distinct.³ The qualified sapi-

1. There are later works where he implies the same but does not thematize the issue.

2. Some parts of this section, as well as portions of §24 and §§27–28, have been published in my "Charles De Koninck and the Sapiential Character of Natural Philosophy," *American Catholic Philosophical Quarterly* 90, no. 1 (2016): 1–24.

3. See De Koninck, *Writings, Vol. 1*, in "Reflections on the Problem of Indeterminism," 435: "The consequences of hylomorphic composition are thus the objective foundation of the distinction between the experimental sciences and the disciplines. Philosophy of nature, being *scientia certa per causas*, can only attain what is essential and necessary to nature, such as the hylomorphic composition of natural substances, the contingency this composition entails, the necessity of evolution, the necessity of humanity as the ultimate end of this ascension of the world, etc. In short, what one can establish with rigor are what Maritain calls *philosophical facts*. Experimental sciences, on the contrary, to the degree that it does not confine itself to pure truisms and tautologies, to the degree that it is an explanatory science, can only give us a probable

ential character of natural philosophy likewise has its roots in Maritain.⁴ For what reasons, then, did De Koninck originally maintain their formal separation?

De Koninck argued that, on the one hand, natural philosophy is a science of explanation in the Aristotelian sense.⁵ It attains the essence of mobile being at a general level but knows this universal with certitude. This level of abstraction is the first level of abstraction, the act by which the mind knows things without their particular or individuating matter. This is the level of abstraction common to all the parts of philosophy and the one commensurate to natural philosophy as science. Motion is contemplated, and “this motion here” only in light of that concept; “body” or “soul” or “organism” are theorized, and the particulars are contemplated only through such concepts.

On the other hand, mathematical physics, a science of observation, works upon objects which it constructs through measurements of particulars. On this point, De Koninck refers us to Eddington: “The physical quantity so discovered is primarily the result of the operations and calculations; it is, so to speak, a manufactured article—manufactured by our operation.”⁶ That is, science knows its object through a system of measurement and symbolism inseparable from the ostensive definitions of its units of measurement.⁷ The standard

knowledge of things. I am not speaking of behavior and theories. These probabilities can achieve enormous proportions, they can provide what we call practical certitude, to the point where they create the illusion of absolute certitude. But one can never lead them back to the principle of contradiction as can be done in the disciplines.” See also *ibid.*, in “The Problem of Indeterminism,” 357: “The experimental sciences cannot attain immutable truths, and that is how they differ from the [philosophical] disciplines.”

4. See Maritain, *Philosophy of Nature*, 155–56.

5. Thus, following Maritain, *Degrees of Knowledge*, 34–37.

6. See De Koninck, “La philosophie des sciences,” 360. Translation by Brian Dragoo; future uses include my modifications to Dragoo’s translation. The quote of Eddington’s is from his introduction to *The Mathematical Theory of Relativity*. De Koninck adds a further instructive quote in the footnote: “But the physicist is not generally content to believe that the quantity he arrives at is something whose nature is inseparable from the kind of operations which led to it; he has an idea that if he could become a god contemplating the external world, he would see his manufactured physical quantity forming a distinct feature of the picture.”

7. See De Koninck, *Writings, Vol. 1*, “The Philosophy of Sir Arthur Eddington,” 118–31; in particular, consider 120: “The qualitatively differentiated spatio-temporal exteriority can be considered by the philosopher, the mathematician, and the physicist. The physicist wants to know the real structure of this exteriority insofar as it is physically measurable. As to what is meant by physically measurable, one can only show it. It has an aspect that is not directly intuited and the means for attaining this knowledge are given.” Later, this becomes a central feature in the symbolic mode of conception of mathematical physics, see De Koninck,

of length, an individual object, has no length, because it is that to which all other standards refer.⁸

This means that the measured object of the sciences tends towards the universal but never attains it. The theory insofar as it is mathematical, or abstractly contemplated, is universal, but never its object, viz., the set of manufactured measurements. The object of science is always the product of an incomplete induction. De Koninck maintains: “[E]xperimental science cannot attain to the first degree of abstraction, . . . it remains confined in prescientific *empeiria*. But just as nature tends toward determination, experimental science tends toward the first degree of abstraction.”⁹ The theory is confirmed in the particular measurements taken “so far.”¹⁰

In short, natural philosophy attains universals as its objects; the sciences do not. Their distinction seems “absolutely sharp” such that they are “not reducible to each other.”¹¹ However, this distinction may not seem perfectly clear: why would an “electric field” or “mass” not be a universal just as much as “cat” or “dog” or “man”? In brief, the unity of such a concept like “electric field” or “mass” is not necessarily that of a natural kind. “Body” is a general universal, but refers in a generic way to a substance that is substantially one and extended. The concept “mass,” on the other hand, can be used to visualize one or many moving things, and these need not be conceived of as extended at all (they could be a system of mass points). The species-neutral mode of the latter conception is grounded on measurements requiring particular standards and representation through symbols. Thus, the two are characterized

“The Unity and Diversity of Natural Science,” 11–15, and below, §24.

8. At the time, the meter was still defined with reference to the standard meter kept in Paris.

9. De Koninck, “La philosophie des sciences,” 360. The first degree of abstraction is also called total abstraction. It will be discussed in more detail in §22.

10. Ibid. Thus, De Koninck applies to the measured objects of the sciences what John of St. Thomas applies to experiential knowledge and induction: see *Curs. Phil.*, I:828b27–35: “Experimentalis autem cognitio non dicit abstractionem intelligibilem, qua cognoscitur res per suam quidditatem, praesertim quia apud nos experientia semper dependet ab aliquibus sensibilibus. Et sic est diversa abstractio a scientia, quae procedit a priori, quantum est ex se.”

11. Maritain, *Degrees of Knowledge*, 37.

by different modes of conceptualization; their separation seems secure. Here we must note, and reconsider further below, the features of this separation: its dialectical character (*ut nunc* or partial universality), the particular science's requirement for individualized standards of measurement, and symbolic conceptualization.

The explanation for this difference between modes of universality (complete, natural-philosophic versus incomplete, measured-symbolic) is hylomorphism. De Koninck maintains, in this early view, that the distinction between the philosophy of nature and the experimental sciences is not a subjective limitation, but founded on an objective necessity in things.¹² Why is hylomorphism the principle of their distinction? Because the real distinction between form and matter does not result in a principle of perfect determination (form) opposed to the utter indeterminacy of prime matter. Rather, form has a "margin of indetermination . . . inversely proportional to the perfection of the form."¹³ This "margin" is the ontological foundation of indeterminacy in natural events because a form cannot perfectly master its material principle. Consequently, the philosophy of nature cannot intuit all the ways in which such a form is realizable in matter.¹⁴ The experimental sciences are employed to fill in what natural philosophy in its generality cannot grasp, for the experimental sciences study the more sensible and hence more material, individual, and contingent particularities.

12. See De Koninck, "La philosophie des sciences," 360: "Since mobile being necessarily implies the non-necessary which tends toward the necessary, the distinction of philosophy of nature and the experimental sciences does not exclusively concern a parcelling out necessitated by our psychological structure, but also an ontological foundation." See also De Koninck, *Writings, Vol. 1*, "Reflections on the Problem of Indeterminism," 436–37: "Abstracting from the margin of subjective uncertainty, the distinction we make between two degrees of knowledge, between these two modes of defining, does not derive exclusively from a partitioning necessitated by our psychological structure—it derives as well from the very nature of things. The same cause explains both the abstractive and rational character of our understanding and the fundamental opposition between these two degrees of knowledge—matter. The opposition designated for us exists as well for intelligences which do not know by experience. (There is no reason why a pure spirit should be able to predict the future position of an individual electron.)"

13. De Koninck, "La philosophie des sciences," 359. This ontological indetermination of cosmic species shapes De Koninck's thinking in his unfinished essay on evolution in a Thomistic cosmos; I return to De Koninck's development of the notion of "form" below, see fn. 140.

14. See De Koninck, *Writings, Vol. 1*, "Reflections on the Problem of Indeterminism," 436: "Because there are more or less contingent fluctuations in nature and degrees of spontaneity, the analytic method of the philosophy of mobile being cannot furnish an adequate and comprehensive knowledge of the cosmos."

21.2 De Koninck's early position on the sapiential character of natural philosophy

Granted the formal distinction between the two, why does this difference give natural philosophy a sapiential character? Due to the distinction of the two studies, the philosophy of nature possesses a sapiential character insofar as it can still consider by its own lights what is provided to it by the experimental sciences. This relationship cannot be reversed because complete universality cannot be comprehended in an incomplete consideration of particulars; the lower unity cannot encompass the higher. In this way, the philosophy of nature imitates metaphysics. Since the formal object of metaphysics is being as such, it not only can reflect upon its own principles, but also upon the principles and conclusions of the other sciences. By reflecting on the principles and conclusions of mathematics, for instance, metaphysics would act as the philosophy of mathematics.

Since the formal object of natural philosophy is being as mobile, natural philosophy cannot reflect upon itself as metaphysics can. Metaphysics, because its mode of conception is being *qua* being, can measure the truth of its principles by measuring them against what they are the principles of, being as such. Natural philosophy, by contrast, "cannot touch on the absolute ground of its subject, mobile being: the being that it grasps only under the angle of mobility."¹⁵ Its mode of conception, studying being as mobile, cannot be used to measure the truth of the principles of mobile being, for the principles are not themselves mobile.¹⁶

However, just as metaphysics cannot intuit *a priori* the many ways being is realized, natural philosophy cannot see in its concepts the determinate ways in which mobile beings are realized.¹⁷ Only the universal aspect of mobility is studied by natural philosophy as an

15. De Koninck, *Writings, Vol. 1*, "Reflections on the Problem of Indeterminism," 437.

16. This does not prevent the natural philosopher from resolving to immobile principles; he merely cannot study them commensurately. For instance, Aristotle concludes to a negative thesis about the first underlying, namely, that it is not subject to generation and corruption; see above, §2.9.

17. De Koninck, "La philosophie des sciences," 361: "Just as the quidditative intuition of the divine essence by the blessed does not give a comprehensive knowledge of all the possibles; just as the metaphysics which

Aristotelian science. The specifics and particular instances of mobile being that escape its abstract grasp can be “recaptured.” The experimental sciences, through their own methods, recapture the intelligibility of these specifics and particulars to the degree this is possible.¹⁸ Once this has been done, the philosophy of nature can consider these results in their aspect of universality. This gives it a sapiential function in judging, defending, and using the experimental sciences.

Note that this relationship presupposes a certain type of scientific subsidiarity. The two inquiries are “friends and not slaves of each other.”¹⁹ This addresses Eddington’s worry that philosophers and scientists, through mutual lack of trust, “both make raids over the border to suggest all sorts of ways in which the other fellow may be deceiving himself and us.”²⁰ The sapiential function of natural philosophy is, therefore, posterior in being to the sciences, at least in respect of learning from them. *Qua* defending and judging science’s principles, natural philosophy would be sapiential insofar as wisdom provides order to the thing ordered.²¹

Since the existence of this sapiential office relies upon the real distinction between natural philosophy and the sciences, does the office remain if the two studies are in fact continuous? This is a question which I will answer in Chapter 7. We shall see that, even when

attains the quiddity of being cannot tell us all the manners in which it can be realized; so the philosophy of nature cannot tell us all the manners in which mobile being, the *fluxibile et non semper eodem modo se habens propter materiam*, can be realized. But once this aspect which escapes the philosophy of nature as science is brought out by the experimental sciences, it can reflect on it without coming out of the domain of mobility which is its object. It can judge, defend and use the experimental sciences. It is wisdom not, no doubt, *simpliciter*, but *secundum quid*. It is this sapiential function of the philosophy of nature that we call philosophy of the sciences.” See also De Koninck, *Writings, Vol. 1*, “Reflections on the Problem of Indeterminism,” 437–438.

18. Ibid.; De Koninck, “La philosophie des sciences,” 361.

19. Ibid.: “It is understood that this sapiential function supposes on the side of the experimental sciences a perfect autonomy in their proper domain where philosophy can play no role. The latter can only reflect on the experimental sciences in the measure that they are closed on themselves. The philosophy which wants to tell the scientist what the metric structure of space is, or how to define intelligence in experimental psychology, cannot know what it is talking about. They are friends and not slaves of each other.”

20. Eddington, “Physics and Philosophy,” 30.

21. Here also De Koninck seems to draw from Maritain, *Degrees of Knowledge*, 51: “Let it be clearly understood that the sciences do not depend on philosophy for their intrinsic development. They only depend upon it *in principe* (not, indeed, in the sense that they would need philosophy to know their own principles and use them, but in the sense that it belongs to philosophy to explain and justify those principles).”

formally unified, general natural philosophy is a sapiential type of knowledge in relation to the particular sciences.

Given this background in De Koninck's earlier work, I will now turn to examine his more developed views concerning the character of natural philosophy.

§22 THE NATURAL PATH INTO THE STUDY OF NATURE EXISTS; THE HUMAN MIND UNDERSTANDS THE GENERAL BEFORE THE SPECIFIC BECAUSE IT KNOWS THE INDISTINCT BEFORE THE DISTINCT, SINCE IT PROCEEDS FROM POTENCY INTO ACT.

Scientia naturalis inter alias est maxime hominis intellectui conformis.

ST. THOMAS AQUINAS
Super Boetium de Trinitate,
q. 6, a. 1a, c.

Plenitudinem [contemplationis] autem scientia naturalis, quae res a Deo procedentes considerat; altitudinem vero contemplationis inter scientias physicas habet metaphysica.

ST. THOMAS AQUINAS
In Evan. Ioan., proem.

In this section, the existence and nature of the natural path in our knowledge will be defended in light of De Koninck's philosophical work. This expands on §1. First, the reason why the natural path exists can be demonstrated from the nature of the human mind (§22.1).²² The precise character of the natural path requires that the subject of a science, in contrast to a demonstrative process, proceed by way of determination and concretion: the *processus in determinando* (§22.2). The character of the natural path is caused by the mind's abstraction from matter in its considerations, which also causes the difference in modes of definition and, consequently, the specific differences among the speculative sciences (§22.3). Finally (§22.4–5), because the character of the natural path is maximally conformal to the human mind

22. St. Thomas does something similar in *ScG*, III.2–3, when he provides metaphysical reasons of the axiom of natural philosophy, viz., that nature acts for an end. Thus, *Physics* I.1 manifested the proper order of natural philosophy's study, but this does not prevent a reason from being given; see Decaen, "The Impossibility of Action at a Distance," 189–90 and 195, fn. 61.

as a knowing power, certain consequences will be drawn from this fact taken in conjunction with St. Thomas' doctrine that "what the intellect first conceives as most known, and into which it resolves all its conceptions, is being [*ens*]."²³

22.1 *The natural path in our knowledge*

The existence of this natural path in our knowledge is recognized in many places by St. Thomas. One place is his explanation of the third meaning of "rational process".²⁴

In a third way, a process [*processus*] is called rational from the rational power, namely, insofar as in proceeding we follow the proper mode of the rational soul in knowing, and thus the rational process is proper to natural science. For natural science, in its proceedings, keeps to [*servat*] the proper mode of the rational soul in two ways.

First regarding this, that just as the rational soul takes from sensible things (which are more known *quoad nos*) its knowledge of intelligible things (which are more known *secundum naturam*), so also natural science proceeds from those which are more known *quoad nos* and less known *secundum naturam*, as is clear in *Physics* Book I. Demonstration which is by sign or effect is especially [*maxime*] employed in natural science.

Second, because it belongs to reason to discourse from one thing to another, this is especially [*maxime*] observed in natural science, where, from the knowledge of one thing, it arrives at knowledge of something else, as from the knowledge of an effect [it arrives at] knowledge of the cause. And not only does it proceed from one thing to another thing in *ratio* which is not other in *re*, as from animal it proceeds to man. (For in the mathematical sciences one proceeds only by those which are of the essence of the thing, since they demonstrate only through the formal cause. And therefore in [the mathematical sciences] one does not demonstrate something of one thing through another thing, but through the proper definition of that thing. For even if some demonstrations ascribe something about the circle from the triangle or vice-versa, this does not occur except insofar as the triangle is potentially in the circle and vice-versa.) But in natural science, where demonstration through extrinsic causes occurs, something is proven of one thing through another thing [that is] wholly extrinsic.

Thus, the mode of reason is especially [*maxime*] observed in natural science, and because of this natural science, among the other [sciences], is maximally

23. St. Thomas, *De Veritate*, q. 1, a. 1, c. (Leon.22/1.5).

24. The first two were discussed above in §17.

conformal to the intellect of man [*est maxime hominis intellectui conformis*]. Therefore, to proceed *rationabiliter* is attributed to natural science, not because it is appropriate [*conveniat*] to it alone, but because it agrees with it chiefly [*praecipue*].²⁵

St. Thomas presents two middle terms in his argument. The mode of proceeding rationally (or, according to the nature of the power of reason as a cognitive power) belongs chiefly to natural science, first, because this mode of proceeding goes from what is more known to what is less known to us, drawing from what is sensible as the source of what is intelligible; this mode is found in natural philosophy because it defines its object, mobile being, through sensible matter.²⁶ Second, this mode of proceeding rationally belongs chiefly to natural science because reason, in knowing distinct sensible substances other than itself, can demonstrate by proceeding from one thing to another thing, and hence from effect to cause (or vice versa). This manner of reasoning is observed in natural science, which demonstrates through all four causes—although here the focus on extrinsic causes indicates that St. Thomas is thinking of the efficient and the final cause.

Now, the reason *why* this mode of proceeding exists must be taken from the nature of the thing—in this case, a power—that does the proceeding. St. Thomas refers us to the doctrine of *Physics*, Book I, ch. 1. This was the second syllogism in Aristotle's *prooemium*: The natural path in human knowledge is to proceed from the more known to us to what is more known by nature. However, to proceed in this way is to proceed from the confused to the distinct, which is to proceed from the universal to the particular. Thus, the natural path in human knowledge is to proceed from the universal to the particular.²⁷ Above (§1.4) a general logical argument was presented to defend this mode of proceeding. Here, however, the reasoning must be drawn from the proper cause. In his commentary on this passage of the *Physics*, St.

25. St. Thomas, *SBdT*, q. 6, a. 1a, c. (Leon.50.159–60:160–99).

26. St. Thomas discusses this mode of definition in *SBdT*, q. 5, aa. 2 and 3, so the discussion in Question 6 would assume it.

27. See St. Thomas, *In Phys.*, lib. I, lect. 1, n. 6 (Leon.2.5). See also McMahon, "The *Prooemium* of the *Physics* of Aristotle," 30ff.

Thomas defends the first premise by arguing that what is more known by nature is what is more in act—the causes of things, and most of all the separate substances.²⁸ Our mind, by contrast, begins in potency and at first is in potency to all that it knows before proceeding into act. However, this is to go from what is more universal to what is less universal, since the more universal compares to the less as potency to act.

St. Thomas' reasoning concerning the minor premise, his appeal to the epistemological and ontological distance between the human mind and God, gives the ultimate cause of the natural path. Nonetheless, the cause of the natural path can be found more proximately in the dependence which the mind has given its own nature.²⁹ This more proximate route, within the study of the soul, would be to recognize the immateriality of the intellect as a knowing power that is nonetheless dependent upon objects of knowledge drawn from sensation. This natural order of proceeding exists because what we come to know scientifically is present, in some way, at first in what we sense and later present in our reason.³⁰ The intellect, being dependent upon organic sense powers, must therefore incrementally actualize itself through time. Therefore, *that* the natural path exists is clear from experience. Why the natural path exists is due to the initial, complete potency of the human intellect which must abstract from individuals in order to know.

De Koninck constantly maintains the necessity of recognizing this natural mode of the human understanding and the consequences which follow when one does not. He frequently points out *that* this natural path exists as manifested by the indirect admissions of others.³¹

28. St. Thomas, *In Phys.*, lib. I, lect. 1, n. 7 (Leon.2.5).

29. See, St. Thomas, *Sent. De Anima*, lib. III, cap. 1-3 and 7.

30. See St. Thomas, Ia, q. 85, a. 3. See also St. Thomas, Ia, q. 84, a. 6; q. 85, a. 1, c. and ad 1; a. 2. See also *De Veritate*, q. 11, a. 1.

31. One example is a biologist, W. S. Beck in *Modern Science and the Nature of Life*; see De Koninck's comments in "The Lifeless World of Biology," in *The Hollow Universe*, 81: "Taking for granted our ordinary acceptance of 'living' and 'non-living,' these writers, from the start, resolve to explain them in terms of the kind of life we know least about, that is, in terms of the so-called lowest animate forms. Once this method is adopted to the exclusion of any other, there is no escaping Professor Beck's conclusion: 'As perceptual objects, plants are plants whether we call them living or not: 'life' is a conceptual object. In other words, Pirie is correct: 'life' is beyond rigorous definition but he, I, we will speak of life *because we all know what it*

He also asserts in his own voice that this is the proper method.³²

The precise form that the natural path takes is important. The human mind signifies what it knows along this natural path through *words* or *names*. Consequently, the natural path can be seen in our words. The natural path shows up in speech (as an effect) in the genesis of analogous terms.

It is not surprising that some people would prefer, if they could, to do away with language altogether, and never to use anything but unambiguous marks or symbols. Nor do I see why we should hesitate to admit that this denial of analogical terms, as a means of intelligible expression, means the impossibility of all philosophy. For if, in naming things, we follow the progress of intellectual knowledge and, if this knowledge proceeds from the more known to the less known with dependence upon the former, it is only natural that we should transfer names of things more known to things less known. Thus the word 'distance' has been transferred from things that are apart locally, to distance in time, distance between simple and complex systems, between ideas, and philosophies. Extended meanings of what is morphologically the same word indicate progress in knowledge. But if the meaning of a word be either unique, or sheer metaphor, so that once the word has been used to refer to something in the order of external sensation or of making, it may never again be used to mean anything else in any proper sense, it must follow that philosophy will have nothing to name, for the excellent reason that there will be nothing else we can come to know so as to need to name it. The very sentence just pronounced, containing such names as 'reason,' 'know,' 'name,' must now stand as a series of mere scratches or noises of which it would be meaningless to ask whether it is likely, unlikely, true, or false.³³

The *reductio* with which this exposition ends argues from a type of monism. If meaning was one and immobile, so too would knowledge be. De Koninck concludes that the reverse

means in the large area of non-ambiguity. The errors to be avoided are compulsive rigidity and failure to be happy in the company of uncertainty. When asked what viruses are and what they do, we can answer. When asked, what is life, we must reply with no more or no less than an enigmatic smile.'” I emphasize the phrase which De Koninck singles out particularly for discussion in “Is the Word ‘Life’ Meaningful?,” 80–83. See also De Koninck’s “The Unity and Diversity of Natural Science,” 5–6, and “Three Sources of Philosophy,” 13–15.

32. See De Koninck, “The Unity and Diversity of Natural Science,” 5–6, as well as his “Introduction à l’étude de l’âme,” 21.

33. De Koninck, *The Hollow Universe*, 18, fn. De Koninck makes a very similar argument about “philosophical terminology” arising from what is more known to us in “Abstraction from Matter,” I:154–56. This is not to say that the Thomistic understanding of language defended here reduces entirely to the context of terms, any more than the meanings of words are atomic; see John R. Mortensen, *Understanding St. Thomas on Analogy* (Lander, WY: The Aquinas Institute for the Study of Sacred Doctrine, 2010), 51–58.

is the case: the meanings of words insofar as our mind uses them as signs share common, related, or transferrable meanings and resolve to common or initial sources. That is, we begin with concepts that are most general and proceed to concepts that are more specific.³⁴ Thus, grasp of analogical naming is an index of cognitive progress; if more robust, it indicates philosophical progress.

This progress of analogical terms arises from the very outset.

As we first try to pin down and reflect upon the meaning of the term ‘life,’ why should we be requested to ignore the life already so familiar to us, and to signify which we normally use this term? That what I venture to call the more sensible and natural approach is indeed more sensible and natural seems attested by our usual manner of speaking. . . . [E]ven in such cases of mere metaphor [the mouth of a river or the bowels of the earth], the words first imply reference to something already known, such as the mouth or internal organs of an animal—of a horse, say, or a man—though not without a generous share of vagueness. Of all our normal language it is true that, whether its words be used as metaphors, given new meanings, or meanings long worn out and now revived, they still imply reference to something already known, something that may be quite certain, no matter how fuzzy at the edges. (All analogical terms are examples of what is meant.)³⁵

Now, this “usual manner” of speaking is not beyond being disciplined. Indeed: the child who calls all men “fathers” or all women “mothers” betrays the indistinct generality of his understanding by his misuse of names for more specific concepts and can be corrected. Rather, the argument merely uses speech as an index of the mind’s progress along the natural path in our knowledge. Our natural language is a stable basis for this progress. Now, these first names are “not without a generous share of vagueness,” yet nonetheless

34. Here one could anticipate what must be discussed in §22.4: what concept is first known, and how is it related to what comes after? Since we do not always possess the facility of language, however, we cannot inspect this progress of our mind’s concepts through our use of words as signs of thoughts.

35. De Koninck, *The Hollow Universe*, 83–84. I include the beginning of De Koninck’s footnote in the last parenthetical. He proceeds to give an example of the analogy of the word “reason.” In this connection, De Koninck is wont to draw on a remark made by Heisenberg in his Gifford Lectures, Werner S. Heisenberg, *Physics and Philosophy: The Revolution in Modern Science* (New York: Harper & Row, 1962), 200–202; see De Koninck’s “The Unity and Diversity of Natural Science,” 22–23, also “Three Sources of Philosophy,” 13. This will be discussed in §25. See also Connell, *From Observables to Unobservables in Science and Philosophy*, 69, concerning this origin and order of our naming.

they “imply reference to something already known, something that may be quite certain, no matter how fuzzy at the edges.”³⁶ The problem with this starting point—be it ever so natural and necessary—is that it is unsatisfying to the mind. Proper progress from what we know first can be difficult to initiate. The mind naturally prefers clarity and distinctness. To reject the natural path, however, De Koninck identifies as an error; I will call this the Cartesian Inversion.

De Koninck, discussing the proper initiation into the study of the soul, draws this distinction in terms of knowing *that* in contrast to knowing *what* something is. While “the first notion of life, that to which one must ever return, comes to us first and principally from the internal experience of living,”³⁷ this *experience* is not itself the subject of study.³⁸ The experience grounds our knowledge that life exists; it is another thing to investigate what life is, and what the principle of life is.

Now, this certitude *that* something is is not in direct proportion to our certitude of *what* something is. This is because of the ontological order of things and the epistemological distance of our mind from the essences it desires to know. The Cartesian Inversion directly reverses this line of causality. After taking pains to point out how St. Thomas argues that we do not directly know the essence of our soul, De Koninck reminds us of Descartes’ definition of “clear and distinct ideas,” his discussion of Aristotle’s definition of motion, and his method for proving the existence of God.³⁹ De Koninck argues:

36. De Koninck, *The Hollow Universe*, 84.

37. De Koninck, “Introduction a l’etude de l’âme,” 13. A student of De Koninck’s, Connell, *From Observables to Unobservables in Science and Philosophy*, 30, calls the first the “fundamental cognitive relation,” upon which is based the second cognitive relation, knowing what something is.

38. De Koninck, “Introduction a l’etude de l’âme,” 16–17. See also Ide, “La philosophie de la nature de Charles De Koninck,” 465–66, and fn. 19, who suggests that this distinction could be the beginning of a rapprochement between phenomenology and the philosophy of nature.

39. De Koninck, “Introduction a l’etude de l’âme,” 18–20. See St. Thomas, *ScG*, III.46; *ST*, Ia, q. 87, a. 1. De Koninck points out the following connections: Descartes’ definition of clear and distinct ideas (*Discourse on Method*, Part II, AT VI.18:16–23; *Principles*, I, 45, AT VIII.22:3–9) provides him with the means to discern the essence of the soul (*Discourse*, Part IV, AT VI.33:3–11), prove that we have a concept of the infinite existence of God (*Meditations*, Meditation III, AT VII.45:23–29), and dismiss the Aristotelian definition of motion (*Rules*, Rule XII, AT X.426–27:16–2:).

In truth, there are no examples more obvious of the inverse relation between certain knowledge and clear and distinct knowledge than the experience of living and being, and the perception of movement; nor a more trenchant illustration of the inverse relation between the knowability of things in themselves and their knowability for us, than that of God. Also, let us mark well the critical turn in the history of human thought; it is achieved by the identification of what is certain for us with clear and distinct knowledge of things so far as what they are in their proper nature. God, in Himself the most intelligible of beings, and the human soul, the most knowable in itself of all the things of nature, become the most known for us so far as “what they are.” On the other hand, movement, the least perfect of acts and consequently the most obscure in itself, is changed into “*rem unicuique notissimam*” so far as its very nature. Here then is a universe conceived to the measure of man. But who does not see that this clarity and distinction are only the result of a confusion without equal and without return? If one finds it already in David of Dinant and Nicholas of Cusa, at least such a confusion was never yet formulated with this clarity, which unmasks it to some and which seduces others. In order to be so immediately, clearly and distinctly perceived by us, the Deity would have to be less than human, and in order to be so well, and also completely, known by us, it would be necessary that the soul, too, be not much of a thing.⁴⁰

From this text we see the most universal way one can state the reason why the natural path exists—viz., because the human mind does not immediately know the essence of what it by nature desires to know. This pains the human mind and it rebels against the natural path in its knowledge. The Cartesian Inversion identifies the character of the initiation of our intellectual life with that which characterizes the Divine intellect. Yet given the actual character of our mind, it follows that this dehumanizes the Deity through our so conceiving Him; our own being becomes even less. The universe is “conceived to the measure of man” because we identify the principles of the universe with what is more certain to us at first. Hence, the Cartesian Inversion turns readily to the mathematical mode of thinking. Consequently, by taking this unnatural beginning, the mind “misses” the beginning of the natural path in the study of nature.⁴¹

40. De Koninck, “Introduction a l’etude de l’âme,” 20.

41. This is the principal way in which philosophers disagree, viz., about where to begin; see Marcus R. Berquist, “Where Philosophers Disagree,” *Lectio* 1 (1994): 13.

22.2 *The orders of determination and demonstration*

However, it would be at least as much a mistake as Descartes' to conclude that *from* such initial, indistinct universals *as such* the mind demonstrates what exists more determinately. This "game of concepts" is the very parody of a sterile Scholastic method which De Koninck seeks to avoid.⁴² To avoid this error, one must make the distinction between the *processus in determinando* and the *processus in demonstrando*.

The process *in determinando* is the order we follow in the consideration of the different subjects and principles of a science according as they are more known to us. But that which is most known to us, and most certain, is the confused. Thus it is that one is aware first of all that this object is a figure, then that it is an enclosed curve, and finally that it is an ellipse. So too, man is first known as animal. We find this order both in intellectual and in sense knowledge. As long as we know the ellipse only as figure or as closed curve, we do not distinguish it from other species of figures, or other closed curves; as long as man is not known in that which distinguishes him from the brute, our knowledge is confused. But this confused thing is also more common, more universal; for the polygon is equally a figure, the circle a closed figure, and horse an animal. So too, in science, we consider things according to that which, in them, is first of all more known, to go on thus by degrees toward that which is more knowable in itself; for, manifestly, man is more knowable in himself than animal; being animal and reasonable, he is more distinct, more in act and hence more knowable in himself. So we advance from subject to subject following this order of commonness. In the science of nature, we try to know in the first place what is proper to a thing insofar as it is mobile, then, what is true of it regarding its mobility according to place, etc. A last term of this whole process would be, for example, the study of the walk characteristic of the elephant. Certainly it would be impossible for a single man to embrace the vast domain which separates the consideration of mobile being from the flight of the dragonfly—that is to say, all the natural sciences. Moreover, each of the many natural sciences, which must already borrow from the field of others, can be indefinitely extended in its own. Nonetheless, such would be the order which ought to be observed in order to have a well ordered view of the whole.

The process *in demonstrando*, as well, is determined by the principle that one must go from the more known to us toward the less known. But it differs from the first by the order that we follow in the search for and demonstration of the

42. See De Koninck, "Introduction a l'etude de l'âme," 24 and see fn. 3.

properties of a given subject. In the process *in determinando*, we go from a less determined subject to a more determined subject: one seeks to know first of all the nature and properties of the soul in general and then the nature and properties of its different species; whereas the process of demonstration is the order that one follows in the acquisition of scientific knowledge of a given subject. While the first process is common to all the sciences, the second can vary from one science to another and even according to the different parts of one science.⁴³

One can fruitfully compare this explanation of the distinction to St. Thomas' text from the *Expositio* quoted at the beginning of §22.1. The first reason given for why the mode of proceeding rationally belongs most of all to natural philosophy is that it belongs to the human mind to proceed from the more to the less known. Note that this is *common* to both processes.

What is proper to the *processus in determinando* is how we apply this axiom of the natural path both within the subject of a single science and to the connection between a more general subject and a more specific one. For any subject, there is a generic level of determination, based upon experience, which frames our understanding of that subject. Nonetheless, within a single study (such as general natural philosophy) the mind achieves a more determinate understanding at that level of study: e.g., "motion" is understood vaguely at first and then, through the general conceptions of act and potency, is understood distinctly. More specific subjects require greater concretion or more detailed experience in order to provide an inductive basis for their study.

What is proper to the *processus in demonstrando* is that it does not concern more determinate conceptions of the aspects of the subject under study but the conception and discourse from the subject to its properties: this is the object of a science, viz., a demonstrated conclusion. Just as St. Thomas notes in his comments that this occurs in a different ways in different sciences (e.g., in the case of natural science in large part, this demonstrative procedure is *a posteriori*, as opposed to the formal *a priori* method of mathematics), so

43. De Koninck, "Introduction a l'etude de l'âme," 25–26. See also De Koninck, *Writings*, Vol. 1, 446–47.

also De Koninck notes that the *processus in demonstrando* can vary from science to science. However, it is the “rational manner” of the process that is most characteristic of natural philosophy, viz., to reason from one distinct thing to another.

These two processes are therefore distinct in the way that the deliverances of the first act of the intellect are distinct from the third act. Because the latter depends upon the former, one cannot make progress through different stages of determination by an appeal to the procedures of demonstration.⁴⁴ Progress is made along the order of determination through successively greater achievements of concretion. This can only be had by gaining, inductively, more experience. It is, by contrast, impossible to arrive at such details deductively; we cannot deduce the idea of an apple from the generic idea of fruit in a Hegelian fashion.⁴⁵ The order of determination is not a “game of concepts” by which one demonstrates the nature of the human soul from the nature of soul in general.⁴⁶ Rather, one must return to experience to give further specificity and determination to a grasp of one’s subject.

The *telos* of this order of determination is an intimate understanding of an *infima* species in its particular character. “It is the author of the *Metaphysics* and of *On the Soul* who wanted to know why dogs run lopsided.”⁴⁷ This is nothing other than to say that the goal of natural inquiry are the first principles, causes, and elements of natural things, from the most universal causes to the more proximate and particular; these are the essences apart from which our minds are born at a distance. This leads us to a crucial distinction:

When the scholastics say that in the experimental sciences are sought the most proximate causes of things, whereas the philosophy of nature seeks the ultimate causes, they are quite right, provided that by ultimate causes one means, not causes most universal in their predicable community (as is the case with the principles considered in the earlier treatises insofar as they are prior to the trea-

44. De Koninck, “Introduction a l’etude de l’âme,” 26.

45. Ibid. De Koninck often notes this in connection with Hegel’s notion of universality. For instance, see “The Principle of the New Order,” De Koninck, *Writings*, Vol. 2, 134.

46. De Koninck, “Introduction a l’etude de l’âme,” 33–35. See also “Are the Experimental Sciences Distinct from the Philosophy of Nature?” in *Writings*, Vol. 1, 447.

47. De Koninck, “Introduction a l’etude de l’âme,” 27.

tises dealing with things in greater concretion), but the ultimate causes which are first by reason of causality, and which we do not know save by way of the more proximate causes. And if one often confuses the two, this is because the properly ultimate causes can be known only in a confused way. So it is that in the *De Anima* we can demonstrate that man is the natural end of all natural species [415b14–27]. But this knowledge, although certain, remains very confused. Theories of evolution are only an attempt to rejoin this end in the order of concretion. It is only by means of the latter [theories of evolution] that we can attain the ultimate cause in itself absolutely. But we have recalled that the experimental sciences remain in a state of motion toward a term that one approaches nearer and nearer without ever attaining it in itself. Thus the reflections of the philosophy of nature, insofar as they are based on the experimental sciences, themselves remain in a state of dialectical movement toward a term which is no less the ultimate aim of all our knowledge of nature.⁴⁸

This distinction between progressing through universals *in praedicando* towards universals *in causando* De Koninck sees as crucial.⁴⁹ The universal in predication is distinguished by being more potential the more general is its conception (e.g., “heat”); by contrast, the universal *in causando* is the more actual the more general is its causality (e.g., the sun).⁵⁰ Thus, to say that “A craftsman is building” is to state a more general cause than to say that “A house-builder is building.” In like fashion, “being” means less than “man,” when naming Socrates; thus, “the more general is the universal *in praedicando*, the more superficially does it explain the objects of which it is said.”⁵¹ Such universals in predication form the human mind in

48. De Koninck, *Writings, Vol. 1*, “Are the Experimental Sciences Distinct from the Philosophy of Nature?” 454–55. De Koninck alludes to an interpretation of Aristotle’s discussion in *De Anima*, II.4, 415b14–27; this conclusion from biology is later applied in *Politics*, I.8, 1256b7–22. The interpretation of the *De Anima* can be found in St. Thomas, *Sent. De Anima*, lib. II, cap. 7 (Leon.45/1.98); see also *Sent. Polit.*, lib. I, cap. 6 (Leon.48.99:210–13): “Sed natura, neque dimittit aliquid imperfectum, neque facit aliquid frustra; ergo manifestum est quod natura fecit animalia et plantas ad sustentationem hominum.”

49. De Koninck, “Introduction a l’etude de l’âme,” 27: “In this process of concretion, to the relation of the universal to the particular of which we have been speaking, another is added which is in a way the reverse of the first. In fact, the more the process approaches distinct knowledge of the particular, the more it approaches just the same a universality which, unlike universality *in praedicando*, is such by its actuality, by its extreme determination which embraces the multiple in its variety and its distinction. The perfection of our knowledge of the universal *in causando* will depend on the degree of distinction according to which we know the particular.”

50. See Ronald McArthur, “Universal in Predicando, Universal in Causando,” *Laval théologique et philosophique* 18, no. 1 (1962): 62–67, 69–82; this article is derived from McArthur’s dissertation, directed by De Koninck.

51. *Ibid.*, 64.

its progress along the natural path. However, that which the human mind seeks to know through its universal predicates are causes which are universal in their reach.⁵²

We approach what is universal in causality as we gain more determinate knowledge of the parts of species of things which are the effects of this universal cause. These species and their formal parts, however, we at first know only generically. On the one hand, this eliminates the proposal that the best beginning in the study of a subject is with its simplest parts, using them to explain the composite whole.⁵³ On the other hand, this allows for a determinate place where the investigation turns towards the parts of the whole and considers them: the orders of intention and composition.⁵⁴ That is, the *partes speciei et formae* must be considered in order to achieve a complete knowledge of the subject at hand, and approach, inasmuch as it is possible, knowledge of universal causes. As De Koninck claims in the text quoted above, if one universal cause which natural philosophy discovers in its character as universal cause is the teleological character of the human species, then it would fall to the more determinate studies of the sciences—in this case biological evolution—to manifest in more concrete terms the aspects of this universal final causality of the human soul.⁵⁵

Even though such universal causes are the goal of its study of nature, the human mind oscillates between the universals in predication (which are never eliminated) and the uni-

52. See De Koninck, "Introduction a l'etude de l'âme," 28–30, where De Koninck addresses, following St. Thomas, the Platonic objection that, in knowing the universal form, we are knowing universals in causality; see St. Thomas, *Sent. De Anima*, lib. I, cap. 1, (Leon.45/1.6–7).

53. See De Koninck, "Is the Word 'Life' Meaningful?," 82–84; De Koninck, *The Hollow Universe*, 90–91: "It was a typically Cartesian view that science must begin with what is most basic in the things under study. Many of us were raised on the 'evidence' that an atom was a much clearer thing than a stone; while in the study of life, we were made to begin by clearing away everything but the amoeba. The assumption was that whatever is less complex ought to be more accessible than the complex. In physics there are no Cartesians left: the world of mathematical physics has turned out to be far more involved than Descartes or even Newton could suspect. It has taken some centuries of experiment and symbolic construction even to approach something basic, such as what are now called atoms and quanta. And every day we learn that these are more complex than was thought yesterday. So the fact must be faced that what we know first and foremost is not what is most basic to things themselves, no matter how much we might like to have it that way."

54. See above, §11.1

55. De Koninck, *The Cosmos, Writings, Vol. 1*, 263–68.

versals in causality.⁵⁶ That is, because of the abstractive character of our thinking, the very essence of our science cannot be changed due to the discovery of universals in causality. This abstractive character gives unity to the subject of our consideration and is a foundation which is not replaced by new discoveries. The human mind therefore oscillates between its universal concepts and the universal causes which those concepts represent.

On the one hand, we cannot simultaneously know by a single and same concept several distinct objects save at the expense of distinct knowledge; on the other hand, we cannot consider the unity of several objects save by simultaneously knowing them. Because it is one thing to have a distinct knowledge of several objects, which is developed in a successive consideration, and the simultaneous consideration of these same objects by means of a single concept is another. This shows the intermediate character of our science which oscillates between the confused universal of which it cannot be rid, and the universal *in causando* that it cannot quite achieve. It could only be truly free if this last were at the same time the beginning of our knowledge; if that which is the most actual in things were also the most known to us.⁵⁷

Thus, even in knowing the human intellectual soul as a universal final cause (e.g., of the arts), a greater intension is always possible within our distinct knowledge of the things ordered to it as to an end. Thus, when we consider these things individually, we proceed in the order of predication to a more specific notion and lose sight of the others; we cannot conceive of them all distinctly from one vantage point.

This is due to the empirical nature of human reason: it depends on the being itself of the sensible and multiple things that it first of all knows, and it can only attain unity in its means of representation by abstracting from the original diversity. That is why none of the concepts by which it knows can be a universal *ad rem* or *in repraesentando* as are the means of knowing of separate intelligences. God, indeed, knows Himself and knows all things, in a manner absolutely distinct, in a single intelligible similitude which is His essence. With the angel, the intelligible similitudes are multiple, but he knows distinctly a great number of things by each of them. This is because these intelligible species derive from the unique *species*

56. See De Koninck, "Introduction a l'etude de l'âme," 32.

57. Ibid., 32–33.

rerum factiva of God, a universal *in causando*, without going through things in themselves.⁵⁸

What De Koninck means by a universal *in repraesentando* will be discussed later (§22.4, §25.3). This “empirical nature of human reason” is, then, the very reason for why the natural path exists. Arising from the character of the human mind, it determines the mode of natural philosophy from the outset. Natural philosophy is not just about natural beings, but it is the philosophy natural to the human being, an intellect united to an organic, sensate body—an intellectual form “*materiae immersa*”—and “*propter hoc scientia naturalis inter alias est maxime hominis intellectui conformis*.”⁵⁹

In the remaining subsections, I will consider this fundamental character of the intellect in two ways: first, insofar as the known is in the knower, or the precise character of abstraction from matter (§22.3); second, insofar as the known is in the knower first in the order of time (§22.4–5).

22.3 Abstraction from matter and the modes of definition

The basis for De Koninck’s understanding of abstraction and the unity and diversity of the sciences is drawn from St. Thomas’ doctrine of abstraction from matter and motion.⁶⁰ What

58. De Koninck, “Introduction a l’etude de l’âme,” 32, fn. 1. See also *ibid.*, 31, fn. 2.

59. St. Thomas, *ScG*, II.51; *SBdT*, q. 6, a. 1a, c. (Leon.50.160:194–96).

60. Two of the classical *loca* for this doctrine are St. Thomas, *In Phys.*, lib. I, lect. 1, n. 1; *SBdT*, q. 5. Consider also *ST*, Ia, q. 85, a. 1, ad 1 and 2. These texts are the basis for De Koninck’s extensive treatment in “Abstraction from Matter”; since this article comes in three parts, I will designate the part in capital Roman numerals followed by the page number, e.g., I:133. See also his “Natural Science as Philosophy,” *Culture* 20, no. 3 (1959): 4–7. The key principles are enunciated in the following text of St. Thomas, *SBdT*, q. 5, a. 1, c.: “Now, something belongs to an object of speculation [*speculabilis*] (the object of the speculative power) on the part of the intellectual power, and something on the part of the habit of science by which the intellect is perfected. Accordingly, on the part of the intellect, it belongs to [such an object] that it be immaterial, because the intellect itself is immaterial. Now, on the part of the [habit of] science, it belongs to [such an object] that it be necessary, because science is of necessary things (as proven in *Posterior Analytics*, Book I). However, every necessary thing, insofar as it is such, is immobile, because every thing which moves, insofar as it is such, is able to be or not to be either simply or qualifiedly speaking (as is said in *Metaphysics*, Book IX). Thus, therefore, a separation [*separatio*] from matter and motion or joining to them [*applicatio ad ea*] belong *per se* to an object of speculation (the object of speculative science). Therefore, the speculative sciences are distinguished according to the order of remotion from matter and motion.” (Leon.50.138:123–40) Here St. Thomas uses “*separatio*” in a more generic sense than he later distinguishes in q. 5, a. 3.

constitutes the essence of an object of speculation is “remotion from” or “application to” matter and motion. This is because matter and motion are opposed to scientific knowledge: what changes, precisely insofar as it changes, cannot be subject to a necessary (unchanging) type of knowledge. There cannot be a science of Socrates as he sits down or strolls about Athens. Such a “science” would be mere narration.⁶¹

The distinction between the speculative sciences follows from this *separatio* or *applicatio* to matter and motion. A thing as an object of speculation either depends upon matter for its being or it does not, and the thing as object either depends upon matter for its being understood or it does not. The first logical possibility (that the object depends upon matter for its being and its being understood) grounds the object of natural philosophy, defining with sensible matter. The second logical possibility (that the object depends upon matter for its being but not for its being understood) grounds the object of mathematics, which defines with intelligible matter. The third logical possibility (that the object depends upon matter neither for being nor for being understood) grounds the object of metaphysics, which considers being *qua* separate from matter. The fourth logical possibility (that the object depends upon matter for its being understood but not for its being) is in fact impossible.⁶²

The value of De Koninck’s treatment lies in unpacking the meaning of the terminology used to make these distinctions: abstraction (separation, application), matter, sensible matter, intelligible matter, and the like. In what follows, I consider his exposition of “matter,” “abstraction,” “sensible,” and “intelligible matter.” This exposition is essential for understanding the *rapprochement* De Koninck proposes between the ancient discipline of natural philosophy and the modern sciences.

61. See De Koninck, “Abstraction from Matter,” III:169–72; on 170 he notes: “Science, then, would be impossible if it had to bear directly upon subjects which can be other than they are: what we call science would be no more than history, i.e. narration. Movement is excluded from scientific knowledge inasmuch as it implies this kind of possibility.”

62. See St. Thomas, *SBdT*, q. 5, a. 1, c. See also Wippel, *The Metaphysical Thought of Thomas Aquinas*, 9.

First, what is meant by the term “matter” in the terminological phrase “abstraction from matter”? To answer this question, De Koninck attends to the order in our naming. We name things only insofar as we know them, and “that is why extended meanings of words indicate an order of progress in knowledge.”⁶³ Now, the etymological origin of words as part of a language is distinct from and subordinate to the meanings which we intend to signify. These meanings have a natural order of genesis in the mind (albeit with errors and many accidental interferences), since at first we do not know things insofar as they are in themselves.⁶⁴ Thus, De Koninck attends first to etymology and subsequently to analogy to understand “matter.”

Let us here try to identify their meaning [form and matter] by taking an example from something well known, which leads us to a primitive meaning of ‘matter,’ viz., timber, the stuff that is used to make houses, tables, broomsticks, etc. ‘Form,’ on the other hand, originally meant the contour, shape or figure of a thing, e.g., the form of a bowling-pin. The emphasis which we are placing upon the original meaning of a word is not intended to suggest that this same meaning is to be identified with its subsequent uses; but rather that to neglect original meanings entirely could lead to confusion with respect to later meanings. Etymology, in the historical and philological sense, can be the key to more abstract meanings of the same word. The principle involved is that even today, a word must be made to refer first of all to something more known to us, before we apply it to something less known. We always have to know what we are talking about.⁶⁵

“What we are talking about” relies upon our first grasp of what things are. In this connection, form and matter are imposed as terms to signify the differences we experience in the constitution of things. The bowling-pin is in some way the same as the broomstick—someone used wood to make them both—and yet they are also different as to the arrangement of those parts. Likewise, the shapes of certain objects in question could be the same, and what

63. De Koninck, “Abstraction from Matter,” I:150. Ibid., 149: “To this end, it will not be enough to point out what these philosophers intended when using such words as ‘matter’ and ‘abstraction.’ All this is bound to still another doctrine, a general, more basic one concerning the use of words and their various impositions.”

64. Ibid., I:153: “To sum up, if the essential differences between things were grasped at once, the differences of names would be taken from them: that whence they signify would be that which they signify—the specific differences of the things themselves. The whole relevance of the distinction between the specific difference of the thing itself and the trait from which the thing’s name is taken derives from the fact that we do not know outright the essential differences of things, and that we can name things only as we know them.”

65. Ibid., I:157 and fn. 1.

one used to compose them could be different. Or a set of objects could be identical in both respects. Thus, distinct terms need to be applied to signify these differences in things which we experience. The artificial and natural things would then come to be defined using form and matter as signifying distinct principles of the being of those things.

In using these terms (form and matter), however, we notice that a difference arises when we consider the individual object. *This* bowling-pin is defined using terms that signify its individual wood and shape, but the terms extend further. We sense the wood and shape of this bowling-pin, and so we could say we sense its form and matter, but when we say what the bowling-pin is, these same terms are not limited to the individual. Otherwise, this bowling-pin and its wood and its shape would be the only wood and shape of such a manner in existence. We are led to recognize that the terms form and matter refer not only to the principles of the individual thing, but to the principles of the definition of that thing insofar as the definition applies to other things of that type. Thus the definition compares to its individuals as form to matter, and the “form” in the definition and the “matter” in the definition are both *formal* in this new sense. An additional use of the term “matter” is proportional to the individual defined and implies some principle of individuation.⁶⁶ It follows that individuals cannot be defined.⁶⁷ At this point—with the term “matter” being used to signify a principle of being, a principle of definition, and a principle of individuation—what is crucial to notice is that a science seeks to know the first through the second while ignoring the third, and likewise with “form.”⁶⁸ The “matter” which science considers therefore receives a distinct name, “common matter.” It follows that if there are formally different sciences then different terms for common matter must be used: this is part of the problem related to imposition of the terms “sensible matter” and “intelligible matter.” The other part of the problem is the paradoxical result that “sensible” or “common” matter thus defined no longer

66. De Koninck, “Abstraction from Matter,” I:158–60.

67. *Ibid.*, I:160–62.

68. *Ibid.*, I:162–66.

refers to what is, in fact, sensible, viz., the *individual's* sensible matter.⁶⁹

“Abstraction” itself is an analogous term. The etymology of the word provides a basis for its imposition (*ab* and *trahere*), but not the sufficient reason.⁷⁰ What it is imposed most fundamentally to signify is the act of the mind considering one thing without considering another.⁷¹ In certain cases this happens to things that are unrelated: when we consider that Socrates is a man without considering that he is married or has a fever. However, by identifying in our experience the consideration of the definition of an individual apart from the individual, we are led to a further imposition of the term “abstract.” The first type of abstraction possible here is “total abstraction,” so called insofar as a whole (the universal) is prior to its parts (the individuals).⁷² However, there is a further sense of the term “abstraction,” usually called “formal abstraction,” belonging to mathematics.⁷³ The reasons why these two abstractions differ is more involved.⁷⁴ We will approach this through

69. De Koninck, “Abstraction from Matter,” I:162–66: “So bone, muscle and nerve, the matter of man, must be considered by any genuine science of man. It should be clear, however, that this does not mean the bone, muscle and nerve of Socrates the individual, although our scientific findings are going to apply to his matter truly enough. What science does, then, is to abstract from individual sensible matter, but not from common sensible matter.”

70. Ibid., II:53.

71. See St. Thomas, *SBdT*, q. 5, a. 3, c.: “Sic ergo intellectus distinguit unum ab altero aliter et aliter secundum diversas operationes; quia secundum operationem qua componit et dividit distinguit unum ab alio per hoc quod intelligit unum alii non inesse, in operatione vero qua intelligit, quid est unumquodque, distinguit unum ab alio, dum intelligit quid est hoc, nihil intelligendo de alio, neque quod sit cum eo, neque quod sit ab eo separatum; unde ista distinctio non proprie habet nomen separationis, sed prima tantum. Haec autem distinctio recte dicitur abstractio, sed tunc tantum quando ea, quorum unum sine altero intelligitur, sunt simul secundum rem; non enim dicitur animal a lapide abstrahi, si animal absque intellectu lapidis intelligatur.” (Leon.50.148:159–73) There is a difference between “abstraction” as an act of consideration and “abstraction” as a psychological causal process involving the agent intellect, here we are considering the former; see Therese Scarpelli Cory, “Rethinking Abstractionism: Aquinas’s Intellectual Light and Some Arabic Sources,” *Journal of the History of Philosophy* 53, no. 4 (2015): 628.

72. De Koninck, “Abstraction from Matter,” II:53–54.

73. Ibid., II:54.

74. Even more involved is the way in which Aristotle and Plato differ on this question: how the mind can know something “otherwise” than it actually exists. See St. Thomas, *SBdT*, q. 5, a. 2; also *ST*, Ia, q. 85, a. 1, ad 1: “Cum ergo dicitur quod intellectus est falsus qui intelligit rem aliter quam sit, verum est si ly *aliter* referatur ad rem intellectam. Tunc enim intellectus est falsus, quando intelligit rem esse aliter quam sit. Unde falsus esset intellectus, si sic abstraheret speciem lapidis a materia, ut intelligeret eam non esse in materia, ut Plato posuit. Non est autem verum quod proponitur, si ly *aliter* accipiatur ex parte intelligentis. Est enim absque falsitate ut alius sit modus intelligentis in intelligendo, quam modus rei in existendo, quia intellectum est in intelligente immaterialiter, per modum intellectus; non autem materialiter, per modum rei

attending to why “sensible matter” differs from “intelligible matter,” for total abstraction retains the former while formal abstraction retains the latter.

What is meant by the term “sensible” when we say that natural philosophy defines with “sensible matter”? Above, we noted that if natural philosophy defines with “sensible matter,” then the meaning of “sensible” refers to a matter other than the sensible matter which we can actually touch or see. “Why, then, retain the adjective sensible to describe an abstract matter which cannot be actually sensed?”⁷⁵ The Aristotelian natural philosopher is therefore doubly odd: he claims to have science of things through “matter” not present in the things known and which is “sensible” by acts of sensation that cannot achieve what they are directed at.⁷⁶

De Koninck explains this oddity using the Aristotelian division of sensible objects, showing how “sensible matter” is sensible only *per accidens*. This matter is sensed through what is sensed *per se* and is itself sensed as “background, incidentally sensible” that is not to be identified with substance, at least at first.⁷⁷ What is intelligible in things is drawn from the senses and can be defined with matter denominated sensible. This is a vague but firm and

materialis.” (Leon.5.331) See also De Koninck, “Abstraction from Matter,” II:54–56.

75. *Ibid.*, I:167.

76. In such manner one can readily appreciate the difficulties Hobbes has with the schoolmen; *Leviathan: With Selected Variants from the Latin Edition of 1668*, ed. Edwin Curley (Indianapolis: Hackett Publishing Co., 1994), Part I, ch. 4, n. 22: “Therefore of absurd and false affirmations, in case they be universal, there can be no understanding, though many think they understand them, when they do but repeat the words softly, or con them in their mind.”

77. De Koninck, “Abstraction from Matter,” I:173: “The point is that, when we call wood ‘sensible matter,’ all that we do is to refer to a subject as apprehended in the act of sensing these qualities and structure which are our only means of identifying wood. We have no sense perception of the nature of wood, nor is there any question of an insight into ‘what wood is’ absolutely. To grant that we can be aware of sensible matter is not to grant more than this: first, that, in perceiving sensible objects, if we can distinguish one from another, in number or in kind, it can only be to the extent that differences in the *per se* sensible objects (like number or figure) may be signs of different subjects (as one man is distinct from another, or from a horse); secondly, that we never sense any object without being made aware of some background, incidentally sensible, about which we know only that it has shape, colour, resistance or absence of resistance, and so on.” And *ibid.*, 172–73: “Someone may suggest at this point that what we are calling sensible matter seems very like ‘substance.’ The term substance, however, has so many meanings, most of which are irrelevant to what is intended here, that we may avoid using it until we meet a problem requiring its explanation. For the present let it suffice that ‘sensible matter’ refers to that which a thing is made of, like the wood of the bowling-pin, or the bones and flesh of man.”

certain first step, initiating the intellect along the natural path beginning with *that* things are present to be known, even before it can say *what* or *why* they are.

Although it must be maintained that sensible matter is known *per se* to the mind, and to the senses only incidentally, this should not be interpreted to mean that the mind thereby knows ‘what the matter is’ absolutely. When the physicist points to the atom as an instance of matter, and then proceeds to show that it is convertible into energy, hinting, finally, that perhaps there is no matter there at all, he does not use the word as we intend it in the phrase ‘sensible matter.’ Whether sensible matter turns out to be a swarm of electrical charges or not does not affect what we mean when naming it; bone and flesh are not less bone and flesh for having an inner structure far more intricate and hidden than was dreamed of when man first knew and named them. And to make reference to what is thus called sensible matter is absolutely necessary for, if this reference be withheld or denied, there will be no way of knowing whether what science is elaborating upon has anything at all to do with the reality first attained by us in sense experience.⁷⁸

That is, this reference to sensible matter is essential for scientific realism. How, then, do we arrive at the conclusion that sensible matter is known *per se* by the mind but only *per accidens* by the senses?

First, one must distinguish between the ways in which the term “sensible” is used.⁷⁹ We can demarcate sensible objects by their communicability to other cognitive powers.⁸⁰ That which is sensed but is incommunicable through speech and through other sense organs are the proper and *per se* objects of that sense (*this* color can be seen but not felt). That which is sensed, incommunicable through speech, but communicable through other sense organs are common and *per se* objects of sensation (*this* motion can be both seen and felt).

78. De Koninck, “Abstraction from Matter,” I:173–74.

79. De Koninck draws these distinctions from Aristotle’s *De Anima*, Book II, ch. 6.

80. See in this connection De Koninck, “Introduction à l’étude de l’âme,” 51: “In fact, common sensibles are always *per se* sensibles. It is true that they are first known as modalities of the proper sensibles. But we must not lose sight of the fact that these modalities are common, that they are not the proper object of a determined sense, and that if one is able to see a figure, one is able also to touch it. But, from this fact, the common sensibles have a communicability particular to them: the blind and the deaf are able to understand the physical definitions of color and sound; one can give of temperature a definition which does not make it known as a proper sensible; but it is impossible to reveal the qualities of color or of sound to the blind or to the deaf.” In this context, De Koninck means “physical” in the sense of belonging to the modern science of physics: color as defined by wavelength or sound by frequency.

What, then, is the accidentally sensible? It is that which is sensed but is communicable only through speech and not through the senses. The *per accidens* sensible, therefore, belongs only to a being with reason.⁸¹ De Koninck notes:

So, when someone says “I met Socrates this morning, and he talked to me,” he means that he actually met the man named Socrates and heard him talk; not merely that he perceived a colour pattern and heard a series of sounds, nor that what he met was only incidentally Socrates. And this implies that, while not perceived *per se* by any of the senses, Socrates is known *per se* nevertheless by the one who senses; though not sensed *per se*, Socrates is yet somehow apprehended *per se* by the one who senses him *per accidens*. . . . Notice also that, when it is asserted that Socrates is *per se* known to the mind and only *per accidens* to the senses, this should not be interpreted to mean that *per se* sensibles are only *per accidens* attained by mind. The mind extends *per se* both to what is *per se* sensible to the senses and to what is sensed by them *per accidens*, grasping both one and the other as connected *per se*, for it is not *per accidens* that Socrates has shape and colour. In a similar way the mind apprehends speech both as a series of sounds and as possessed of meaning.⁸²

This excursus on the sensibility of Socrates helps us to understand how matter is sensible *per accidens*. The substance of Socrates, his individuality and hence individual matter, fall under the sensible *per accidens*. Since common matter is derivative from this matter of Socrates and other human beings, “It follows that what we call the sensible matter of Socrates, is sensible only in the manner that Socrates himself is, that is, *per accidens*.”⁸³ Therefore, the natural philosopher defines what is essential to substances that he knows through his senses. Consequently, it is only *indirectly* that he defines with reference to sense experience.

81. St. Thomas, *Sent. De Anima*, lib. II, cap. 13 (Leon.45/1.120–22). This is not to deny that irrational animals act with respect to *per accidens* sensibles, nor to assert that the apprehension of *per accidens* sensibles is without its own complexities. Such apprehension requires the *vis cogitativa* in human beings; here one must consider Daniel D. De Haan, “Perception and the Vis Cogitativa: A Thomistic Analysis of Aspectual, Actional, and Affectional Percepts,” *American Catholic Philosophical Quarterly* 88, no. 3 (2014): 397–437.

82. De Koninck, “Abstraction from Matter,” I:171, 172.

83. *Ibid.*, I:172.

Lastly, what is meant by the term “intelligible matter” in the definitions of mathematics?⁸⁴ First, we must clarify what the mathematical object does not attend to in the abstract consideration of the mind. When we consider a mathematical sphere, we think of it apart from any sensible determinations which it has—*per se* or *per accidens*. That is, we are not considering a colored sphere (yellowish-brown), a material surface, or even a material subject (bronze). If this were not the case then proofs about spheres could not proceed without a consideration of such features.⁸⁵

Nonetheless, there can be many spheres in our geometric consideration (many lines, many squares, etc.). Thus, the word “matter” can be extended to designate the individuality of mathematical objects. For this reason, just as the definition of material beings makes reference to common sensible matter, so also the definition of mathematical beings can make reference to their own manner of common matter. In this act of consideration, the mind attends to the mathematical as individuated and as a subject. Since the latter is only possible through the intellect, the square or sphere considered as a subject is called intelligible, and so also its matter. Mathematical objects must be defined with common intelligible matter.⁸⁶

By distinguishing the manner in which the natural philosopher and the mathematician achieve their definitions, we can reemphasize the commensurate character of natural philosophy to the human intellect. The formal abstraction of mathematics, by prescind-

84. The root of “intelligibility” in things is form or act—everything is intelligible insofar as it is in act. Thus, in natural philosophy, nature as form is a principle of knowledge; St. Thomas, *SBdT*, q. 5, a. 2, ad 6: “Anima et aliae formae naturales, quamvis non moveantur per se, moventur tamen per accidens, et insuper sunt perfectiones rerum mobilium, et secundum hoc cadunt in consideratione naturalis.” (Leon.50.144:172–76) In view of the theory of evolution, De Koninck must update this doctrine of form such that natural forms can also be an *effect* of something prior. He does this in his *Cosmos*; I provide a brief summary below, fn. 140.

85. De Koninck, “Abstraction from Matter,” II:58: “In the abstract sphere, the continuum is as the matter, and the shape is the form. In other words, in order to arrive at the true geometrical sphere, the mind must completely abandon that reality which requires sensible matter in its definition. That it has indeed done so is manifest from the fact that neither the definition of the mathematical sphere, nor any proofs or reasonings derived from that definition ever need to be confirmed by comparison with natural objects.”

86. See *ibid.*, II.65–69; St. Thomas, *SBdT*, q. 5, a. 3, c.: “Substantia autem, quae est materia intelligibilis quantitatis, potest esse sine quantitate; unde considerare substantiam sine quantitate magis pertinet ad genus separationis quam abstractionis,” with my emphasis (Leon.50.149:270–74).

sensible matter, possesses a manipulable clarity in the natures it considers (“nature” and “manipulable” being used in analogous senses) because they are purely formal; yet it also shares in total abstraction (since it considers its objects apart from individuating matter). Mathematical objects, therefore, have the double advantage of being more knowable to us at first and more knowable in themselves.⁸⁷ While mathematics is easier for the human mind since it requires only the mind’s proximate tool (the imagination), it is not conformal to the human being as a knower. That is, the human intellect knows through its senses; hence, the mode of defining with sensible matter is the mode which aligns most of all with the intellect in concert with the full range of human sense powers.

22.4 *The natural path and what is first known*

Because the natural path and consequently natural philosophy is maximally conformal to the human mind as a knowing power, certain consequences for the remaining three sections of this chapter (§§23–25) will be drawn from this fact taken in conjunction with St. Thomas’ doctrine that “what the intellect first conceives as most known, and into which it resolves all its conceptions, is being [*ens*].”⁸⁸ The interpretation of this principle is a key to understanding the nature of the human mind, how natural philosophy is a qualified form of wisdom, and

87. See St. Thomas, *SBdT*, q. 6, a. 1b, c.: “Cum enim mathematica sit media inter naturalem et divinam, ipsa est utraque certior.” (Leon.50.160:232–34) Also, Tommaso de Vio Cajetan, *Commentary on Being and Essence: (In De Ente et Essentia d. Thomas Aquinatis)*, trans. Lottie H. Kendzierski and Francis C. Wade (Milwaukee: Marquette University Press, 1964), 46: “In formal abstraction the more abstract a thing is, the more knowable it is in its nature. In total abstraction the more abstract a thing is, the more knowable it is to us.”

88. St. Thomas, *De Veritate*, q. 1, a. 1, c.: “Quod primo intellectus concipit quasi notissimum, et in quod conceptiones omnes resolvit, est ens.” (Leon.22/1.5) St. Thomas consistently maintains this as a principle; see Peter De Bergomo, *Tabula Aurea* (Rome: Editiones Paulinae, 1960), 514, who lists *ST*, Ia, q. 5, a. 2, c.; q. 11, a. 2, ad. 4; Ia-IIae, q. 55, a. 4, ad. 1; q. 94, a.2, c; *In I Sent.*, d. 8, q. 1, a. 3, c.; d. 19, q. 5, a. 1, ad. 2 and ad. 8; *De Veritate*, q. 11, a. 1, c.; q. 21, a. 1, c.; q. 21, a. 4, ad. 4; *Q. Disp. de Pot.*, q. 9, a. 7, ad. 6 and ad. 15; *De Ente et Essentia*, prooem. De Bergomo also lists five *loca* in the commentary on the *Metaphysics* and one in the commentary on *Liber de Causis*. Wippel, *The Metaphysical Thought of Thomas Aquinas*, 41, cites additionally: *SBdT*, q. 1, a. 3, obj. 3 and reply, *In I Sent.*, d. 38, q. 1, a. 4, obj. 4 and reply; *In Meta.*, lib. I, lect. 2, n. 46; lib. IV, lect. 6, n. 605.

bears upon De Koninck's assessment of the matter.⁸⁹

A first step to understanding what St. Thomas means by this principle is its context. In the *De Veritate* passage, he is presenting Aristotle's solution to the problem of discovery (the solution to the Meno paradox). Thus, it seems plausible that the principle should be interpreted in the order of time.⁹⁰

A second step is based upon logic and epistemology.⁹¹ What, of necessity, is the first thing in the temporal order which the human mind knows? If we only know things insofar as they are in act, and our mind, before it knows, is only in potency, and must proceed from potency into act, then only something in act can be what is first known. The natural path demands that what is first known, therefore, be imperfect, and indeed, "the most imperfect concept of all is the first by way of origin."⁹² However, what the intellect conceives are universal concepts. Universal concepts, however, can be considered as either definable wholes or predicable wholes. Now, taken as a definable whole, "being" ("what is") when known indistinctly is the most imperfect concept of all.⁹³ This is the case since every other concept adds to the concept of being as a definable whole.⁹⁴ Therefore, "being" is first by way of origin.

89. In regard to what follows, I would like to acknowledge my debt to John Francis Nieto's several unpublished papers which deal with how to understand the principle at issue.

90. St. Thomas, *De Veritate*, q. 11, a. 1. The key passage in the body of the article (Leon.22/2.350:264-271): "Similiter etiam dicendum est de scientiae acquisitione; quod praexistunt in nobis quaedam scientiarum semina, scilicet primae conceptiones intellectus, quae statim lumine intellectus agentis cognoscuntur per species a sensibilibus abstractas, sive sint complexa, sicut dignitates, sive incomplexa, sicut ratio entis, et unius, et huiusmodi, quae statim intellectus apprehendit." See also Cajetan, *Commentary on Being and Essence*, 49-50.

91. See *ibid.*, 40-42, 44-50.

92. *Ibid.*, 48.

93. Cajetan argues that, as definable wholes are prior to predicable wholes naturally, this implies that they are also prior temporally, since the former are based on the actuality of what is known and the latter based on the potentiality of what is known. Now, St. Thomas points out in many places that being cannot be divided by differences. Thus, to make the argument more precise, one must maintain that "being" here means a definable whole, viz., "being" defined as "what is." This definition applies analogously to all the categories.

94. For instance, substance adds "what exists through itself," and accident, "what exists in another." I note here that "being" as a definable whole would also be that to which we resolve all other concepts, if it is the basis for the notion of all the categories.

Now, what “being” means here is not a predicable whole, i.e., a total abstraction univocally common to the ten genera of being.⁹⁵ Nor is this “being” which is the subject of metaphysics. Rather, this notion of “being” is what the mind first abstracts from singulars; Cajetan calls this “being concretized in a sensible quiddity.”⁹⁶ This closely parallels what St. Thomas argues elsewhere.⁹⁷ The natural mode of the human mind is proportioned to know material beings and only through their natures to know immaterial beings. This is the reverse of an angel, who knows immaterial substance first and through such knows material things. If a metaphor is in order, the human mind is a physicist first and metaphysician after, while the angel is metaphysician first and physicist after. “Being” which is first known must be a sensible being, and thus defined with sensible matter.⁹⁸

Thus, the mind has a common, natural beginning, but is there some guarantee that the mind will succeed in following the natural path? Failure would seem odd since the mind possesses a natural inclination to this path—indeed, such an inclination constitutes this path or order in thought. However, pressed with difficulties of satisfying wonder and eliminating ignorance, the mind might begin at the wrong place when trying to know natural things.⁹⁹ The mind may revolt against the natural order and attempt to erect another regime in its place. This “revolt of the natural philosophers” is a theme De Koninck develops in contrast to what is “naturally first” to the mind.

95. Since being is not a genus and cannot be differentiated from something outside being. However, having experienced many beings, whether substances or accidents, the mind knows that this notion of being is applicable to all of them insofar as they exist; the mind would therefore confusedly grasp being as predicable of all that it experiences. That it is *analogously* so predicated is seen only later.

96. Cajetan, *Commentary on Being and Essence*, 44, fn. 16: “*ens concretum quidditati sensibili.*”

97. See St. Thomas, *ST*, q. 84, a. 7, c.

98. Ashley, “The River Forest School and the Philosophy of Nature Today,” 3–5, explains that this claim that the “ens” which is first known is physical being and not metaphysical being (the *ens qua ens* of traditional Thomistic metaphysics), grounds the proper conception of the order of learning and consequently is the remote basis for properly understanding the relationship between natural philosophy and the sciences.

99. And as Aristotle says in the *Ethics*, there are many ways to err. The mind that does not begin from what is common must begin from what is proper, or private; De Koninck defines this as a system, see “Three Sources of Philosophy,” 18–19.

22.5 *The revolt of the philosophers of nature*

De Koninck treats of this revolt in an appendix to his essay on the primacy of the common good.¹⁰⁰ He aims to show what happens when the mind confuses the being which it first knows with being that is most knowable simply speaking. The mind revolts against its own nature insofar as it revolts against speculation.

De Koninck begins his treatment with a thought experiment: what are the consequences of denying the priority of the speculative order to the practical order?¹⁰¹ At its root, this denial negates natural ends. Consequently, practical reason could not direct towards an end according to “right reason,” but could rather direct as men wished things to be. Indeed, on this hypothesis without natural measures, prudence becomes sheer technique: “Man would be the measure of all things, and there could be no other measure.”¹⁰² Human nature tends to exalt the technical order over the speculative order due to the mind’s weakness. The intellect must also be measured by things in order to be fulfilled, whereas in the technical order the mind can be the measure. Hence the temptation to desire our own technique in preference to the natural speculative operation of the mind.¹⁰³ The rejection of the natural priority of the speculative order requires as a corollary that one reject as well the natural order the mind would have taken within that speculative order. De Koninck notes that early modern

100. In particular, the second part mentioned in the essay’s title, *The Primacy of the Common Good Against the Personalists and The Principle of the New Order*; he specifies this theme in “Appendix V: The Revolt of the Philosophers of Nature.” See *Writings, Vol. 2*. To be clear, De Koninck speaks principally in this appendix of Feuerbach and Engels, but this focus on dialectical materialism does not lead to complete equivocation given what he argues in the body of his essay, i.e., *The Principle of the New Order*. “Revolution” would, admittedly, be more of a play on words.

101. De Koninck, *Writings, Vol. 1*, 110ff: “As Aristotle says in the *Ethics*, if man were the best thing in the universe, political science and prudence, not speculative wisdom, would be the best knowledge. Let us, then, consider the hypothesis that political science and prudence are the best knowledge and see what follows rigorously from it.”

102. De Koninck, *Writings, Vol. 2*, 111. For De Koninck, *ibid.*, 112, this means that the “history of modern philosophy has actually worked out the various conclusions we have deduced from the hypothesis that man is the best thing in the universe.”

103. See *ibid.* I do not think De Koninck means to argue that appetite is the only source of error, although it is a factor; see De Koninck, “Three Sources of Philosophy,” 19.

humanists exalted the “formlessness” of man—the initial indeterminacy of his intellect and will.¹⁰⁴ Since the human mind begins in the vaguest of conceptions about its connatural object, making this formlessness into a perfection eliminates the need to follow the natural method for further determining those primary concepts. This was referred to above as the Cartesian Inversion.

Thus, just as the error of the “personalists” is the rejection of the primacy of the highest common good, the universal cause of goodness, so also the principle of the revolution of the modern philosophers of nature is the rejection of the primacy of inquiring after the Divine truth *indita rebus*. The revolution of the natural philosophers is a revolution against the natural order, the “natural road” the mind takes.

At the beginning of Book Two of the *Physics* nature is defined In the course of this same book it is demonstrated that nature acts for an end, the first principle and first cause of nature itself. In the light of this demonstration, Saint Thomas defines nature as “a reason (*ratio, logos*) put in things by the divine art in order that they might act for an end.” In effect, action for an end presupposes intelligence, or at least a participation in intelligence. Nature properly speaking is therefore a substitute for intelligence. *Ratio indita rebus ab arte divina*, the most unreasonable nature is always a divine *logos*. Even the purely material principle, the passive principle of all things, being as well properly nature, is as it were a divine word.

The aim of the philosophy of nature is to know, in their ultimate specific concretion, these divine *logoi* and the end that specifies them and attracts them; to know perfectly the natural being whose form is separable and the term of all other natures, as Aristotle says in the same book of the *Physics* as well as in *On the Parts of Animals* (ch. 5). Nonetheless, this aim is only a dialectical limit of the study of nature, a term that we can ceaselessly approach but which we can never adequately attain.

Let us take note that the role of hypotheses increases to the degree that we approach things in their concretion. In the hypothesis, there is not only the aspect which calls for experimental confirmation, there is also the more profound tendency to get ahead of experience and to deduce it by way of a conclusion. Given the method we must employ on the road to that ultimate concretion, it

104. De Koninck, *Writings*, Vol. 2, 113–14; he cites as an instance Pico della Mirandola’s *On the Dignity of Man*.

would suffice to isolate this tendency in order that, at the limit, there would arise a world entirely of our own making. Seen in this respect, the limit toward which experimental science tends is the condition of the demiurge.

The method of the discovery of the reasons which anticipate experience is a method of reconstruction. Always in this precise relation taken abstractly, to reconstruct the universe is in some fashion to construct it. And if, *per impossibile*, this limit could be reached, the universe would be only a projection of our own *logoi*. But to attain that limit it would be necessary that we have practical knowledge of natural things; it would be necessary that natures be to us among things operable.

We have already said that the attempt to see the entire cosmos as a great flow, as an immense torrent arising always from a unique *logos*, from a first reason where natures are like whirls in the flux, is very laudable, even essential to a sapiential view, provided that one takes into account the limits and conditions of this method. . . .

For us, these intermediary constructions have for their limit nature, the divine *logoi*, seminal reasons, which are not operable by us, although to the degree we approach them, our practical empire over the world ceaselessly expands.¹⁰⁵

Concerning this assessment, I note the following. De Koninck begins with an implicit understanding of the parameters of natural philosophy. He then specifies its ultimate aim, arrived at via a process of determination or concretion. This goal is approached as a limit because of the natural mode the human mind. Our insight into a universal cause must always be through concepts universal in predicable totality, and thus generic. Because of the difficulty in approaching this limit, the mind employs dialectical tools by which it can make its natural object of investigation more intelligible to itself. As these hypotheses outstrip experience, they must always be revised by the test of experience. The limits of such hypotheses are natures in their specific concretion, their own proper being.¹⁰⁶

Here we find a certain tension: the mind naturally contemplates an order which it does not make and yet seeks to enrich the poverty of its natural mode of knowledge with an order

105. De Koninck, *Writings*, Vol. 2, 143–45.

106. Note that this approach is “laudable” and even “essential to a sapiential view,” even as that same method extends our “practical empire.” The theoretic eros of the ancients and the thumetic science of the moderns explain the difference between these two methods.

that it does make. If scientific theories, hypotheses, or mathematical models are replacements for the real, how can they be part of a speculative discipline? What we must see is whether the modern methods of the study of nature can still be used as extensions of the natural path, provided this tension is resolved. The remaining sections of this chapter present this resolution.

§23 THE NATURAL PATH PROVIDES NATURAL PHILOSOPHY WITH A PERENNIAL CHARACTER: THERE ARE THEORETIC MOMENTS IN NATURAL PHILOSOPHY WHICH ARE FIRST AND NECESSARY BOTH WITH RESPECT TO US AND IN THEMSELVES.

But if it is true that there exists a philosophy within positive science, we must conclude that the philosophy of nature admits of two states. It exists in a state of disengagement, of clarity and of consciousness in the discipline which bears this name of philosophy of nature and is the work of the philosopher. It exists in positive science obscurely and vitally.

YVES R. SIMON

The Great Dialogue of Nature and Space

The distinction and relationship between common and proper experience characterizes the matter, as it were, of the natural path.¹⁰⁷ The *processus in determinando* begins with the original source of our certainty about things.¹⁰⁸ Even though vague and indistinct at first, this knowledge is the permanent foundation of our intellectual life.¹⁰⁹ From the necessity of these materials, we can see that general natural philosophy achieves perennial conclusions.

107. Besides De Koninck, one should consult Michael Augros' work on this distinction; see "Reconciling Science with Natural Philosophy," *The Thomist: A Speculative Quarterly Review* 68, no. 1 (2004): 105–141, and *A 'Bigger' Physics*, Lecture, MIT / Institute for the Study of Nature, January 2008. In the former, Augros calls this distinction "universal" versus "confined" experiences; in the latter, it is "general" versus "special" concepts. The terms "common" versus "proper" will be used here.

108. De Koninck, "Three Sources of Philosophy," 17–18.

109. Yvan Pelletier, "La connaissance confuse, principe et fondement permanent du bien achevé de l'intelligence spéculative" (PhD diss., Université Laval, 1974), 123–39.

23.1 *The distinction between common and proper in experience and conceptions*

A return to the natural order of proceeding requires a return to an old way of asking questions. The natural philosopher becomes interested in asking “What is it?”¹¹⁰ The more ancient type of question insists on following the bent of the mind towards things and sees this to be different from a question about calculation or expediency. To ask “What is time?” and to get the reply “This is how to measure time” is an attempt to sidestep the question; one would then also be satisfied with the answer, upon our asking “What is a book?” that tells us: “Here is how you obtain a book”¹¹¹ Indeed, the two types of question correspond to two very different types of intellectual desire—we could “wonder” what time is or we could “wonder” how much time it takes to get to our destination.¹¹²

In order to answer these types of questions, one must begin with what is common in human experience of nature, for this, since it is natural, is prior to other types of experience. This “common experience” is a phrase that can be used in many ways. From this “common experience” one can also draw “common conceptions.” By “common experience” I do not intend to mean “common sense,” which can be inaccurate or a “primitive” experience and (consequently) conception.¹¹³ Further, “common” as I take it here is not opposed to “proper”

110. See De Koninck, “Random Reflections on Science and Calculation,” 101: “It is an historical fact that, so long as the study of the physical world made essential use of names, little was achieved to further knowledge of the kind now called physics. Where the Greek philosophers sought to know what the things of nature are, we appear to have renounced that type of inquiry for the simple reason that it does not lead to the kind of knowledge about nature actually obtained by another type of method, whose possibilities have only begun to reveal themselves. Is there however any good reason why the former mode of investigation should be abandoned altogether and everywhere? Is it always beside the point to be interested in objects and to ask what things are? The physicist, from the very outset, defines movement by the way he measures it, and that is what movement is to him. But does this mean that it can never be anything but irrelevant to ask what movement is, apart from this operational way of defining it? Today there is fairly general agreement that such questions are of their nature futile.”

111. De Koninck uses to this example of Wittgenstein’s (although for De Koninck’s own ends), in several places: “Natural Science as Philosophy,” 14; *The Hollow Universe*, 2, 54.

112. See especially *ibid.*, 69–72, and 71–72, fn. 1.

113. Augros, “Reconciling Science with Natural Philosophy,” 115–16: “Sometimes what everyone naturally thinks at first, before being taught otherwise, is called ‘common sense.’ Taken in this way, it is common sense, for example, that a sailboat cannot sail faster than the wind that is pushing it. Scientists and sailors assure us that this piece of ‘common sense’ is actually false. It is noteworthy that even those who have never

in the sense that my experience of motion is opposed to your experience of the same motion (these very sensations of ours are “private” and “incommunicable”).

Common experience is “the experience that all healthy adults have and cannot avoid having,” while proper experience is “any of the sort that only some people have.”¹¹⁴ For instance, proper experiences in this sense are dislocating one’s shoulder or tasting Laphroaig; while these occur to many, both can be avoided. Common experience draws upon what is to be experienced in all natural bodies, for instance: change, place, time, action and passion, and sensible qualities. Proper experience answers to features not found in all natural things (not all liquids taste like Laphroaig). It is because the experience answers to what is in the object when encountered at first that the former is found in all men (experiencing subjects) while the latter is not. Note that common and proper are opposed relatively to each other and do not as such differentiate species of knowledge.¹¹⁵ However, a proper or confined experience is not prevented from being verifiable of all natural bodies; it is just that what is more knowable to the mind at first does not penetrate to such a universality.

Common conceptions drawn from common experience are therefore distinct from proper

sailed before (perhaps I should say especially those who have never sailed before) will resist the notion that a sailboat can sail faster than the wind. Clearly their resistance is due not to any experience of sailboats but to their experience of some more general thing. They know that ‘No effect can exceed its cause.’ They are quite right about this; they are only mistaken in thinking that the sailboat sailing faster than the wind violates that principle. It is up to the physicists to explain how a sailboat can sail faster than the wind that is pushing it, without doing violence to that very general principle, upon which scientists also depend.” Limiting particularities of our experience (e.g., where we are born) provide the “primitive” element which makes for the vagueness in the true notion of “common experience” being developed here.

This pejorative “common sense” is critiqued by von Weizsäcker, quoted by Augros, “Reconciling Science with Natural Philosophy,” 115, fn. 22: “Aristotle wanted to preserve nature, to save the phenomena; his fault was that he made too much use of common sense. Galileo dissects nature, teaches us to produce new phenomena; and to strike against common sense with the help of mathematics.”

114. Ibid., 113; see also 113–15 and fn. 18: “Scientists make this distinction, too. Werner Heisenberg, for example, says, ‘Since the time of Galileo the fundamental method made it possible to pass from general experience to specific experience, to single out characteristic events in nature from which its ‘laws’ could be studied more directly than from general experience.’” See Heisenberg, *Physics and Philosophy*, 149.

115. Yet proper experiences are required for progress in specific domains of knowledge. In this sense Francis Bacon is correct to insist on “experiments,” for common experience (taken in the sense just defined) is insufficient for a science of nature in its details. Relied upon as a rule for the whole, common experience (in the defined sense) unavoidably sours into “casual experience,” see Bacon, *The New Organon*, I.100, 81–82.

conceptions drawn from proper experience. This is not just a difference between what is more generic and what is more particular, although this can be involved (for instance, “man” is a conception more specific than “animal” but both are drawn from common experience). Here again we should note that “common” is opposed to “proper” relatively, not as dividing types of study. For instance, “motion” is a common conception in one sense, but proper in another: everyone has a conception of it, but not everyone has gone through the process of seeing its definition. Yet such a process occurs in one and the same general level of the study of nature. Further, a proper conception can still be universally present in things but not universally recognized. For instance, “weight” is a common conception, whereas “mass” is a proper one. Nonetheless, the latter is found in all tangible bodies of common experience in the sense defined.

Common conceptions provide the foundation for proper conceptions. Nonetheless, our progression from common to proper conceptions requires a constant return to experience of the natural order. For instance, the attempt to identify the *primum mobile* in general natural philosophy proceeds at one level of determination, founded on the common experiences and conceptions belonging to that order. Proper experience and conceptions are required to advance this general inquiry, viz., in cosmology. Similarly (and ideally), our common conceptions of “life” and “organ” and “good” are extended to more details realms of study in biology, for instance.¹¹⁶

Without the foundation of common conceptions, and when proper conceptions, malformed, are substituted for the common, philosophy becomes a “system.” This is the way to resolve one aspect of the tension which was raised previously, viz., the tension between how the mind must proceed naturally versus its desire to “run ahead” of experience. The common conceptions, although foundational, can be reflected upon only with difficulty. While they are better known to us at first, they are also indistinct: “Conceptions are called common not

116. De Koninck, *The Hollow Universe*; for “life,” see 83–87, for “organ,” 95–98, for “good” 98–111.

only because they are commonly held by all but also because of an intrinsic commonness that explains why they are proportionally vague or confused.” Indeed,

there is a direct proportion between the inescapable certitude of the things most commonly yet most vaguely known and the difficulty of describing or defining them. Yet, if we did not have such preexistent knowledge, we would ask no question about anything, nor would we communicate with one another except by sniffs and grunts.¹¹⁷

This is the difficulty characteristic of the rational way of proceeding in natural philosophy. The necessary abstraction required to know the world, unlike the abstraction of mathematics, does not yield a concept clear and intelligible in itself. Yet these common conceptions cannot be abandoned; to begin to philosophize (or to begin to philosophize about nature in particular) basing oneself only upon proper conceptions is to erect a “system.”¹¹⁸ That is, our common conceptions are our first contact with reality, and unless we draw upon such preexisting knowledge of nature to integrate proper conceptions based on proper experience, we make no true progress.

General natural philosophy itself would be a system in this sense if the conceptions proper to it (e.g., the explicit definitions of motion, place, and time) are not drawn from common conceptions.¹¹⁹ Thus, the revolt of the philosophers of nature can only be countered by disciplined attention to what is first known. Abandoning the natural beginning, the original meaning of our words naming the natural world would be lost and replaced by a web of meanings which are, in reference to the common natural origin of meanings, merely proper.¹²⁰ (It remains to be seen whether there is a place for the artificial, proper mode of

117. De Koninck, “Three Sources of Philosophy,” 14–15.

118. Ibid.: “The distinction between common and proper conceptions allows us to define what a philosophical ‘system’ is and, accordingly, how to construct one. As Spinoza and Hegel understood it, a philosophical system is one that starts from proper conceptions as if they could be substituted for common ones.”

119. Ibid., 17–18.

120. De Koninck, “Abstraction from Matter,” 156: “Many believe that to recognize the simplest words of common speech (although the whole of Aristotle’s vocabulary, however awesome it may have come to look in modern languages, was derived from them) as relevant to philosophy, is to condemn the latter as a science

knowledge which builds upon natural, common beginnings.) To rebel against the natural path is to rebel against the nature of the human mind:

Perhaps system building in philosophy is a protest against the priority of things as against our knowledge of them—against the fact that our minds must grope *in umbra intelligentiae*. We may well be by nature inclined to build a wall between our proper conceptions and the common ones. The peculiar fashion in which we raise the problem of science and philosophy is one indication of this divided mind. Perhaps our difficulty is traceable to unwittingly wrong proper conceptions of what science and what philosophy are.¹²¹

23.2 *The perennial character of general natural philosophy*

In view of his defense of common experience and common conceptions, it is not surprising that De Koninck defends the notion that perennial conclusions are attained by the philosophy of nature.¹²² Indeed, Part I was aimed, in anticipation, at substantiating this view. Most of all, the argument aimed at showing the course of the *Physics* terminates in non-trivial (even if indistinct) knowledge, viz., that some fundamental cosmic body must exist. The investigative arc of the *Physics* was read in light of trying to achieve this demonstration.

In this investigation, the natural philosopher is analyzing common experience and common conceptions, determining more precise or proper conceptions from that experience, and discovering through argument the need for and the existence of a fundamental body and

and abandon it to anthropomorphism. This is a denial of the progress of knowledge from more to less known. Rather than surrender to words in common use, some suggest that the philosopher should create his own vocabulary, out of nothing, so to speak, and employ only 'technical' terms divorced from usual meanings; much as the mathematical physicist, who must have recourse to symbols from the very start. If this position were correct, it would imply that philosophy is a body of knowledge unrelated to what is actually more known to us; that it is based, perhaps, on some intuitions that are the privilege of a few, the only ones to have the right of calling themselves philosophers; or that the science is based on intuitions proper to some particular school. In effect, the reason why one does not understand the technical terms would be the lack of the proper intuitions. . . . This position, which is rather widely held, implies that progress from the more commonly known to the less known, as well as the new impositions of words that attend it, cannot be achieved."

121. De Koninck, "Three Sources of Philosophy," 18–19.

122. See De Koninck, *The Hollow Universe*, 54–70, for a discussion of place and time; "Random Reflections on Science and Calculation," 101–102, concerning the basic points of the *Physics*; also "The Unity and Diversity of Natural Science," 6–7, 10, 18–19. De Koninck's remark in *The Cosmos, Writings, Vol. 1*, 274, about the first mobile body.

causal condition of the cosmos which he has observed based on common experience. Yet the mind still wants to know more.¹²³ Here, the natural philosopher must be able to recognize the need for a new order of determination, found in cosmology.

23.3 *Primary versus primitive experience*

This requires discriminating between primitive and primary experience. Primitive experience is that material which the inquirer begins with, interprets, clarifies, corrects, and (if corrected) he progresses beyond. Primary experience aspect of experience cannot be outmoded.¹²⁴ What is primitive in our experience of the world, therefore, can be replaced with correct conceptions of things: one argues for the sphericity of the earth and corrects the primitive judgment about its flatness. What is primary, however, could not be eliminated without taking away grounds for making such a scientific argument or discovery.

This twofold aspect is at first blended in our experience. Distinguishing the primary from the primitive is not an *a priori* conceptual exercise.

So we do not know *a priori* what is really primitive in the concepts of daily experience, and that what we take for essential and relevant may be only accidental. There is an exception, however, and this exception, as we saw, refers to that aspect of our daily experience which reveals to us the basic structure of the material world. Science adopts this part of our daily experience completely and without any restriction because its fundamental methods are built entirely upon the pre-supposition of this basic structure.¹²⁵

123. De Koninck, *Writings, Vol. 1*, 452: "It is right to reproach those who are content with this kind of consideration as if they had attained the ultimate causes, their air of false profundity, unless one calls the confused and undetermined profound."

124. See Van Melsen, *The Philosophy of Nature*, 13: "In speaking of pre-scientific knowledge a difference should be made between a primary fundamental pre-scientific knowledge and a primitive one. The latter is that which is involved in supplying the different data of daily experience to science as the first material to investigate. Primary pre-scientific knowledge, however, reveals to us such fundamental data of matter as, for example, the species-individual structure." See also Pelletier, "La connaissance confuse," 131-38, who makes a similar distinction.

125. Van Melsen, *The Philosophy of Nature*, 15.

Van Melsen uses this distinction to lead us directly to a difference of some sort between the bases of the philosophy of nature and modern science: “The philosophy of nature is interested in the primary and fundamental aspect of this experience, whereas science, taking this aspect for granted, focuses attention on the more detailed aspects of daily experience.”¹²⁶

Even within the inquiries proper to the general philosophy of nature, one finds primitive and primary aspects to our experience which must be distinguished in order to make progress.¹²⁷ What remains after *a posteriori* clarification of primitive pre-scientific knowledge shows that general natural philosophy studies what is given in primary, common experience. Without making this distinction, one could think that any claims about the priority of the philosophy of nature to science would rely only on *primitive* pre-scientific knowledge.¹²⁸

The sources for mistaking the primitive for the primary can easily arise from the side of sensation.¹²⁹ However remote from direct sense-perception, the correction of primitive con-

126. Van Melsen, *The Philosophy of Nature*, 29.

127. One such example (§2 above) is Pre-Socratic, primitive experiences and theories of substantial change. Ibid., 101–107, disagrees; 107: “Substantial change is a very important philosophic concept, but it does not furnish a good starting-point for the philosophy of nature.” Instead (ibid., 107–23), he proposes that Aristotle’s own arguments be reinterpreted to instead defend a different starting point for natural philosophy, the species-individual structure. However (ibid., 121), this results in Van Melsen taking the logical distinction between primary substance and secondary substance as the starting point when investigating change. As a consequence (ibid., 122–23), he must conclude that there are two types of changes: when one individual becomes two individuals (primary substance changing), and when one kind becomes another (secondary substance changing). This does nothing more than to create a natural philosophy of logical intentions in opposition to descriptions of individuals changing in quantitative ways—thus, it is not a beginning of natural philosophy as a science of things but of a logical system.

128. Ibid., 13: “Scientific knowledge of the same data of daily experience is, therefore, far better than pre-scientific knowledge. It would be senseless, indeed, to attempt to build up a system of daily experience without the corrections, purifications and elaborations of modern science. . . . [O]ne of the main reasons why so many scientists object to a philosophy of nature is exactly that they suppose that a philosophy of nature is just such an attempt. If that supposition were true, then their criticism would be correct. There cannot be any serious doubt about that. The problem is, however, whether all pre-scientific experience is of the same kind” Making such progress, however, does not preclude the converse possible error, that what the scientist takes to be primitive may in fact be primary, given a neglect of the general philosophy of nature. For instance, Berkeleyian problems would arise when color realism is denied, and this as a result of the dichotomy between primary and secondary qualities; see Wolfgang Smith, *The Quantum Enigma: Finding the Hidden Key*, 3rd ed. (Hillsdale, NY: Sophia Perennis, 2005).

129. De Koninck, “Abstraction from Matter,” 177, supplies examples: “In our estimates of common sensibles we inevitably commit ourselves far more as to the status of the things ‘out there,’ although on the other hand, our mistaken judgment can be corrected by measurement. It is partly because of this possibility of verification by measure, that the common sensibles are accorded a more objective status than the proper

ceptions cannot be achieved without reliance upon primary experiences and conceptions.¹³⁰ For instance, Ole Roemer's discovery that light travels was based on a time-discrepancy in the transit of Jupiter's satellites through Jupiter's shadow. This required observations to be collected over eight years, prior knowledge of the geometric arrangement of the orbits and the periods of the orbiting bodies involved, not to mention common conceptions of motion and constant signal travel. Even when correcting a primitive experience, Roemer relied upon the more fundamental idea relating differences in speed to differences in time when traversing the same distance.¹³¹

23.4 *The history of an inquiry branching off the natural path*

A certain "history" of an inquiry into a subject thus arises where primary experiences are used as the bases to correct primitive experiences as one gains new information, i.e., new confined or proper experiences. This temporal structure arises because the mode of rational proceeding in natural philosophy is maximally conformal to an intellect immersed in matter and thus in time. De Koninck draws this comparison when explaining why Aristotle calls the study of the soul a history:

One can call it that to the extent that it is of the nature of history not to arrive at the end of its inquiry. That is how Thomas understands the phrase. "*Et dicit historiam, quia in quadam summa tractat de anima, non perveniendo ad finalem*

ones. But it should be noted that the process of measuring involves a certain operation, namely, the collation and comparison of measure and measured, as in counting or in determining a length; and that this operation is performed by the mind, though on the basis of, and together with, external sensation."

130. De Koninck, "Abstraction from Matter," 178: "Errors concerning the subject are also very frequent. It is easy to fall into the habit of thinking that a fluid, like water, is a continuous homogeneous mass, comparable to the three-dimensional continuum of geometry, so that no matter how long we might keep on halving it, we would always have water. The sun appears to revolve around the earth. The propagation of light seems instantaneous. Misjudgments like these concerning the subject of the common sensibles are so natural that scientific correction of them is of recent date, and the means of correction remain very remote from direct sense-perception."

131. See Aristotle, *Physics*, VI.2, implicit in 232a23–b14, and see VI.4, 235a11–13; *De Anima*, II.7, 418b20–25; Torretti, *The Philosophy of Physics*, 36–40; Max Jammer, *Concepts of Simultaneity: From Antiquity to Einstein and Beyond* (Baltimore, Md: Johns Hopkins University Press, 2006), 42–43, 63–64; Wallace, *From a Realist Point of View*, 147.

inquisitionem omnium quae pertinent ad ipsam animam, in hoc tractatu. Hoc enim est de ratione historiae."¹³²

De Koninck provides a detailed commentary on how one “leaves” the natural path and enters cosmology in this historical development of an inquiry.¹³³ He begins by noting that moving away from defining sensible matter in terms of the immediate proper sensibles and instead using the common sensibles is not sufficient to understand how modern science has constituted quantitative and symbolic modes of thought in physico-mathematical cosmology. Now, the order of “composition” which St. Thomas delineates in his *prooemium* is where this new mode of definition is applied in modern cosmology. (This order of composition was discussed above, §11.1.) This order proceeds from the formal whole to its material parts; however, understanding the formal whole requires understanding the formal parts of that whole—the parts of its species.

With regard to the object of cosmology, viz., the universe, living beings are not included intrinsically. The process of determination from the *Physics* to the *De Caelo* follows the order of general to specific. After mobile being in general, one studies the next most general mobile subject, viz. what is locally movable or body insofar as it has a determinate order of place within the universe, a *situs*.¹³⁴ Under this more determinate yet not exhaustive conception, rocks and men are taken on a par. Only a common aspect of their natures is considered. For this reason, the level of determination within cosmology will eventually run its course and require a more determinate conception which approaches those natures which its mode of consideration cannot attain proximately enough. The third order of speculative reason corresponding to composition, therefore, cannot use the formal parts of the cosmos considered from within cosmology to compose all that is within the cosmos—most conspicuously living things. With living beings we find the presence of a mode of composition which is other than

132. De Koninck, “Introduction a l’etude de l’âme,” 44.

133. See *ibid.*, 57–61. He draws upon the *prooemium* of St. Thomas’ commentary on *De Caelo*.

134. See St. Thomas, *In Phys.*, lib. I, lect. 1, n. 4 (Leon.2.4), and compare *In De Caelo*, pr., n. 5 (Leon.3.3). Consider also Falcon, *Aristotle and the science of nature*, 7–16.

that of the universe as such but which however engages the same parts of the universe. These wholes, in fact, have in their turn proper formal parts by which they differ specifically from every other *ensemble*. The *partes diffinitivae* of man are not those of other natural beings.¹³⁵ Thus, the orders of intention and composition found in speculative reason are limited in their applicability—they are limited to the order of determination of the genus under study. This applies in a much stronger way when a composite type of knowledge (like mathematical physics) is utilized:

Why is the provisory character of scientific theories implied in those processes of the science of nature which have been compared to the orders of intention and composition of practical reason? Remember what St. Thomas said about the order of intention: “*artifex intendit totam domum perficere.*” It is the house in its entirety that the artisan intends to construct. Applied to the science of nature, that means that the physicist reaches toward knowing the whole universe. But in order to have a strictly scientific knowledge (we mean the term in its Aristotelian sense) of the universe, it would be necessary to know it not according to just any of its parts, but according to those of the parts which define the whole—*partes [quae] sunt priores in consideratione quam totum, et ponuntur in definitione totius*. We can say that these parts must be those which are the most common, that their movement must be the most common—since it is a question of the universe. But what are these parts? What are the laws of the motion in question? The laws which govern the parts of the universe are necessarily, in this order, the most universal laws—*in causando*. But we do not know these laws.

It will be said that, if we do not truly know the general laws, we can at least know particular physical laws. To that we respond first of all that in stopping thus with a particular law one abandons precisely the point of view of the universe. On the other hand, every particular physical law, by the very fact that it is physical, regards the parts of the universe as such; its sufficiency in a closed field can only be apparent. If it truly were, one would have to be able deduce the general laws from it. That is what *cognitio certa per causas* requires. In reality, the general laws that we posit are never other than hypotheses on the basis of which we can logically infer particular laws as conclusions.¹³⁶

The mode of mathematical physics is especially hindered from completeness insofar as its has prescinded from the qualitative modalities of experience and the words used to express

135. De Koninck, “Introduction a l’etude de l’âme,” 57.

136. Ibid., 59.

nature as a whole. In this fashion De Koninck arrives at the limitations of the modes of definition proposed by modern science:

In certain respects, the scientist resembles the artisan. A man is truly a builder of houses only if he knows the matter necessary to make one. (Lest some architect deficient in the art of the mason take offense, let us agree that the builder in question embraces several citizens: an architect, bricklayers, carpenters, a plumber, bricklayers, etc.) However furiously convinced he be of the necessity of a habitation for the featherless biped, as long as he does not know with what materials a house can be made, nor how to use them, he is no builder; his ideas on the workable matter, however proximate, are still dialectical. In short, one must know the elements, not in just any way, but in a sufficiently precise way that the house stands upright and answers to its purpose. The scientist has a vague idea of all that he seeks to know better. He knows that there are universal rules that govern the behavior of the universe, and he knows it better and better. Seeking to know what these rules are, he is given for a limit a knowledge whose demands are compared to the building of a house. Were it only to arrive at speculative truth, it would be necessary that he know exactly the rules that define the whole. Restrained by the invincible imprecision of his measurements (an account of them is made in proportion as they are made precise), not being a separated observer (the slowness of the light reminds him of it), he will have to compromise with the truth in order to keep himself to an indefinite approximation of it. He becomes an apprentice-builder. He tests the materials, he knows that some will do better than others. But he knows just as well that neither the ones nor the others will ever be suitable.¹³⁷

To synthesize these two passages, De Koninck maintains that in the more determinate study of nature embarked upon by cosmology, the modern scientist is to be compared to the *artifex* who builds a house. In order to have a complete and sustainable universe, he must know with speculative precision its *partes diffinitivae*. He possesses only a vague idea of the house—the cosmos—as to its essence, and has proposed in a dialectical fashion many theories with a greater degree of applicability to the cosmos found in his more expert experience. Despite his best efforts, he remains an apprentice-builder, and not a master builder, because his theories are always dialectical. However, the more certain part of his knowledge (that founded upon

137. De Koninck, "Introduction à l'étude de l'âme," 60–61. De Koninck's footnote is included in the parenthetical remark.

the first order in speculative reasoning from the more to the less general), while capturing the whole in an indeterminate fashion (and thus grounding the scientist's certainty that there is more to know), cannot fully satisfy his desire to know, his goal of building the entire house.

§24 NATURAL PHILOSOPHY AND THE MODERN PHYSICAL SCIENCES ARE FORMALLY ONE TYPE OF KNOWLEDGE.

You may smile at this proposal and say, "But what could we possibly learn from the Aristotelians when it was precisely by breaking with them that Galileo was able to open the way for the vast success of modern science?"

BENEDICT ASHLEY
"The River Forest School
and the Philosophy of Nature Today"

In this section, the formal unity between natural philosophy and the experimental sciences will be shown. This will involve revisiting De Koninck's original positions, elaborated above in §21.1, and showing why it is insufficient, and why he changed his mind.¹³⁸

24.1 Recapitulation of the earlier view; the original problem

First, to review De Koninck's early position. The distinction he defended at first between natural philosophy and the modern sciences depends upon the failure of the latter to attain to the first degree of abstraction (i.e., from individuating matter). Thus the distinction appealed to the mode of definition found in a science, but it did not make the role of sensible matter explicit, which is the basis of De Koninck's new account.¹³⁹ De Koninck resolved this limitation to hylomorphism. The philosophy of nature attains certainty because it sees the hylomorphic composite in its universal character; it does not proceed to study things qua

138. Consider also Pascal Ide's treatment of this topic, in "La philosophie de la nature de Charles De Koninck," *Laval théologique et philosophique* 66, no. 3 (2010): 466–70. De Koninck's view is closely related to that of the River Forest school of thought on this point; see Ashley, "The River Forest School and the Philosophy of Nature Today," 8. Some differences between De Koninck and these Dominicans will be discussed in Chapter 7, §27.

139. See above, §21.1, p. 348.

particulars. The experimental sciences study what escapes the universal, viz., the contingent particulars. This position rests upon the claim that since our universal knowledge about mobile beings cannot be analyzed to gain more insight into particularities, a different type of knowledge is required to do so, viz., the particular natural sciences. De Koninck changes this view and finds a way to explain both the sameness of the object that natural philosophy and the particular natural sciences seek to know and how they each define their object with sensible matter. To unite the sciences in this way, he had to develop the theory of abstraction from matter.¹⁴⁰ Since the natural philosopher must define with sensible matter,

140. Leslie Armour gives an insightful account of the origins of the problem De Koninck faced, i.e., “the situation created by the fact that one of the central features of the rise of modern science was the growing conviction that reality is not directly revealed in our experience.” See his “The Philosophy of Charles De Koninck,” in De Koninck, *Writings, Vol. 1*, 9, and see generally 8–24. Armour notes (18, 19) that the original account of abstraction proposed “a straightforward account. The form which informs the thing can also inform the human intellect—though the object which is the knowledge will be ontologically quite different from the object which is the thing. This view . . . came to grief with the rise of modern science because it seemed that nothing of the object was actually in the intellect, and skeptics like Simon Foucher taunted the Cartesians with the claim that even ‘ideas’ could not fill this gap. They could not ‘fill the gap’ because, if they were to fill the gap, they would have to resemble the objects in the world. To do this they would have to have some property in common with the things in question. And this would bring back the scholastic (Aristotelian) theory. . . . [De Koninck] certainly knew that he could not simply go back to the ‘scholastic’ view that the properties of things are in some simple way just transferred to the intellect. For this would be to suppose that the modern crisis which one might call the separation of the intelligible and the sensible had never occurred. De Koninck’s answer was to develop the theory of abstraction.” Now, to develop the theory of abstraction, viz., abstraction from matter (§22.3), one must also develop the notion of form (for the mind in its abstraction considers what is formal apart from what is material). I discuss this development of abstraction in §24.3, below. By focusing on the modern development of species- or “form-neutral” common features (what are termed the common sensibles), De Koninck is able to relate the formal object of physico-mathematical science to the formal object of natural philosophy. This begins to answer a Baconian account of the conceptualization of form that is typical of modernity (see below, p. 413).

What about a developed notion of form? Previously (above, pp. 349 and 374), I noted that De Koninck develops the notion of “natural form” to incorporate, respectively, physical indeterminacy and the evolution of species. This innovation was criticized by some of De Koninck’s contemporaries; Ernan McMullin, “Realism In Modern Cosmology,” *Proceedings of the American Catholic Philosophical Association* 29 (1955): 141, notes that the indeterminacy of chance events “are not due to an intrinsic defectibility or ‘indetermination’ of the ‘nature’ itself; to hold this would be to mistake the Aristotelean determinability of proper matter by extrinsic factors for an uncharacteristic Platonic indetermination or incoherence in the being of the physical object itself. I am aware that some Aristotelean scholars like O. Hamelin and C. de Koninck, prefer the Platonic interpretation here. It seems preferable, however, within the content of Aristotle’s system as a whole, to say that this system is formally determinate and determinist as far as the physical world is concerned.” The accuracy of McMullin’s brief remark would require more space than is available here (briefly, De Koninck would take issue with resolving chance to purely “extrinsic” factors). Indeed, De Koninck’s view of form—since it attempts to connect, on the one hand, the contingency in nature and in chance events (distinguished by Aristotle, see *Prior Analytics*, I.12, 32b4–14), with the emergence of new forms via evolution through a

De Koninck was required, in the modern context, to provide an explanation concerning how the unobservables of modern science were captured in a neo-Aristotelian mode. This

process requiring (to his mind) both *per se* and *per accidens* causality, on the other hand—is an adaptation of the old Aristotelian and Thomistic understanding, and hence McMullin’s criticism might simply be misplaced.

To consider De Koninck’s notion of form, see “The Problem of Indeterminism,” 380–83, 390–96, and “Reflections on the Problem of Indeterminism,” 404–410, in *Writings, Vol. 1*, both written and published in the mid-1930’s. Further, his *Cosmos*, in the same volume, should be consulted, in particular 262–70. (All citations in this note are from this volume unless otherwise specified.) The contingency or indeterminacy of chance events De Koninck resolves to the contingency within natures (see De Koninck, “La philosophie des sciences,” 359: “From the pure potentiality of matter it follows exactly that no natural form can be entirely determined *ad unum*. The margin of indetermination overflowing the form is cause of contingency in nature.”). This contingency *within* natures De Koninck resolves to the inability of form to perfectly master its correlative material principle; the existence of composites is not so determinate as to escape the order of what happens for the most part. The perspective De Koninck takes when explaining his position is metaphysical: he compares the absolute determination (perfection) of God to the relative indetermination (imperfection) of creatures. Within the latter order, there is a hierarchy of determination or perfection within the intellectual universe (the angels) that decreases as it approaches, like a limit, the various cosmic species (De Koninck compares this angelic hierarchy to polygons successively inscribed in a circle as their limit, with the intellectual cosmic species as the limit, since man is the *raison d’être* of the other non-intellectual cosmic species). This decrease of positive indetermination (perfection, freedom from interference *ab extra*) is met with an increase of negative indetermination that is fully realized only in a species where the principle of determination (form) is paired with a principle of indetermination (matter). A cosmic species is such because it, unlike the angelic species (which share no natural common genus), possesses pure indetermination within its own essence.

Man as a cosmic species contains virtually three other irreducible kinds: the animal, vegetative, and elemental. These four are termed by De Koninck “philosophical” species (258) or “limit species” (409) or “absolute natural species” (399) because they have no intermediaries that can be cleanly opposed based on their proper operations (being, living, sensing, and knowing). While only man cannot have a subspecies of these limit species (since his form is at root spiritual and the completion of the cosmic hierarchy of kinds), the other three can. Indeed (381), unlike the differences between one angelic species and another (which admits of no intermediaries and no evolution from one to the next), these lower three cosmic species admit of intermediaries and a process of ascendant evolution from one to the next. Thus, “the different sub-species, the species of dog, the species of elephant, cannot be absolutely opposed as are the species-individuals which are pure spirits; that is to say as well that their definition will include the notion of matter.” (Thus, in this philosophical vantage point of defining species, all evolved species are “varieties” that come about like cuts in a line; see 262, 381; 399, n. 23; 410.) De Koninck maintains that the pure potency of prime matter *requires* indetermination within cosmic essences when considering form as a co-principle to matter (this is the “margin” about each form). This helps account for the evolution of species: “The determination that is a material form is yet to be so far as determination goes. If it were completely given in advance, generation for example would be a pure releasing into existence of a form already determined in the matter.” Further: “To say that matter is pure potency is to say that, as such, it always exceeds the form—because the form, itself determinate, does not entirely determine the matter, it cannot be entirely determined *ad unum*. A form entirely determined *ad unum* is by definition a subsistent spiritual form.” (266)

De Koninck’s development of the notion of form, therefore, places indeterminacy within cosmic species or essences so as to allow for an account of the evolution of varieties within a metaphysical hierarchy of cosmic species via the contingency of chance events and the agent causality of a spiritual cause (see Ch. 4 above, p. 243). These cosmic species have man as their *raison d’être* (De Koninck’s arguments following St. Thomas’ classical idea of the necessary completeness of the universe cannot be discussed; see 264–66). This means that matter in the cosmos is at the service of spirit and sub-human forms are “much less states than tendencies” (266; for this reason De Koninck accuses modern natural philosophy of the “sin of angelism”

would heal the rift between sense experience and science insofar as it would show science's dependence upon experience in a way that accounted for the new symbolic and mathematical tools at science's disposal.

24.2 *The formal unity of natural philosophy and the sciences*

We find the reasons for his change of position in a short article De Koninck published in 1941. There, De Koninck makes the core of his earlier view the leading objection.

It seems [the experimental sciences and the philosophy of nature] are quite distinct. The philosophy of nature is in effect presented as a very definite body of doctrine whose conclusions do not need to be confirmed by experience. By experimental science, by contrast, one commonly means today a knowledge which takes its proper principles from sense experience, but these principles themselves are such that the conclusions derived from them must be in their turn verified by experience. If despite the goodness of a formal consequence a conclusion is not sufficiently guaranteed, this is because the principles from which it derives are not themselves certain, and one can still question them. For this reason the experimental sciences fall into the genus of dialectics, whereas the properly demonstrative knowledge questions only its conclusions. The suppositions of the experimental sciences ought to be neither true nor false; it suffices that they save appearances. In philosophy of nature, on the contrary, it seems that propositions must be true.¹⁴¹

To paraphrase: on the one hand, the philosophy of nature is a fixed doctrine, with no need of verification in experience; that is, once its principles are drawn accurately from individual

when it conceives cosmic varieties after such an angelic model of species—see De Koninck, “Thomism and Scientific Indeterminism,” 61). This is De Koninck's revision of “forms” and “natures” (especially of sub-human nature) so as to countenance the evolution of species: it entails (269) that “nature is essentially a principle of ascending movement” from less perfect species to more perfect species. The “ultimate disposition” of sub-human species is something that can only be investigated *a posteriori* by inquiry into what the “laws inscribed in [such natures]” have produced in the course of history (see above, Ch. 4, fn. 77). What remains unchanged in De Koninck's view is how the natural philosopher *knows* form: it is by observation of the effects, accidents, and properties that lead him to a knowledge of cosmic essences.

141. See “Are the Experimental Sciences Distinct from the Philosophy of Nature?” in De Koninck, *Writings*, Vol. 1, 445. In support of the antepenultimate sentence of this quote, De Koninck cites St. Thomas, *Exp. Po. An.*, lib. I, lect. 21, n. 3: “Sciendum tamen est quod interrogatio aliter est in scientiis demonstrativis et aliter est in dialectica. In dialectica enim non solum interrogatur de conclusione, sed etiam de praemissis: de quibus demonstrator non interrogat, sed ea sumit quasi per se nota, vel per talia principia probata; sed interrogat tantum de conclusione. Sed cum eam demonstraverit, utitur ea, ut propositione, ad aliam conclusionem demonstrandam.”

mobile beings, only the propriety of the inference to its conclusions need be examined. On the other hand, the experimental sciences are fluctuating; their conclusions must be verified by experience regardless of the soundness of the argument used to obtain them; thus, both their principles and their conclusions can be questioned. The philosophy of nature proceeds analytically and demonstratively, from independent universal principles. By contrast, the experimental sciences proceed dialectically, and their principles need not be true universals, but only sufficient to save the appearances. They possess only partial inductive completeness: the universal *ut nunc*.

To begin to counter his earlier position, De Koninck argues for the continuity of what are really two modes of the same inquiry. The unity between natural philosophy and the sciences flows from the fact that both their object (or conclusion) and their mode of definition (formal object) are the same.

The philosophy of nature seeks to know what natural things are, not in a confused manner, but in their proper concretion. The unity of that end is not broken by the diversity of means employed.¹⁴²

Here one should note in what “the unity of the end” consists. The conclusion (object) of natural philosophy as a science can be taken either formally or materially. The conclusion is materially one if it concerns the same subject of demonstration (demonstrating that the earth is round through astronomy or through physics) and, more generally, the same genus of such things about which the demonstrator concerns himself. Conclusions are formally of one sort if their demonstrations use the same mode of definition, for the mode of definition constitutes the formal object of a science. The formal object of natural philosophy is definition with sensible matter. This formal object allows us to characterize the subject genus of natural philosophy—mobile being—in a formal way. This subject is that about which we

142. De Koninck, *Writings*, Vol. 1, 445. This basic view is repeated in “The Unity and Diversity of Natural Science,” 10–14, as well as De Koninck, “Natural Science as Philosophy,” 2–9.

seek scientific knowledge, and this knowledge is found in the science's *objects* or conclusions; these together constitute the *end* of scientific inquiry.

In this way, the coordinate species of natural philosophy, e.g., biology, still seek the same end as natural philosophy.¹⁴³ Thus, if biology defines with sensible matter and seeks to provide knowledge within the same subject genus, then it is unified with natural philosophy. Insofar as its investigations towards complete concretion are still ongoing, they are the dialectical extensions of general natural philosophy (or, as De Koninck would point out, the general study of the soul). It should be recalled (§17.1), that even as dialectical extension, these inquiries are still part of the same science. This is the sense in which, as St. Thomas notes, the dialectical is opposed to the demonstrative mode of proceeding within a science.¹⁴⁴

This argument through a common terminus and mode of definition was also available to the ancients when discussing the mixed sciences (the other mode of subordination). These remain “principally natural since they terminate in the natural things that it is their goal to know better.”¹⁴⁵ In a later work, De Koninck argues:

True, optics and harmonics are formally mathematical, since in them we apply to subjects of sense experience mathematical knowledge which, even when applied, remains mathematical. Though only materially natural, the subject which we aim to reveal is nonetheless natural. For this very reason we call such sciences ‘more natural’ than mathematical: “*because everything is named and specified by its terminus*: hence because the business of these sciences terminates in natural

143. A coordinate species would be subordinated to general natural philosophy as its species. The other type of subordination, the mixed sciences, is discussed just below. See De Koninck, “The Unity and Diversity of Natural Science,” 6–11; St. Thomas, *In Po. An.*, lib. I, lect. 25: “Sed intelligendum est unam scientiam esse sub altera dupliciter. Uno modo, quando subiectum unius scientiae est species subiecti superioris scientiae; sicut animal est species corporis naturalis, et ideo scientia de animalibus est sub scientia naturali. Alio modo, quando subiectum inferioris scientiae, non est species subiecti superioris scientiae; sed subiectum inferioris scientiae comparatur ad subiectum superioris, sicut materiale ad formale. Et hoc modo accipit hic unam scientiam esse sub altera, sicut speculativa, idest perspectiva, se habet ad geometriam.”

144. St. Thomas, *SBdT*, q. 6, a. 1a, c.: “Et sic rationabilis processus dividitur contra demonstrativum. Et hoc modo rationabiliter procedi potest in qualibet scientia, ut ex probabilibus paretur via ad necessarias probationes.” (Leon.50.159:149–53)

145. De Koninck, *Writings*, Vol. 1, 449.

matter, even though they proceed through mathematical principles, they are more natural than they are mathematical.”¹⁴⁶

Because things are specified by their terminus, the inquiry of the experimental sciences is one with that of natural philosophy. Even if they are numbered (at times) among the mathematical sciences, and even though their formal element (their middle term) is also mathematical, it has a mixed character. It is a mathematical taken together with sensible matter, and this accidental union makes this mode of knowing qualified.¹⁴⁷ Thus, even though defining with sensible matter is extrinsic to the genus of the mathematical mode of definition, it belongs properly to the mode of natural philosophy. The use of mathematical physics as a means to knowing natural things, therefore, requires that the mode of definition be brought to a certain unity, even if this unity is found in terms that are dialectical.¹⁴⁸ What exactly

146. De Koninck, “The Unity and Diversity of Natural Science,” 11–12. He cites St. Thomas, *In Phys.*, lib. II, lect. 3, n. 8 (Leon.2.63).

147. In his footnote to the quote above, De Koninck notes: “It is true that physico-mathematical sciences are sometimes called *species scientiae mathematicae*. But this does not mean that they are a species of a genus in the way animal is a species of body. As St. Thomas explains: ‘Interdum tamen dicitur aliquid esse species alicujus generis propter hoc quod habet aliquid extraneum, ad quod applicatur generis ratio. . . . Et simili modo loquendi dictuntur astrologia et perspectiva species mathematicae, inquantum principia mathematica applicantur ad materiam naturalem.’” He cites *ST* Ia-IIae, q. 35, a. 8 (Leon.6.247). Nonetheless, see also *ST*, IIa-IIae, q. 9, a. 2, ad 3: “[Q]uilibet cognoscitivus habitus formaliter quidem respicit medium per quod aliquid cognoscitur, materialiter autem id quod per medium cognoscitur. Et quia id quod est formale potius est, ideo illae scientiae quae ex principiis mathematicis concludunt circa materiam naturalem, magis cum mathematicis connumerantur, utpote eis similiores, licet quantum ad materiam magis convenient cum naturali, et propter hoc dicitur in II Physic. quod sunt magis naturales.” (Leon.8.75) See also Cajetan’s commentary, *ibid.*: “[I]n responsione ad tertium secundi articuli non dicitur quod scientiae mediae sunt magis mathematicae quam naturales—cum falsum sit, absolute loquendo: quia simpliciter sunt scientiae naturales, utpote non abstrahentes a materia sensibili; omnis enim scientia non abstrahens a materia sensibili est naturalis, ut patet VI *Metaphys.*”

As Maurer notes in St. Thomas Aquinas, *The Division and Methods and the Sciences: Questions V and VI of his Commentary on the ‘De Trinitate’ of Boethius*, 2nd, trans. Armand Maurer (Toronto: The Pontifical Institute of Mediaeval Studies, 1958), 43, fn. 22, the text in *Physics*, II.2, 194a7–8 was mistranslated in the medieval Latin Aristotle. Instead of describing the mixed sciences as “the more physical parts” of mathematics, the text was rendered “more physical than mathematical.” Regardless of this mistranslation, however, the two reasons utilized (*viz.*, from Aquinas, that something is denominated from its terminus, and from Cajetan, that the middle sciences still include sensible matter) show why the middle sciences are united to the formal object of natural philosophy.

148. See St. Thomas, *SBdT*, q. 5, a. 3, ad 5: “[M]otus secundum naturam suam non pertinet ad genus quantitatis, sed participat aliquid de natura quantitatis aliunde, secundum quod divisio motus sumitur vel ex divisione spatii vel ex divisione mobilis; et ideo considerare motus non pertinet ad mathematicum, sed tamen principia mathematica ad motum applicari possunt. Et ideo secundum hoc, quod principia quantitatis

does this mean?

Indeed, this is an old difficulty concerning the middle term used in a demonstration in the mixed sciences. How does one avoid the objection that such an argument is in four terms? If the subject is defined with sensible matter, then must not the middle term in the minor premise be the same? But if the middle term is defined with intelligible matter, then the major term seems bound to follow suit. How can a conclusion have sensible matter in its account, when the middle term uses intelligible matter in its? William Wallace maintains that the unity of the middle term is analogical.¹⁴⁹ The difficulty with this reply at face value is that St. Thomas states outright in other places that the middle term is mathematical.¹⁵⁰

However, St. Thomas also maintains that “the mobile and incorruptible beings, on account

ad motum applicantur, naturalis considerat de divisione et continuitate motus, ut patet in VI Physicorum. Et in scientiis mediis inter mathematicam et naturalem tractatur de mensuris motuum, sicut in scientia de sphaera mota et in astrologia.” (Leon.50.150:343–56) See also St. Thomas, *In De Caelo*, lib. 3, lect. 3, nn. 4, 6 (Leon.3.236–37), on why mathematical principles can be used: “Scientia quae se habet ex additione ad aliam, utitur principiis eius in demonstrando, sicut geometria utitur principiis arithmeticae: magnitudo enim addit positionem supra numerum, unde punctus dicitur esse unitas posita. Similiter autem corpus naturale addit materiam sensibilem supra magnitudinem mathematicam: et ideo non est inconueniens si naturalis in suis demonstrationibus utatur principiis mathematicis: non enim est omnino aliud genus, sed *quodammodo sub illo continetur*.” The conclusions of the earlier treatises are also “dialectical” but in a different fashion: they are dialectical when one considers the “descent” from general to particular. The more material and concrete is known dialectically.

149. Wallace, *The Modeling of Nature*, 295–96: “Quantity as understood in physics is analogous to quantity as understood in mathematics, for, granted that the two meanings are partly the same and partly different, there is a proportionate understanding of the two terms that allows transitions to be made between them.” Wallace’s position agrees with De Koninck’s in that the middle term that arises is hypothetical and can be based on number-measures. What Wallace means by “modeling” nature is the use of analogies. What lies within the term “modeling” as used in this analogical way, however, is brought out more clearly by De Koninck’s account (see §25).

150. St. Thomas, *SBdT*, q. 5, a. 3, ad 6: “Et inde est quod de rebus naturalibus et mathematicis tres ordines scientiarum inveniuntur. Quaedam enim sunt pure naturales, quae considerant proprietates rerum naturalium, in quantum huiusmodi, sicut physica et agricultura et huiusmodi. Quaedam vero sunt pure mathematicae, quae determinant de quantitativibus absolute, sicut geometria de magnitudine et arithmetica de numero. Quaedam vero sunt mediae, quae principia mathematica ad res naturales applicant, ut musica, astrologia et huiusmodi. Quae tamen magis sunt affines mathematicis, quia in earum consideratione id quod est physicum est quasi materiale, quod autem est mathematicum est quasi formale; sicut musica considerat sonos, non in quantum sunt soni, sed in quantum sunt secundum numeros proportionabiles, et similiter est in aliis. Et propter hoc demonstrant conclusiones suas circa res naturales, *sed per media mathematica*; et ideo nihil prohibet, *si in quantum cum naturali communicant*, materiam sensibilem respiciunt. In quantum enim cum mathematica communicant, abstractae sunt.” (Leon.50.150–51:362–91) I discussed this difficulty in Brungardt, “Mobiles, Bodies, and the Science of Quantified Motion,” 21–25; closer consideration of De Koninck’s views have led to a more developed solution.

of their uniformity and regularity, can be considered as to their motions through mathematical principles, which cannot be said of corruptible mobiles.”¹⁵¹ If we can somehow drop the condition that *incorruptible* substances alone are the subjects of mathematical physics, then we have the logical space needed to answer the difficulty by finding in corruptible mobile beings sufficient quantifiable “uniformity and regularity.”

Consider the various mixed sciences. Music considers numerical proportions found in sounds. This involves corruptible matter. Optics considers the visual line. This involves sources of light, visible objects, and a power of sight that are corruptible. The science of weights considers corruptible things insofar as proportions between different distances are found in them. So the middle sciences are not barred from applying mathematical principles to corruptible things as such. Rather, the uniformity and regularity of quantified things determines this applicability.

Thus, the reasoning St. Thomas uses can be extended: corruptible things could also be studied through mathematical principles *insofar as* they exhibit uniformity and regularity. For instance, the ideal gas law would be an example of knowing gases insofar as they exhibit uniform and regular behavior: the pressure of a gas in a given volume is directly proportional to its temperature.¹⁵² Therefore, it is not the case that the middle term is mathematical in one premise but physical in the other. Rather, it is dialectically mathematical in both. It is said truly of the minor term *only insofar as* that subject admits of such a mathematical character.¹⁵³

151. St. Thomas, *SBdT*, q. 5, a. 3, ad 8 (Leon.50.151:415-21).

152. Chaotic systems can now be studied by mathematical principles insofar as some regularity underlies them: Richard F. Hassing, “Modern Natural Science and the Intelligibility of Human Experience,” in *Final Causality in Nature and Human Affairs*, ed. Richard F. Hassing, vol. 30, Studies in Philosophy and the History of Philosophy (Washington, D.C.: The Catholic University of America Press, 1997), 245–46, mentions non-linear equations applied to turbulent flow in fluids and variations in insect populations.

153. Recall St. Thomas, *SBdT*, q. 5, a. 3, ad 6: “Et propter hoc demonstrant conclusiones suas circa res naturales, sed per media mathematica; et ideo nihil prohibet, si in quantum cum naturali communicant, materiam sensibilem respiciunt.” (Leon.50.151:388–90) Mullahy, “Subalternation and Mathematical Physics,” 100–101, helpfully points out that modern techniques of measurement show that no perfect fit can be achieved between the mathematical and the physical; this gives mathematical physics as a subalternate or mixed science a properly dialectical character. Hence, Mullahy’s term, that such mixed sciences are “dialectically

This “only insofar as” that requires the middle term to be dialectical indicates two things. First, it reveals an inherent imprecision in this mode of science, both on the side of application to material quantity and in the measurement of that quantity. This results in a provisory character of such arguments. For instance, the argument that the earth is a sphere (because it casts a circular shadow no matter how the earth is oriented), follows only insofar as the circularity of its shadow obtains—later arguments maintain that the earth is an oblate spheroid. Second, and more importantly, it indicates that the unity of this science is *derived from reason*, because the mind in its consideration composes as its object of consideration something of two distinct modes of abstraction. These are the features which De Koninck identifies as the dialectical reconstructions by which mathematical physics advances.¹⁵⁴

Thus, the genus of a mixed science is only qualifiedly one. If a middle science were to be purely one, a new abstraction “between” physics and mathematics would be needed to justify this new degree of intelligibility.¹⁵⁵ Thus, at least according to this modification of St. Thomas, a mixed science is a speculative science that aims to know mobile beings through mathematical principles insofar as they apply—that is, it is a science “*quae accipiunt principia abstracta a scientiis pure mathematicis, et applicant ad materiam sensibilem.*”¹⁵⁶ It is important that St. Thomas mentions sensible matter, which captures in its consideration the *per se* subject of motion, and hence a mixed science is not abstracted in its consideration from mobile subjects.¹⁵⁷

subordinate,” is apt.

154. See the passage quoted at the end of §22.5, p. 379.

155. Mullahy, “Subalternation and Mathematical Physics,” 104–105, points out that even though the subjects are only qualifiedly one, they are *per se* related. That is, the accidental difference added to the subject of the subalternating science (“visual” added to “line”) is not an arbitrary accidental difference: see 104–105: “[T]he two subjects [of the subalternating and subalternated science] do not merge to make up an *unum per se*, for that would make the latter a mere division of the former. They are, however, *per se* related. As John of St. Thomas carefully points out, the subject of the subalternated science is not the aggregate of the subject of the subalternating science and of the accidental difference, *sed respicit unum illorum per se, non tamen absolute, sed ut modificatum et connotatum per aliud, . . .* Obviously this peculiar relatedness has a foundation in nature.” Ibid., 105, Mullahy follows John of St. Thomas and argues that a mixed science possesses only a qualifiedly unified mode of abstraction.

156. St. Thomas, *In Phys.*, lib. II, lect. 3, n. 8 (Leon.2.63).

157. Ibid., lect. 11, n. 3 (Leon.2.88): “Nam astronomia . . . *inquantum* enim applicat principia mathematica

Now, St. Thomas clearly recognized the hypothetical character of such mathematical explanations.¹⁵⁸ De Koninck clarifies this dialectical character and how the modern mathematical sciences define with sensible matter. The middle terms provided by mathematical physics are dialectical in at least this sense, that they are provisional universals since they are dependent upon limited observation and measurement of particulars. As far as the unity of the formal object of natural philosophy and mathematical physics are concerned, this means that their differences arises only in method. In particular, this is due to the particularity or individuality which experimentally measured objects possess, as well as the mode of signification employed by the symbols in which their measurements are expressed. As a consequence, mathematical physics still defines its objects using sensible matter, albeit remotely.¹⁵⁹ In the remainder of this section, I will consider precisely how modern mathematical physics defines with sensible matter. If it does, then this completes De Koninck's case for the unity of natural philosophy and the modern sciences.

24.3 How the modern physico-mathematical sciences define with sensible matter

In his change of mind, the very feature which De Koninck took to be the formal difference between natural philosophy and the sciences in his earlier position (whether or not they attain

ad materiam naturalem, circa mobilia considerationem habet.” My emphases. Jean De Groot, *Aristotle's Empiricism: Experience and Mechanics in the Fourth Century BC* (Las Vegas: Parmenides Publishing, 2014), 326–38, argues that Aristotle finds the unity between the *mathēmata* and the more physical of the *mathēmata* in their “common element.” See *ibid.*, 335: “With his expression centered on *to koinon*, Aristotle stresses that mathematical traits belong to their natural subjects just as much as they belong to separated mathematical forms. In this, Aristotle seems to keep in play the Pythagorean insight that the mathematical traits and objects later separable in thought appear ‘live’ in natural things and precede in experience the separable mathematical objects that provide demonstrations.” Thus mathematical principles are not so much *applied* to natural things (*pace* St. Thomas), as they are separated from them; *ibid.*, 336: “Aristotle was not thinking in terms of mathematics being applied to physical problems. The entire problematic of his time for mathematical natural science was a movement in the opposite direction, from the natural science to separated mathematics. So, the common element which he addresses in *Posterior Analytics* I is not something identical in each subject matter but rather something the same by proportional ratios holding in the same way in each case.”

158. See the texts quoted at the end of §11.3.

159. See De Koninck, “The Unity and Diversity of Natural Science,” 12–16, which presents in summary fashion what De Koninck considers in “Introduction a l'étude de l'âme,” and “Abstraction from Matter.” See also his *The Hollow Universe*, 50–54.

universality) is merely a difference in the manner in which the same object is investigated. What is accidental had been taken for something essential. The existence of what is accidental (provisional universal terms) is, furthermore, explainable by what is in fact essential (the mode of defining with sensible matter). That is, both modes of investigation define mobile being with sensible matter. Yet on the one hand, the general part of natural philosophy also resolves its terms to common and primary experience; its terms and their definitions (e.g., “motion”) are stable. On the other hand, those sciences which are subjective species of general natural philosophy (e.g., biology), require proper experience and conceptions and yet could directly retain sensible matter in their definitions and would therefore possess the same formal object.

Yet, as just discussed, the difficulties arise when mathematical principles are used, due to their remove from sensible matter. How do the modern mathematical sciences define with sensible matter? In order to anchor modern scientific definitions in sense experience, we can find three steps in De Koninck’s thinking.¹⁶⁰ First, how are common sensibles involved in these definitions? Second, to what extent are number-measures independent of the proper sensibles? And lastly, how does the *per accidens* sensible called “sensible matter” belong in

160. De Koninck, “Abstraction from Matter,” I:187–88. Paradoxically, the advances of modern scientific research make reference to what is sensible *more* and not less necessary; see Ibid., I:167: “Philosophies of experimental science are so distrustful of our senses in the study of nature that they are quick to make objections to the argument that sensible matter must be included in scientific definitions. . . . The need to explain what is meant by the archaic phrase ‘common sensible matter’ might perhaps be made to seem less acute by substituting for it the more conveniently vague and non-committal ‘reference to sense-experience.’ But this would merely be to evade a problem basic to an understanding of what natural science is about in each and every one of its parts. Moreover, in our day, we have an obvious reason for continuing to use the old, candid and exact expression, a reason better than any the ancient philosophers could have dreamt of. The present knowledge of anatomy, physiology and, more especially, of the chemistry and physics these involve, have made us realize that the very organs of our senses can never be described adequately in terms of what we know first in sensation. Knowledge of the ultimate constituents of these organs, whatever they may be, would presumably lead us far away from anything that can be rendered in terms of sensible qualities like hard and soft, wet and dry, warm and cold, or in terms of taste, smell, sound and colour. So it is more important than it ever was to bear in mind that these sensible qualities are what we know first and best and that, no matter how far investigation may lead us away from this familiar realm, it continues to be the indispensable starting-point of all our knowledge about nature, and one to which we must always return. Unless anchored in sense experience, the study of nature can never keep to the right track, nor lead towards the truth.” See also De Koninck, “Introduction a l’etude de l’âme,” 46ff.

such definitions?

De Koninck first points out that the physicist or scientist proposing measurements (the diameter of the sun, the distance to a star), cannot be speaking entirely geometrically. His measurements must make use of an agreed-upon standard of measurement and lay claim not to the quantity which the mind considers in mathematical abstraction but the quantity which can be sensed, a common sensible. This is particularly true of measures which go far beyond the powers of the naked eye or fingertips. Such measurements only have meaning if referred to what is eventually subject to sensation as a common sensible.¹⁶¹

However, this attention of measurement to the common sensible permits what De Koninck terms a *first cognitive retreat*, a quasi-abstraction. That is, the mind sees in the relation of common to proper sensibles an analogous relation as subject bears to form. The common sensible such as motion and quantity can be considered apart from their sensible qualities: “It is attention to this relation of anteriority of a *per se* sensible which permits at least a first step backward in the presence of objects.”¹⁶²

Still, the measure-numbers so obtained are not abstract in the sense of a mathematical abstraction.¹⁶³ They make concrete use of an agreed-upon standard of measure, which resolves to a sensible object (e.g., the meter) which is an individual.¹⁶⁴ As such, the definitions

161. De Koninck, “Abstraction from Matter,” I:188.

162. De Koninck, “Introduction a l’etude de l’âme,” 52. Compare De Koninck, “Abstraction from Matter,” I:170.

163. That is, this is not an abstraction *stricte sensu*, for in this case form is not abstracted from matter but what stands as matter is abstracted from form. This may lead the mind *toward* the mode of abstraction found in mathematics, but only accidentally, insofar as common sensibles share more of the character of mathematical objects. By this “quasi-abstraction,” therefore, the natural object becomes less intelligible as natural but more intelligible in a certain respect. St. Thomas’s argument on this point is found in *SBdT*, q. 5, a. 3, c.: “Non autem inveniuntur abstractiones eis oppositae, quibus pars abstrahatur a toto vel materia a forma; quia pars vel non potest abstrahi a toto per intellectum, si sit de partibus materiae, in quarum diffinitione ponitur totum Similiter autem cum dicimus formam abstrahi a materia, non intelligitur de forma substantiali, quia forma substantialis et materia sibi correspondens dependent ad invicem, ut unum sine alio non possit intelligi, eo quod proprius actus in propria materia fit.” (Leon.50.149:248–52, 258–63)

164. I do not think it harms De Koninck’s argument that the meter is no longer defined with reference to a standard meter kept in Paris. The referent will still be an individual such that other individual standards can be determined from it: a physical constant in its individuality. Indeed, if the standard is now a *natural* instead of an *artificial* referent, this makes the connection to sensible matter that much closer.

of units are in some sense operational, but more precisely they are rooted in an individual. The standard of length, in this sense, would have no length. This individuality, and the proper sensibles attendant to the standard, root the number measures in sense experience.¹⁶⁵

Nonetheless, this standard of measure allows what De Koninck calls a second cognitive retreat before objects: the measurement produces quantities and numbers to which alone the mind attends at the end of the measurement. The sensible qualities of the objects can be ignored, even though sensible operations with standard measures had to be performed to attain them, precisely because of the numbers produced at the end of the process: “As long as we confine ourselves within the very restrained field of common sensibles envisaged uniquely as modalities of sensible qualities, it is impossible to penetrate into this domain where quantitative determinations can no longer be represented as modalities of proper sensibles.”¹⁶⁶ In the first retreat before objects the mind attends to the anteriority of the

165. De Koninck, “Abstraction from Matter,” I:188–89. See also De Koninck, “The Unity and Diversity of Natural Science,” 11–14.

166. De Koninck, “Introduction à l’étude de l’âme,” 52, where the entire context is instructive: “[In the *De Caelo*] local movement is attributed to bodies, and simple bodies are defined ‘*secundum gravitatem et levitatem*,’ but these last have not been separated from the sensation we feel in lifting a weight; in order for the definition to be strictly physical, it would have to have been confined to the number-measure obtained by means of a balance, that is to say, to the operational definition of mass. Lifting a rock to put it on the balance involves two things not easy to separate: the action, the very real effort that we feel, and the result of the measuring procedure. However, the reading of the graduated scale is totally independent of what we feel in lifting the rock. Just the same, in measuring a temperature by means of a thermometer, we entirely abstract from the sensation of heat, and even if we had never felt this sensation, thermodynamics would not be changed in anything. It is by limiting ourselves to the result of measurement alone that we will be able to engage ourselves freely on the path which leads to first principles as such. *As long as we confine ourselves within the very restrained field of common sensibles envisaged uniquely as modalities of sensible qualities, it is impossible to penetrate into this domain where quantitative determinations can no longer be represented as modalities of proper sensibles.* There is no need to go as far as the electron, the quantum, the potential, in order to find objects which are not homologous with the level of sensible experience. Looking more closely, even simple length, so soon as it is a number-measure defined by the description of the object and of the practical operation we have effectuated to obtain the number, is already expressible only by means of a symbol. The number-measure is not, as such, an object of sense; and that of which it is the sign is not an object in the manner of an apple. It is less than a name. That is why we call it symbol.” My emphasis.

The expression of this intelligible object requires symbols, and not names; see below, §25. The number-measure taken as the object of consideration by the mathematical physicist is not a *per se* sensible after both “retreats.” The definition of the standard of measure is itself sensible and defined with reference to sensible matter separately. Thus “the metrical aspect of nature” contains a double composition by the mind in its measurement: the standard must first be set up and then applied. The unity which the mind brings to this process, De Koninck claims, can only be signified through a symbol.

common to the proper sensibles. By this second retreat, however, we *choose* to limit our consideration “to the result of measurement alone.” Without this free choice mathematical physics would be impossible, because there is no *natural* abstraction by which the mind can consider sensible quantity itself in independence from sensible qualities, for matter cannot be abstracted from form.¹⁶⁷ This is the act of the mind by which a quasi-genus is composed for a mixed science and upon which mathematical physics is grounded. Here De Koninck offers an olive branch to Galileo. The result of sensible measurement, detached from the measured sensible, permits the mind to begin to attend to what is uniform and regular. Measurements transcribe nature into the “language” of symbolic mathematics.

How exactly, then, do the definitions of mathematical physics refer to sensible matter? De Koninck himself maintains that “the more conveniently vague and non-committal ‘reference to sense-experience’” is not sufficient. Has he met his own standard?¹⁶⁸ By arguing, first, that measurements cannot be of quantity as such, but of the common sensible quantity and, second, the measurement standards used must be subjects of the proper sensibles, he has established “*that* the physicist must define with sensible matter,” yet it is a further step “to show just how he takes account of it.”¹⁶⁹

De Koninck turns to Arthur Eddington for a solution.¹⁷⁰ In a way, the solution appeals

One could fruitfully compare De Koninck’s account to Sokolowski’s account of internal and external measurement systems, models, and the relationship between theory and experiment in *Pictures, Quotations, and Distinctions*, 145–51. His “Exact Science and the World in Which We Live,” *ibid.*, 155–70, especially 164–70, should also be considered. A complete comparison and contrast is outside the scope of the present project.

167. See above, fn. 163.

168. De Koninck, “Abstraction from Matter,” I:167.

169. *Ibid.*, I:190, and *ibid.*: “The common impression that his statements disregard sensible matter entirely is not without justification, to say the least; for he certainly appears to confine himself to the order of common sensibles, that is, to sensible numbers, magnitudes and modes of quantity, and soon arrives at entities and structures beyond the reach of actual sensation. It is therefore our duty to explain exactly how, even in the mathematical science of nature, the law governing all natural science applies, namely, that contact with, and dependence upon, the material reality upon which we lay our fingers is the ultimate test of validity.” Consider also Charles De Koninck, “*Sedeo, ergo sum: Considerations on the Touchstone of Certitude*,” *Laval théologique et philosophique* 6, no. 2 (1950): 343–348.

170. Recall that De Koninck wrote his dissertation on the philosophy of Eddington: “La philosophie de Sir Arthur Eddington” (PhD diss., l’Institut Cardinal Mercier de Université Louvain, 1934); see De Koninck, *Writings, Vol. 1*, 99–233. The core of De Koninck’s understanding from this treatment (written some 23

to the natural philosophical theorem which has been present since *Physics*, Book I. The sensible and fluctuating, to be real and intelligible, must have a subject and some formal aspect. Eddington recognizes this when he calls the measured object “knowable to mind.”¹⁷¹

In particular, notes De Koninck,

“Knowable to mind” we interpret as “sensible matter.” For it is acknowledged that there is reference to the actuality in question by the material sense organs, while Eddington goes on to explain . . . that the “final guarantor is the mind that comes to know the indications of the material organs.” These statements account well enough for what we call “sensible matter,” insofar as it is *per se* knowable to the mind while only incidentally sensed—a kind of actuality and knowability that we demonstrate to sense according to the third mode.¹⁷²

The “third mode of demonstrating to sense” is when we point out “This man, Socrates.” The senses *per accidens* pick out a unity which only the mind can recognize *per se*.¹⁷³ However, we should recall that the mathematical physicist confines himself to the domain of the common sensibles in a very particular way, through the “two cognitive retreats.” Consequently, mathematical physics, in order to define its object, depends upon the senses in three ways:

years prior to the “Abstraction” article structuring my exposition), seems intact, *ibid.*, 123: “It is number measure itself that is the formal objects of physics.” See also *The Cosmos*, in De Koninck, *Writings, Vol. 1*, 339–40, fn. 49 and 50; and De Koninck, “Introduction a l’etude de l’âme,” 53 for the solution currently being presented, although it is clearer in “Abstraction from Matter.”

171. De Koninck cites a long selection from Eddington’s Gifford Lectures (Chapter XII, “Pointer Readings”), but these are the pertinent passages: “The potentiality of the whole physical world for awaking impressions in consciousness is an attribute not to be ignored when we compare the actual world with worlds which, we fancy, *might* have been created. . . . We recognize the actuality of a particular world because it is that world alone with which consciousness interacts. However much the theoretical physicist may dislike a reference to consciousness, the experimental physicist uses freely this touchstone of actuality. He would perhaps prefer to believe that his instruments and observations are certified as actual by his material sense-organs; but the final guarantor is the mind that comes to know the indications of the material organs. Each of us is armed with this touchstone of actuality. . . . If actuality means ‘known to mind’ then it is a purely subjective character of the world; to make it objective we must substitute ‘knowable to mind.’ The less stress we lay on the accident of parts of the world being known at the present era to particular minds, the more stress we must lay on the *potentiality* of being known to mind as a fundamental objective property of matter, giving it the status of actuality whether individual consciousness is taking note of it or not.” See Sir Arthur S. Eddington, *The Nature of the Physical World* (Ann Arbor, MI: Ann Arbor Paperbacks, 1963), 264, 266, 267.

172. De Koninck, “Abstraction from Matter,” I:190.

173. *Ibid.*, I:184: “The physicist, to whom [Socrates] may be no more than a bundle of events, could not possibly point him out in any other way; his roundabout way of demonstrating to sense can never terminate anywhere but in the domain to which he had to confine himself from the start: the domain of common sensibles.”

(i) It confines itself to the metrical aspect of nature, first revealed as common sensibles (or primary qualities), and to which we must always return, (ii) The common sensibles are not perceived independently of some proper sensible or other, (iii) The mind cannot help but refer the metrical structure to a background which we call sensible matter.¹⁷⁴

We can see the limitations of mixed sciences from this new account of sensible matter. First, the metric's reference to an individual standard means that the definition of the metric is quasi-nominal.¹⁷⁵ That is, they depend upon the individual; they are not "nominal" in the sense of being a mere interpretation of a name. Much less, then, can such objects express "what a thing is."¹⁷⁶ A provisional character also arises from this object. This is due to the incomplete induction which experiment provides to theory. Further, the very meaning of the names given to the object of study (which the measure-numbers symbolize) are unsteady. De Koninck uses the example of the term "atom," whose meaning has shifted through the course of scientific investigation. Furthermore, the aim of using mathematical physics in the first place was to extend our knowledge beyond what common and primary experience allowed (see §11.1). It is for these reasons that De Koninck characterizes the modern sciences as dialectical extensions of natural philosophy. Using sensible matter and aiming at the same object, they are still formally one (although in the qualified was just elaborated for mathematical physics).¹⁷⁷

174. De Koninck, "Abstraction from Matter," I:193.

175. De Koninck, "The Unity and Diversity of Natural Science," 13. See also De Koninck, "Abstraction from Matter," I:194: "The definitions of mathematical physics are therefore a very special type of interpretation: one which ultimately amounts to the designation of an individual something that will be the unique standard until a new convention is made. If we made the historical 'Socrates' equivalent to 'philosopher,' meaning that no one is a philosopher except in the degree that he is a duplicate of Socrates, we would be following a parallel usage."

176. Ibid.

177. De Koninck, *Writings, Vol. 1*, 453: "If by philosophy of nature is understood a science in a quite rigorous sense, that defined in Posterior Analytics, I.1, and if by experimental sciences we mean those branches of the knowledge of natural things which remain in a condition of dialectical movement because they cannot sufficiently detach themselves from the singular and whose generalizations will thus always be tentative and provisory, it is understood that the two are quite distinct. Nevertheless, they bear on the same subject, their principles have a common origin, sensible matter; their term is the same, knowledge of natural things as much as possible in their proper principles. In this respect, the experimental sciences are only a continuation

To summarize: mathematical physics defines with sensible matter. The measurements which constitute the formal object of these sciences has a sensible referent (in two ways, the standard of measure and the measured), and defines with “sensible matter” as does the natural philosopher. However, the natural philosopher’s objects are not a whole that is unified only by the mind, whereas the objects of the mathematical physicist are so unified. This is typical of the accidental unity of a mixed science. The mathematical physicist uses symbols to signify these measurements based on individual standards. Consequently, an *ut nunc* universality remains as a function of attempting to define through individualized standards of measurement, a finite number of measurements, and symbolic conceptualization. Mathematical physics’ proxy for sensible matter in these definitions are expressed in such a mode, the measurable knowability of matter. Nonetheless, the terminus or final cause of taking such measurements is a knowledge of beings definable through sensible matter. Thus, while the mathematical sciences have terms whose meanings fluctuate as these sciences progress, they are still teleologically one with natural philosophy. Natural philosophy and the experimental sciences (including the mathematical sciences) are, therefore, distinguished by two rational modes of proceeding (the demonstrative and the dialectical), but they are not formally different as to their objects.

of the properly demonstrative sciences of nature. But this continuation requires the use of another method, not only in the search for principles, but for the choice and positing of the principles themselves.” See also De Koninck, “The Unity and Diversity of Natural Science,” 16: “It should now be plain that our study of nature can proceed on three different levels: that of science, that of opinion, and that of terms that are themselves provisional—whose meanings are accordingly unstable.”

§25 THE DIFFICULTY IN SEEING THE RELATIONSHIP BETWEEN PHILOSOPHICAL PHYSICS AND EMPIRICAL, MATHEMATICAL PHYSICS IS CAUSED BY A TENSION BETWEEN THE NATURAL ORIGIN OF WORDS USED BY THE FORMER AND THE ARTIFICIAL ORIGIN OF THE SYMBOLIC CONSTRUCTIONS CHARACTERISTIC OF THE LATTER.

Go, go, go, said the bird: human kind
 Cannot bear very much reality.
 Words strain,
 Crack and sometimes break, under the burden,
 Under the tension, slip, slide, perish,
 Decay with imprecision, will not stay in place,
 Will not stay still.

T. S. ELIOT
 “Burnt Norton”

Because symbols play such a large role in De Koninck’s understanding of the mode of definition of modern mathematical physics, it remains to give some account of what a symbol is. Some mention will also be made of another crucial element in De Koninck’s understanding of natural philosophy, viz., a dialectical process in thought towards a limit. Taken together, these features provide a fuller understanding of how the human mind’s progress along the natural path is aided by the instruments it devises to realize more fully the end-goal of its inquiry.

25.1 *Words and symbols; three competing accounts*

De Koninck is concerned with what symbols in mathematics and mathematical physics are and how they compare to names. In particular the issue concerns how they signify—in what way they bring to mind something other.¹⁷⁸ I will review De Koninck’s analysis of the nature of symbols, comparing it briefly to two competing accounts, Jacob Klein’s and Sean Collins’. These three accounts maintain (1) that a symbol is an accidental unity of *per se* units of signification (De Koninck), (2) that a symbol is a second intention taken as a first intention (Klein), (3) that a symbol is an instrumental sign of the artificial order of

178. Following the definition of St. Augustine, *De Doctrina Christiana*, Book II, ch. 1, n. 1: “Signum est enim res, praeter speciem quam ingerit sensibus, aliud aliquid ex se faciens in cogitationem venire.”

reason (Collins). I consider Collins' account to be the most adequate; a sign of this is that the other two flow from and are explained by it. What De Koninck requires to maintain his thesis about natural philosophy can be maintained even more clearly using Collins' precision about symbolic signification.

Presupposed to this discussion is the nature of signification. Aristotle tells us:

But what these [spoken sounds] are in the first place signs of—affections [παθήματα] of the soul—are the same for all; and what these affections are likenesses of—actual things—are also the same.¹⁷⁹

The natural order, which is the foundation of the speculative order in reason, is prior in being and causality to our concepts of the natural order and these concepts are in turn prior to the vocalized words which we use to signify natural things through our concepts (“affections of the soul”). This means that our conceptual order is prior in being to the spoken word insofar as it is a conventional sign.

Now, the affections of the soul can be distinguished into “impressed” and “expressed” intelligible species, for we do not always actively consider what we know. It is the expressed species which is called an “interior word,” the *verbum cordis*.¹⁸⁰ Indeed, St. Thomas, comments, the exterior, vocalized word is a word in virtue of the concept or mental word which gives it its significance.¹⁸¹ Our spoken words depend upon our intellectual words as upon

179. Aristotle, *On Interpretation*, 1, 16a6–7.

180. St. Thomas, *ST*, Ia, q. 27, a. 1, c.: “Quicumque enim intelligit, ex hoc ipso quod intelligit, procedit aliquid intra ipsum, quod est conceptio rei intellectae, ex vi intellectiva proveniens, et ex eius notitia procedens. Quam quidem conceptionem vox significat, et dicitur *verbum cordis*, significatum verbo vocis.” (Leon.4.305)

181. See *ibid.*, q. 34, a. 1, c.: “Ad cuius evidentiam, sciendum est quod verbum tripliciter quidem in nobis proprie dicitur, quarto autem modo, dicitur improprie sive figurative. Manifestius autem et communius in nobis dicitur verbum quod voce profertur. Quod quidem ab interiori procedit quantum ad duo quae in verbo exteriori inveniuntur, scilicet vox ipsa, et significatio vocis. Vox enim significat intellectus conceptum, secundum philosophum, in libro I *Periherm.*, et iterum vox ex imaginatione procedit, ut in libro *De Anima* dicitur. Vox autem quae non est significativa, verbum dici non potest. Ex hoc ergo dicitur verbum vox exterior, quia significat interiorem mentis conceptum. Sic igitur primo et principaliter interior mentis conceptus verbum dicitur, secundario vero, ipsa vox interioris conceptus significativa, tertio vero, ipsa imaginatio vocis verbum dicitur. . . . Dicitur autem figurative quarto modo verbum, id quod verbo significatur vel efficitur, sicut consuevimus dicere, hoc est verbum quod dixi tibi, vel quod mandavit rex, demonstrato aliquo facto quod verbo significatum est vel simpliciter enuntiantis, vel etiam imperantis.” (Leon.4.365)

their cause. This motivates John of St. Thomas to expand the definition of “sign” to include both vocal and mental words; a sign is “that which presents to a cognitive power something other than itself.”¹⁸² A mental word is a formal sign, “formal knowledge which presents the thing itself not by mediation,” while a vocal word is an instrumental sign, or “what presents something other than itself by reason of preexisting knowledge of itself.”¹⁸³ Consequently, I will use the term “word” instead of “expressed species” because it is less cumbersome, and distinguish it from “spoken word” or “written word.”¹⁸⁴

In contrast to this account of signification, we should recall two counterpoints. The first point is the notion of species-neutral universality, a concept defended by Francis Bacon.¹⁸⁵ Bacon’s nominalism leads to a redefinition of “form.” One “who knows forms comprehends the unity of nature in very different materials.”¹⁸⁶ Aristotle’s principle—that for every specific type of substantial form there is a specific matter—is thus overturned.¹⁸⁷ Rather, “a true form is such that it derives a given nature from the source of an essence which exists in several subjects.”¹⁸⁸ Thus, forms (or the laws of behavior of bodies) exist indifferently (or

182. John of St. Thomas, *Curs. Phil.*, I:9a19–21. I translate “repraesentat” in the definition as “show” or “exhibit” to avoid a strictly representationalist interpretation of Thomistic epistemology. It seems warranted due to John’s division of this genus. This definition enlarges the traditional Augustinian one, see *ibid.*, fn. 1 (alt. text): “Ita tradimus definitionem signi, ut complectatur omnia signa, tam formalia quam instrumentalia. Definitio enim, quae communiter circumferetur: ‘Signum est, quod praeter species, quas ingerit sensui, aliud facit in cognitionem venire,’ solum instrumentali signo competit.”

183. *Ibid.*, I:10a4–9.

184. De Koninck, when discussing “names” as opposed to symbols, makes use of the ambiguity of “name” as a substitute; I will attempt to point out where usage could be clearer.

185. Although the term is not his: see Hassing, “Physical Continuum,” 111, fn. 2; Wallace, *From a Realist Point of View*, 314–43.

186. Bacon, *The New Organon*, Book II, Axiom III, 103. Bacon’s redefinition of form is in Axiom II of the same Book: “For though nothing exists in nature except individual bodies which exhibit pure individual acts in accordance with a fixed law, in philosophical doctrine, that law itself, and the investigation, discovery and explanation of it, are taken as the foundation of both of knowing and doing. It is this law and its clauses which we understand by the term Forms, especially as this word has become established and is in common use.”

187. See Aristotle, *Physics*, II.2, 194b8–9: “Moreover, material is among things relative, for there is a different material for a different species.” Bacon’s illustration in Book II of the *New Organon*, “an example in the inquiry into the form of heat,” takes “heat” to be present univocally in both celestial and terrestrial kinds; see Book II, Axiom XI, 110ff.

188. Bacon, *The New Organon*, Book II, Axiom IV, 104.

“neutrally”) in diverse subjects (or what were previously considered unique species).

The second point is complementary to the first. It is Descartes’ idea, inserted as a qualifying clause to his Third Rule in the *Discourse*. When conducting our thoughts in order, we may suppose “an order among those that have no natural order of precedence.”¹⁸⁹ The Third Rule broadens Bacon’s species-neutrality into a method: “That is,” Kennington points out, “method to be certain need not be guided by any natural articulation that we ordinarily find in things.”¹⁹⁰ These two points are forerunners of the symbolic mode of conceptualization, a radical departure from the natural mode of signifying caused by words.

Consider a first example of the use of symbols in Descartes’ analytic geometry. In general, this analytic method produces formulas which indifferently determine an infinity of points.¹⁹¹ Such symbols do not directly signify the lines which their formulas calculate. As one commentator notes:

The equation is ambiguous. It appears to signify the line. The presence of variables prevents its determination to any one point. Precisely this indetermination

189. René Descartes, *Discourse on Method*, ed. Pamela Kraus and Frank Hunt, trans. Richard Kennington (Newburyport, MA: Focus Publishing / R. Pullins Co., 2007), 25.

190. Ibid., “Interpretive Essay,” 68. This inattention to “natural articulation” is distinctively modern; contrast Plato, *Timaeus*, 29b: “In every subject it is of utmost importance to begin at the natural beginning [κατὰ φύσιν ἀρχήν].” See also Aristotle, *Ethics*, Book I.7, 1098b4–8: “But each set of principles we must try to investigate in the natural way [πεφύκασιν], and we must take pains to determine them correctly, since they have a great influence on what follows. For the beginning is thought to be more than half of the whole, and many of the questions we ask are cleared up by it.”

191. René Descartes, *The Geometry of Rene Descartes*, trans. David Eugene Smith and Marcia L. Latham (New York: Dover Publications, 1954), 22: “Then, since there is always an infinite number of different points satisfying these requirements, it is also required to discover and trace the curve containing all such points,” and 89: “I shall not stop to consider in detail the curves corresponding to the other cases, for I have not undertaken to give a complete discussion of the subject; and having explained the method of determining an infinite number of points lying on any curve, I think I have furnished a way to describe them,” and 88–90: “It is worthy of note that there is a great difference between this method in which the curve is traced by finding several points upon it, and that used for the spiral and similar curves. In the latter not any point of the required curve may be found at pleasure [*par cete derniere on ne trouve pas indifferément tous les points de la ligne qu’on cherche*], but only such points as can be determined by a process simpler than that required for the composition of the curve. Therefore, strictly speaking, we do not find any one of its points, that is, not any one of those which are so peculiarly points of this curve that they cannot be found except by means of it. On the other hand, there is no point on these curves which supplies a solution for the proposed problem that cannot be determined by the method I have given.”

gives it the appearance of turning the mind to the line. But the equation does not attend to the line. It attends indifferently to any of its points.¹⁹²

Consider the ellipse understood through an algebraic function and coordinate axes, $(x^2/a^2) + (y^2/b^2) = 1$. It is actually not an ellipse but rather the illustration of the possible results of a procedure seeking certain points. If the plot of such points were skewed and the coordinate axes proportionately skewed, the same function still plots onto the skewed axes and the “same” algebraic figure results. Yet this skewed ellipse is, in itself, a different ellipse than the original. What happens here is that the actual species of the line is neutered and considered not in its intrinsic natural order but within the order provided through the function, a relationship extrinsic to the line that is captured only by the mind.¹⁹³

A second example of symbols, from mathematical physics, is the concept of mass, m . This m present in momentum equations can stand in for (variously) the mass of a single body, a point-mass, or systems of such bodies or point masses.

Our symbolic concept of momentum stands in no necessary relation to the mobile and its unity and continuity. It is neutral to whether the thing in motion is many or one and whether the one or many are divisible or indivisible. What makes a momentum one and what relates one momentum to another has no relation to

192. Nieto, “Continuity and the Reality of Movement,” 73.

193. See Jacob Klein, “The World of Physics and the ‘Natural’ World,” in *Lectures and Essays*, ed. Robert B. Williamson and Elliott Zuckerman (Annapolis, MD: St John’s College Press, 1985), 18–19. Furthermore (16), to be more precise, it is the case (according to the ancient Greek geometers) that “to this generality of procedure” for drawing a conic “there does not correspond the generality of the object.” That is, “There is no ‘general object’ for the drawing to represent in a merely symbolic way.” Whereas, to the modern mode of conceptualizing conic sections, the generality of procedure (embodied in the symbolic function) corresponds—no, more than that: is identical with—the generality of the object thereby represented. Compare to David R. Lachterman, *The Ethics of Geometry: A Genealogy of Modernity* (New York: Routledge, 1989), xi: “An Apollonian locus is not the same as a Cartesian locus, even though sentences or propositions containing terms designating them may have the same truth-value. (The same would also hold, *mutatis mutandis*, for a Euclidean and a Hobbesian circle or for a Archimedean and a Leibnizian spiral.) ‘Not to be the same’ is, of course, the salient phrase . . . Briefly, it is not a matter of reference or meaning; rather, the difference concerns the source of the intelligibility of the figure (or statement) at issue: in the one, the ancient case, this source is the nature of the figure in its own right, while in the other, modern, case, it is to be found in the strategies and tactics certain to bring the figure into visible or ‘bodily’ being. A distinction in the manner of knowing entails a difference in the mode of being.”

the mobile and its divisibility into parts; it is rather related to the system of concepts called vector algebra.¹⁹⁴

Thus, the solar system—which has no natural unity as a substance—can be “thrown together” within our symbolic conception of its total mass as if it were one. It becomes one by our “setting up together” under one mark, m , the diverse parts. Key instances of this mode of conception considered in Chapter 5 were the universe itself, captured through the GR-based models, as well as the mathematical concept of entropy.

Jacob Klein, for his part, concludes that symbolic conception arises when one shifts “the meaning of the concept from *intentio prima* to *intentio secunda*, together with their simultaneous identification.”¹⁹⁵ A second intention, Klein argues—generic “number,” with which we cannot calculate, any more than we can pet and feed generic “animal” (these have being only in the intellect; neither can come before the imagination)—comes to be represented by a letter sign— x , a , along with signs for $=$, $+$, $-$, \div , \times (equality and the arithmetic operations)—in such a way that we *can* calculate with letter-signs that have no actual (but only potential) numerical determinacy. (It is as if we created a generic animal that we can feed and pet!)¹⁹⁶ The written algebraic letter-sign is thus a “materialization” of this mode of conception, for it displays externally the imagination’s presentation of the symbol. The example of the ellipse illustrates what Klein means: the functional concept of the ellipse is a symbolic concept.

De Koninck, for his part, holds that a symbol is a conventional sign by which the mind signifies in the mode of a name what can, in principle, be merely an accidental whole.¹⁹⁷

194. Hassing, “Physical Continuum,” 145.

195. Klein, “The World of Physics and the ‘Natural’ World,” *Lectures and Essays*, 26. Wolfgang Smith, in “The Pitfall of Astrophysical Cosmology,” *The Wisdom of Ancient Cosmology*, 138–39, expresses a similar thesis, concerning the reification of equations. See also “*Sophia Perennis* and Modern Science” in the same collection, 19–35.

196. I thank Blaise Blain for the helpful metaphor. See Klein, *Origin of Algebra*, 208: “When . . . the *ens rationis* as a ‘second intention’ is grasped with the aid of the imagination in such a way that the intellect can, in turn, take it up as an object in the mode of a ‘first intention,’ we are dealing with a symbol, either with an ‘algebraic’ letter-sign or with a ‘geometric’ figure as understood by Descartes.”

197. This is most clearly expressed in Charles De Koninck, “The Nature and Use of Symbols in Science,”

By contrast, a conventional sign is only a word or name when the thing signified is one *per se*. Thus, the symbol stands in between a name, which signifies a natural, *per se* whole, and an indefinite name (such as “non-man”) which signifies a “whole” that is one in the qualified sense of being unified in the mind as the negative of that *per se* whole to which the indefinite name is opposed.¹⁹⁸

In imitation of its etymological origins, a symbol “throws together” and collects as parts meanings or intentions which already have *per se* unity.¹⁹⁹ On the one hand, a name, such as “triangle” or “man,” signifies something which has *per se* unity. Even the combination of notions involved in the notion of a triangle (“figure,” “plane,” “bounded,” “three,” “line,” “straight”) are related to each other such that they form a unified essence. Thus, De Koninck maintains, “A conventional sign is a name only when the signified is something one *per se*.”²⁰⁰ “Name,” on this account, would therefore be said analogously of an individual’s proper name or the names we give artificial wholes. On the other hand, a symbol, in principle, can stand for a collection of notions which have no *per se* unity: “point” and “sneeze” and “Saturn” and “nothing” could be signified by the symbol *x*.

Laval théologique et philosophique, an article in page proofs of unknown date (with a pagination of 75–83), found in the De Koninck archives. Editing suggestions have been made to De Koninck’s text; these have been included in [brackets] in my quotations, with De Koninck’s original proofs given a strikethrough in the corresponding place. The substance of the position outlined there, however, can be found in other published writings.

198. De Koninck, “The Nature and Use of Symbols in Science,” 77–80.

199. See De Koninck, *The Hollow Universe*, 10–11: “In other words, symbols, unlike names, abstract from what is one *per se*. Aquinas pointed out that ‘Symboloum collectionem quamdam importat,’ as the sign of what is ‘thrown together,’ meaning that, as distinguished from the sign that is a name, the symbol refers to what is no more than a collection, an aggregate, a heap, an accidental whole.” The source of the reference to St. Thomas is *In Sent*, lib. III, d. 25, q. 1, a. 1. See the unpublished De Koninck, “The Nature and Use of Symbols in Science,” 75 (again, editing suggestions have been made to De Koninck’s text; these have been included in [brackets] in my quotations, with De Koninck’s original proofs given a strikethrough in the corresponding place): “The origin of the word ‘symbol’ may help us to understand how it differs from a name. The Greek noun ‘*symbolon*’ comes from the verb ‘*ymballein*,’ meaning, literally, ‘to throw together’: *syn*, with, *ballein*, to throw. Hence the meaning of symbol as the result of [symbol came to stand for the effect of] throwing together: a heap, or collection. The word was ~~used to~~ [extended to] mean a sign of an agreement, like a wedding-ring; [a sign] of membership in a group, such as a uniform, or a passport; or a sign of rank, as the insignia of office.”

200. De Koninck, “The Nature and Use of Symbols in Science,” 76. See also *ibid.*, 10: “And though to name the aggregate is impossible, to assign a symbol to it is the simplest thing in the world.”

For what is not itself *per se* one, in the way a man or a circle is, can nevertheless be gathered together by the mind, set apart, and assigned a symbol that is one. We are not of course thinking of *heap* or *aggregate* as such, of which a definite notion is easily possible, but of a particular heap which, by itself, cannot have a name.²⁰¹

This single, arbitrary sign, the symbol, therefore stands in between a name and an indefinite or infinite name such as “not-man.”²⁰² Like a name, the symbol’s account does include notions

201. De Koninck, *The Hollow Universe*, 10. See also De Koninck, “The Nature and Use of Symbols in Science,” 77: “For the present, it is enough to realize that the mind can ~~put together~~ [combine] objects which ~~cannot~~ [do not] form something one *per se*, ~~such as a triangle or a square; yet the mind can~~ [and can nevertheless] express ~~the~~ [this] combination in the mode of something one *per se*, by means of a single, arbitrary sign that is not a name.” It is beside the point to object that there would be no use for such a symbol. Rather, the point is that a symbol is such a thing in principle. Furthermore, as shall be pointed out later on, even were a ‘name’ conventionally invented to signify the collection also signified by this *x*, this would not be a name in the true sense; the reason being is that the very *notion* of such a unity is still accidental, and thus the various mental concepts which the mind can distinguish within its notion are prior, *per se* wholes. This seems to require that a symbol is much like a proper name; the individual as such cannot be defined through mental words. See also De Koninck, “The Nature and Use of Symbols in Science,” 76: “It is not ~~the~~ [an] oral or visual structure that constitutes ~~the~~ [a] name.” Indeed, to conflate a name with its oral or visual structure is to make a mistake closer to what Klein identifies as the process of making a symbol—“Since words signify by convention, a sign such as a name is ~~not at all~~ [never] essential to what it is used to signify; on the other hand, what a name signifies is indeed essential to the name.” This indicates that the origin for the meaning of a name, even as a conventional sign, lies in the natural unity which it signifies and which is grasped by the mind.

202. See De Koninck, “The Nature and Use of Symbols in Science,” 77–80, and on 80: “Now, since the mind can bring together objects which do not belong together in virtue of what they are, and which in themselves do not form something one *per se*; since we can relate to one another things that are quite unrelated in themselves, ~~making, e.g., a mentally ordered whole out of a heap~~ [making out of a heap, for example, a mentally ordered whole], to such a whole, which has no proper name, the mind can assign an arbitrary sign in the mode of a name. Such a sign ~~would~~ [will then] be a symbol implying reference to the original meaning, viz., ‘collection.’ Only a symbol, in this sense, could be the substitute for a name, ~~and used to signify~~ [signifying] what has no more than the unity of a collection or incidental whole. This, then, is one meaning of ‘symbol,’ to be distinguished over and against both ‘name’ and ‘infinite name.’

“[An example or two will help us to summarize what has been said.] For instance, in the statement ‘all the objects in this [rubbish-]heap [(a shoe, a cabbage, a sheet of newspaper)] ~~are, together~~ [make] 25,’ ~~viz.: a shoe, a cabbage, a sheet of newspaper, etc.; concerning them we can distinguish a twofold unity~~ [a twofold unity concerning objects can be distinguished]: [first,] one which is theirs because they are here, heaped in the same place; ~~the other is~~ [secondly, that] due to the fact that each is an *object* and that together they are 25. In either case the reason why they form a whole is extrinsic to what these things are, ~~namely~~ [since it is either] the place they have in common, or the fact that each and all are invested with the intention of ‘object’ and that the mind can group them in ~~that~~ [the] respect as if they were a whole, viz., a totality of 25. No matter how different, things such as a horse, a point, a sneeze, and a relation of identity, can be brought together by the mind under the heading of ‘objects’ and be set forth as an instance of 4, where ‘4’ is the symbol of such a collection.”

This idea is latent in his published work; e.g., De Koninck, “Random Reflections on Science and Calculation,” 96: “*Logismos* side-steps the distinction between what is *per se* and what is *per accidens*, either as

which are *per se* one; however, these notions are not *per se* one with respect to each other. Thus, the symbol and the infinite name are one and have supposition only because of an act of reason.²⁰³ Like an infinite name, a symbol signifies things which are one only accidentally, namely in virtue of a naturally-sourced, unifying act of the mind. Unlike the infinite name, however, the symbol is not indefinite in scope nor is it defined against a single *per se* unity, as is “non-man.” Symbols, according to De Koninck, are therefore a mode of conventional expression capable of ignoring the distinction between the *per accidens* and the *per se*, whether in being or unity.²⁰⁴ A symbol can allow the mind to consider as *per se* one what is not one in reality (as the mass *m* of the solar system). Likewise, a symbol can allow the mind to consider as a *per se* essential being what is not such in reality (as *x* standing for numbers diverse in kind: *x* standing for a real number in the real number system would be much more clearly standing for a composed essence).

Now, perhaps De Koninck goes too far. The extreme character of the principle of formation of a symbol (that it is capable of mentally unifying what is not *per se* one in notion) needs some reconciliation with the fact that such accidental unities are useful or applicable to explanations of the natural order. Indeed, the symbolic concept of “mass” or “energy,” for instance, could only cut across Aristotelian natural kinds because of some point of common

to being or as to unity. That the mind can transcend this division is plain from the fact that nothing prevents it from stringing together the following: ‘bald-headed pale barn-building flute-playing thrice-married ill-tempered barber,’ where the connections are all plainly *per accidens* (otherwise it would be impossible to be one of those things without being the other too). We cannot name what it is to be such a particular accidental ensemble—although it may be true of ‘Oscar’—but it is the easiest thing in the world to let a symbol stand for it.”

203. St. Thomas, *In Peri Herm.*, lect. 4, n. 13: “Omne enim nomen significat aliquam naturam determinatam, ut homo; aut personam determinatam, ut pronomen; aut utrumque determinatum, ut Socrates. Sed hoc quod dico non homo, neque determinatam naturam neque determinatam personam significat. Imponitur enim a negatione hominis, quae aequaliter dicitur de ente, et non ente. Unde non homo potest dici indifferenter, et de eo quod non est in rerum natura; ut si dicamus, Chimaera est non homo, et de eo quod est in rerum natura; sicut cum dicitur, equus est non homo. Si autem imponeretur a privatione, requireret subiectum ad minus existens: sed quia imponitur a negatione, potest dici de ente et de non ente, ut Boethius et Ammonius dicunt. *Quia tamen significat per modum nominis, quod potest subiici et praedicari, requiritur ad minus suppositum in apprehensione.*”

204. De Koninck, “Random Reflections on Science and Calculation,” 95.

applicability to each kind.²⁰⁵

Collins' definition of a symbol relies upon a fourfold division of how order is related to the human mind.²⁰⁶ The fundamental division is between (first) the speculative or apprehended order (the order which reason considers but does not make) and (second) the orders of logic, ethics, and art. The four types of habits which perfect these orders become (1) the speculative sciences (an order that reason does not make, but only considers, in three modes of definition), (2) logic (the order that reason, as it considers, makes in its own act), (3) moral philosophy (the order that reason, as it considers, makes in operations of the will), (4) and knowledge of artificial production (the order that reason, as it considers, makes in

205. De Koninck recognizes that symbols, while fictions, are “nonetheless effective.” See De Koninck, “Random Reflections on Science and Calculation,” 93: “It [the number ‘2’ understood symbolically] is a convenient fiction which our mind has produced. Though it be a fiction, it is nonetheless effective, as can be seen from the fact that by means of it we can count things regardless of what they are; and this is of course because ‘*what the things are*’ is of no account to the calculator. The indifference of this number to the nature of the numbered is equalled only by the indifference of the elements of a heap to their neighbours in the heap. Whether they belong together or not, the mind can put them together for a purpose alien to their nature or to their lack of it.” Indeed, *ibid.*, 94–100, De Koninck discusses this merely functional and no longer quidditative mathematics in detail. (Here we seen beginnings of the connection of De Koninck’s position to Collins’, where De Koninck states that the mind *produces* the unity. (The aspect of *practicability* in the sense of *material apt to be worked on*, especially in calculation, lends itself to clearer interpretation from Collins’ frame of understanding a symbol as a product of art, for art needs natural materials apt for the purpose of the artisan.)

This difficulty, viz. that symbols are not *random* collections of things only accidentally united, even though they can be such in principle, is the thrust, I think, of Collins’ objection to his own presentation, see Sean Collins, “The Heritage of Analytic Philosophy,” *The Aquinas Review* 10 (2003): 62: “Moreover it seems false, on closer consideration, to say that symbolic representation itself lacks any *thought* in what it properly signifies. Modern physics, where symbolic representation has its most marvelous success, involves highly abstract thinking. Far from being impeded by symbolic representation, that thinking is widely understood to be possible only through symbolic notation. And it is true, after all, that symbolic representation falls into the general category of ‘conventional sign,’ just as words do. How can there be a conventional sign of any sort without some thought lying behind it, and therefore being signified?”

206. *Ibid.*, 63. This is the fourfold distinction made by St. Thomas in his *prooemium* to his commentary on Aristotle’s *Ethics*. See St. Thomas, *Sent. Ethic.*, lib. I, lect. 1 (Leon.47.4:14–24): “Ordo autem quadrupliciter ad rationem comparatur: est enim quidam ordo quem ratio non facit, sed solum considerat, sicut est ordo rerum naturalium; alius autem est ordo, quem ratio considerando facit in proprio actu, puta cum ordinat conceptus suos adinvicem, et signa conceptuum, quae sunt voces significativae; tertius autem est ordo quem ratio considerando facit in operationibus voluntatis; quartus autem est ordo quem ratio considerando facit in exterioribus rebus, quarum ipsa est causa, sicut in arca et domo.” It is important that Collins’ begins by examining the relationship of reason to order as such, because both Klein and De Koninck presuppose specific modes or aspects of such a relationship in their own accounts. Thus, Collins begins from a stance which is already prior to the other two accounts. What is held in common between De Koninck and Collins will be examined below.

exterior things of which it is itself the cause).

Collins notes that there are verbal correlates of the first three orders as modes of signifying—that is, they enter into speech not as what is expressed but the manner in which it is expressed.²⁰⁷ Thus, the first (speculative) order produces the mode of indicative sentences and the third (ethical) order produces the mode of jussive sentences (“do this, don’t do that”). The logical order has no unique mood but is contained in the logical intentions of its statements (this is the order of second intentions). However, there is “no mode of verbal expression proper to the fourth order. . . . The reason is that both the logical order and the ethical order differ from the purely artificial in being consequential to the order of things apprehended.”²⁰⁸ That is, the order in logic and in ethics arise and enter into speech by being necessarily measured and determined by the speculative order, and this apprehended order is the principle of speech.

The artificial order, on the other hand, distinguishes itself by this, that it is not a necessary consequence in thought of what is merely apprehended, or of what we *discover as real* (though it does inevitably depend thereon). The artificial order has its existence from arbitrary human invention—which, by way of an important corollary, is to say that it *exists* only according to a certain analogy. The reason why there is no verbal expression of the purely artificial order is therefore this: the order of artifacts is not consequential to the order of natural being, of what is simply apprehended.²⁰⁹

The artificial order, then, while consequent to and dependent upon the order of nature speculatively apprehensible, is not necessarily determined by it, and thus gives rise to no unique modes in speech or thought.

207. Thus, the indicative mood of a sentence such as “Socrates is a man,” is a feature of the sentence’s grammar, but is not what is expressed. It is subordinate to what the sentence means, even though it is expressed in the given speech. Similarly, the subject and predicate of the sentence are part of its logical and grammatical structure, but are not themselves objects of consideration or signification. See Collins, “The Heritage of Analytic Philosophy,” 63–67.

208. *Ibid.*, 68–69.

209. *Ibid.*, 69–70.

However, the artificial order does possess its own form of expression: “Symbolic representation is what is . . . appropriate to the artificial order.”²¹⁰ Thought

exists as *constructive*, that is, capable of producing something not in the order of the simply real, but of imitation. And in this act of construction, symbols serve as *instrumental* signs. Thus, for example, the symbol “x” may be set down to distinguish certain numerical elements from others—not formally because we find them to be distinct, but because we *want* them to be.²¹¹

This means that symbols are not just instruments for signifying objects, but for making their objects exist and exist as *apprehendable*.²¹² A symbol, then, is a sign arising from the artificial order which constructs the object it signifies. The symbol is the sensible seal completing this construction of an intelligible object.²¹³ Hence symbols “signify” analogously:

To state this in another way, we may say that reason, beginning from the senses, orients itself towards the intelligible, and expresses that orientation in words. But the purpose of symbolic representation is the opposite: here reason, beginning from itself, orients itself towards something to be made. The making is not complete without a sensible, material seal placed on the act of thinking, namely the symbol. Or, to put the matter in yet another way, it is only the word which signifies through an *apprehensive concept*, a concept through which being is revealed. The symbol, most formally, *signifies* only by analogy, through what may be called a *constructive concept*, which does not formally reveal being but expresses mental construction.²¹⁴

210. Collins, “The Heritage of Analytic Philosophy,” 70.

211. Ibid.

212. Ibid., 71: “Two distinct points must therefore be observed. I have just said that the symbol is not merely a sign of an existing object, but an instrument for *making* an object exist. Correspondingly, therefore, we must also observe that the symbol is not merely the sign of the apprehended; it is an instrument for making its object *apprehendable*. These are, plainly, closely related aspects of the symbol’s character, for the apprehendability of a thing depends on its status as real. The symbol is a kind of seal placed upon an act of the mind, *through which* a thing to be made is accomplished. By serving as a seal placed on the existence of its object, the symbol also serves to make the object apprehendable—either without qualification, or in some degree or respect. In this way, symbolic representation bears a resemblance to imperatives and other kinds of ‘directive sentences,’ since these, too, are not merely signs of something but instruments of human agency. But it differs in this: ‘directives’ always signify, if not the immediately real itself, at least what is consequent upon the real. Symbolic representation, by contrast, signifies that which has existence through the very act of symbolizing.”

213. It is, therefore, not an “instrumental sign” in the sense that John of St. Thomas defined above. Rather, while both spoken words and symbols are conventional (i.e., instrumental) signs, symbols, according to Collins, are also instruments of constituting the object understood. A symbol being called an “instrumental sign” is, therefore, almost an equivocation, but there is some reason to the name, as Collins argues.

214. Collins, “The Heritage of Analytic Philosophy,” 74.

This completes the exposition of Collins' account of symbolic signification. In summary, a symbol is a constructive concept; it signifies by constituting the object signified. This implies that the symbol can be, after the fact, discussed in words (as an artifact can), as well as that, prior to the fact, it must draw on what is simply apprehended as the artificial draws upon natural materials. Collins is not claiming that scientific concepts are merely artificial constructs that do not touch what we ordinarily experience in nature. Indeed, the origin of these symbolic concepts is found in concepts that arise in the natural order of apprehension and thus, in the mind of the scientist, as in Hamlet's mirror, symbols can show nature something of her own feature and image.

From this exposition, we can see that Collins' account explains Klein's own account more accurately. Collins himself notes this in his paper:

Jacob Klein has the almost unparalleled merit of having recognized the need to look for a distinction between words and symbols in their forms of intentionality. But Klein's account fails because he does not see clearly how to distinguish the order of logic from the order of things made in exterior matter, that is, from Aquinas's fourth enumerated order. . . . Klein seems to have recognized that symbolic representation is a sort of exteriorization of an order produced by the mind. But his account would make symbolic representation only accidentally distinct from the order of (verbal) logic, and therefore it finally fails to account for how symbols have a distinctive form of intentionality.²¹⁵

That is, the symbol, most fundamentally, is not a confusion of the orders of first and second intentionality (or of the apprehended order and the logical order) but of the natural order and the artificial order. Nonetheless, the two confusions are very similar insofar as they both require that an order independent of the human mind's activity (whether in thinking or purposing) be identified with an order dependent upon that activity. Still, were a symbol

215. Collins, "The Heritage of Analytic Philosophy," 71, fn. 22.

such as Klein suggests it is, then there would be no fundamental difference between the order of verbal (Aristotelian) logic and symbolic representation.²¹⁶

Collins' account also explains why De Koninck latches onto the mark of *per accidens* unity which is in principle available to symbolic conceptualization. Here we must distinguish between a symbol which perfects the significance of a meaning which is already there to be simply apprehended (e.g., a statue as a symbol of liberty or gold currency as a symbol of value), and a symbol which entirely constitutes the thing it symbolizes.²¹⁷ De Koninck's symbols, which can in principle be used to signify what is one entirely *per accidens*, are of the latter sort. On Collin's account, a symbol as such brings together a whole which is accidental precisely because of the fact that it is the product of an artificial order, which order, of its essence, produces accidental unities. This feature of being a constructive concept, furthermore, explains why what is in principle wildly accidental can be nonetheless useful and hold the mirror up to nature. Since the symbol is an artifice, it requires natural parts for its materials. The applicability of its symbolization depends upon the adequacy its artificer reaches in his selection of appropriate natural materials.

Nonetheless, Collin's account of symbols is latent in De Koninck's work. As noted above, the symbol is a constructive concept. As an instrumental sign used by the inquiring mind, it therefore differs by way of origin from names, which arise from the order of apprehension (from mental words). De Koninck notes the artificial origin of symbols most of all when he

216. An indication that there is something more fundamental (viz., the constructive order of reason) can be found in the evidence which Klein himself ably notes. For example, Klein's exposition of John Wallis' *Mathesis Universalis* recalls how Wallis argues that the true principle of number is zero, that the unit is divisible, and that all quantitative consideration is reducible to ratios; Klein, *Origin of Algebra*, 214–19. For instance, see *ibid.*, 218–19, on the divisibility of the unit: "When arithmetic wishes to imitate in some way the infinite divisibility of geometry, it supposes a unit or a one which is something whole, as it were, but divisible into as many parts as you please." The phrases "it supposes" and "whole, as it were" and "as you please" are signs of the order of artificial construction employed for the sake of utility in calculation. In effect, what Wallis' positions require is an artificially constructed order of quantity that ignores the proper specific differences and character of discrete and continuous magnitude—this follows the spirit of Descartes' Third Rule and Bacon's functional species neutrality.

217. See Collins, "The Heritage of Analytic Philosophy," 72–73.

notes that symbols divorce questions about “what a thing is” from the problems symbols are designed to solve. The symbol allows for the mathematician or physicist to abstain from essences.²¹⁸ The symbol allows for the art of calculation to proceed unencumbered by a Socratic dialectic about the essence of “2” or “mass.” The modern symbol can treat the number as if it were a heap—indeed, the symbol is indifferent to the essential or accidental unity of numbers. The person calculating does not care who is right: Democritus or Aristotle. Unlike an Aristotelian number theorist, who must worry about the *per se* unity of his subject, the calculator can treat “2” as if it were shorthand for “1 + 1”.²¹⁹ The symbol even forestalls such thought about what one is thinking about.²²⁰ This act of ignoring the difference between the *per se* and the *per accidens* which symbols permit shows that the key element of Collin’s account, viz., that the order which the mind imposes on things can treat the accidental and essential indifferently, states distinctly what is latent in De Koninck’s thinking.

218. De Koninck, “Random Reflections on Science and Calculation,” 90: “What Mill believes of names [all definitions are of names, and of names only] applies literally to the symbols of the art of calculation, whether used in mathematics or in physics. To define a symbol, as we have explained already, is simply to interpret the symbol by explaining how it is to be taken, not by stating what the thing is to which it refers. For instance, when asked to define the number two, the art of calculation will not try to tell us what two is. What two is never enters into the operation of calculating; in that operation, two is only a term with a function similar to that which it fills in an equation like $2 + x = 5$. Whether two, here, is actually ‘one two’ or ‘two ones’ will make no difference to the art.”

219. Ibid., 93–95; De Koninck, *The Hollow Universe*, 8–13. On the essence of number as to its form, see Michael Augros, “Aristotle on the Unity of a Number,” *Philosophia Perennis: The Journal of the Society for Aristotelian Studies* 1, no. 2 (1994): 67–94.

220. De Koninck, *The Hollow Universe*, 8–7, 14–18, 41–42; De Koninck, “Random Reflections on Science and Calculation,” 87: “We are sometimes led to believe that the use of symbols is merely a way of economizing words. This is not the whole truth. It is essential to realize that the mathematical physicist, as well as the mathematician, does not use symbols instead of names merely for the sake of abbreviating his equations, but because, if expressed in names, the equations could not be solved in the proficient and mechanical way which these require.” Collins, “The Heritage of Analytic Philosophy,” 55–56: “Forestalling thought is never the purpose of a word, of what is said: what is said always lies immediately between the thought of the speaker and the anticipated thought of the listener. . . . Symbols, on the other hand, by being made of something substantial and permanent, mimic that which perdures even in the absence of thought.”

25.2 *The priority of words along the natural path*

The priority of words to symbols can now be manifested.²²¹ Words or names are prior in all of Aristotle's senses of "before" discussed in *Categories*, Chapter 12: prior in time, being, explanation, nobility, and causality.

That words are prior in time is clear both from historical accounts and from the order in which one usually encounters and understands them when they are used. Indeed, the temporal priority of words to symbols is due to words' priority in explanation. Words are the only appeal to explaining what symbols intend. Hermann Weyl notes:

The mathematical game is played in silence, without words, like a game of chess. Only the rules have to be explained and communicated in words, and of course any arguing about the possibilities of the game, for instance about its consistency, goes on in the medium of words and appeals to evidence.²²²

Why must we appeal to words? The answer lies in the priority in being of the natural order to our speculative thinking. Mental words are caused by the natures of which they are the likenesses. Thus, even though the conventional origin of words leads to different languages, the significance of vocalized words is caused by prior concepts and could not exist without them.

A fortiori, words are prior in causality to symbols, for the significance of any symbol depend upon the significance of words. Furthermore, words are also prior in being or nature, for the natural is prior in being to the artificial, and mental words are natural formal signs, while symbols are artificial instrumental signs which construct what they signify. This priority in being makes clear the nobility of words over symbols. The argument is as follows: the

221. De Koninck points this out in many places. See, for instance, De Koninck, *The Hollow Universe*, 16–18, 30–32; De Koninck, "The Unity and Diversity of Natural Science," 23; De Koninck, "Is the Word 'Life' Meaningful?," 79, 86–87.

222. Hermann Weyl, "The Mathematical Way of Thinking," in *The World of Mathematics*, ed. James R. Newman, vol. 3 (New York: Simon & Schuster, 1956), 1848. See also De Koninck, *The Hollow Universe*, 30–32, referring to this passage.

highest natural end of man is nobler than any artificial purpose devisable by human agency.²²³ This follows from the arguments provided by Aristotle and St. Thomas that intellectual activity (which cannot be artficed) is the highest activity of man.²²⁴ However, the adequacy of this activity to its objects requires words, for words are the natural signs that signify the being they apprehend. A symbol, by contrast, must construct its object, and a speculative order is opposed to a constructed order.

However, in a qualified manner, symbols are more noble than words.²²⁵ That is, words require (in being and causality) a prior order of complete existence. However, symbols are not so dependent: by constructing their object (out of what materials soever, in whatever stage of completeness), they can reach further into things which (in themselves) are barely intelligible due to matter. They therefore excel words in the order of explaining what has little intelligibility in itself. As artifices, symbolic thinking separates us from the natural order to some degree.²²⁶ Yet, if used properly, our art can perfect nature by drawing objects less intelligible in themselves into a domain that has more intelligibility to us. Hence, while qualifiedly more noble than words, they are posterior to words simply speaking.

223. Following the distinction between “end” and “purpose” set out by Robert Sokolowski, “What is Natural Law? Human Purposes and Natural Ends,” *The Thomist* 68, no. 4 (2004): 507–529. Sokolowski follows Francis Slade, “Ends and Purposes,” in *Final Causality in Nature and Human Affairs*, ed. Richard F. Hassing, vol. 30, Studies in Philosophy and the History of Philosophy (Washington, D.C.: The Catholic University of America Press, 1997), 83–85.

224. Yet as noted above in §22.5, when the primacy of the speculative order is denied, then the mode of symbolic signification, born of the technical order, is “nobler,” for meaning as such becomes a construct.

225. Collins, “The Heritage of Analytic Philosophy,” 76–78: “In the early days of quantum mechanics, Heisenberg was deeply struck and puzzled by the fact that it proved impossible to describe, in words, the realities of the quantum world. Why was it necessary to approach the goal through the contrivance of symbols? And why, having done so, could one not say what the symbols were representations of? . . . Heisenberg recognized that in the end, an investigation into the material basis of physical existence would have to dispense with terms and concepts which presuppose that existence already completed. The realm of atomic physics was found to be a realm where the mind could not simply take in what was there, because ‘what was there’ was on a level still too material and unformed to be directly grasped. Yet the mediation of symbolic representation, by which the mind ‘goes out of itself’ rather than merely ‘taking in,’ proves to afford a kind of intelligibility.”

226. De Koninck, “Random Reflections on Science and Calculation,” 98–99: “To sum up, once a writer resorts to what was called symbolic construction or creative definition, he should realize that he may no longer use names; or should bear in mind that they are linguistic devices sure to cause confusion in the measure that they continue to evoke what can no longer be intended.”

De Koninck, thinking of Heisenberg's comment in *Physics and Philosophy* that our ordinary words come in contact with reality, notes how this indicates the priority of a mode of knowing nature based upon words (natural philosophy) that is prior to modern science:

[Heisenberg] has described for us the full meaning of natural philosophy. Having started with the concepts of natural language, as we move on into the realm of symbolic construction controlled by the test of experience, we must be constantly ready to sweep into reverse, as it were, lest contact with reality be lost. In doing so we will use ordinary language, whose concepts appear more stable than the precise terms of "scientific" knowledge. If we keep the total aim of natural science in view, symbolic terms are inadequate: to isolate them from the concepts of natural language is to divorce them from nature and therefore from natural science.²²⁷

The distinction between Aristotelian natural philosophy and modern physics could be phrased in terms of a distinction between a "qualitative" and a "quantitative" physics.²²⁸ De Koninck also notes this mode of distinguishing the two; Aristotelian physics' reliance upon sensible qualities as opposed to modern physics' use of quantities (primary "qualities") seems to divide them cleanly.²²⁹ However, it seems that the distinction is better characterized based upon the above quote, following Heisenberg's observations of the stability of meanings of words (better known to us at first), a natural language which "[touches] reality."²³⁰ The better contrast is between words and symbols; between two modes of conceptualization.

De Koninck notes this elsewhere:

227. De Koninck, "The Unity and Diversity of Natural Science," 23.

228. Connell, *From Observables to Unobservables in Science and Philosophy*, 146: "The modern quantitative and descriptive approach to terrestrial motion is very different from the qualitative approach of Aristotle." Connell cites Holton and Roller's *Foundations of Modern Physical Science* (Reading, Mass.: Addison-Wesley Pub. Co., Inc., 1958) 22, as a representative view. Jammer, *Concepts of Space*, 217, briefly mentions what seems to be the better distinction, viz., between "Galileo's . . . geometrico-mathematical language" against "the Aristotelian logico-verbal method of investigation." While it was the burden of this section to show why calling the new Galilean method a "language" is an equivocation, the description of the Aristotelian method is apt.

229. De Koninck, "The Unity and Diversity of Natural Science," 8: "Allow me to call your attention to the fact that, in *On Generation and Corruption*, Aristotle pays chief attention to sensible qualities, such as hot and cold, wet and dry. For this reason, there are many who point out that his view of nature was essentially a qualitative one, whereas the modern one tends to be entirely quantitative."

230. Heisenberg, *Physics and Philosophy*, 202; the context, 201–202: "Any understanding must be based finally upon the natural language because it is only there that we can be certain to touch reality, and hence we must be skeptical about any skepticism with regard to this natural language and its essential concepts."

The first thing to be noted is that in our work all the doctrine will be expressed by means of words, and not by means of symbols. Now, it has lately become obvious that the giant strides in the mathematical study of nature are concomitant with a gradual emancipation from the use of words. Until he is allowed to use symbols that are not names, the mathematical physicist is not sure what he is saying. But notice how this very statement about the use of symbols rather than words uses nothing but words, and it is difficult to see how such statements could be made in any other way. One might of course suggest that our statement be represented by the symbol S; but the interpretation of the symbol would of necessity carry us back to the statement made in words.²³¹

This explains why it is better to contrast the old and the new physics under the rubric of words vs. symbols. This is because the common sensible of quantity can be incorporated into mathematical physics only through a symbolic mode of conceptualization (see §24.3). The new physics is quantitative in the sense intended only because it is symbolic, not symbolic because quantitative.

The use of the term “modeling” to describe what a modern physicist does to reality also parallels this distinction.²³² (Here one should recall the standard model of modern physico-mathematical cosmology, outlined in Chapter 5, as an example.) Such “models,” insofar as they are always incomplete, are attempted reconstructions—symbolic reconstructions—of the universe in the most universal and concrete form the advances of modern physics can conceive. The reconstruction, however, is always incomplete; it exists in a state of dialectic: “Seen in this respect, the limit toward which experimental science tends is the condition

231. De Koninck, “Random Reflections on Science and Calculation,” 85; the closing sentence of the previous section indicates how relevant De Koninck judges the distinction to be, *ibid.*, 84–85: “Something has simply got to be done to show how the old science is related to the new.”

232. See Collins, “The Heritage of Analytic Philosophy,” 87: “The most salient and destructive effect of the confusion of words and symbols is a mischaracterization of thought itself. (To be entirely thorough we should have to acknowledge that even this is not strictly true. The mischaracterization of thinking itself eventually leads to the mischaracterization of being itself. . . .) If all thought is symbolic, then it is natural to conclude that thinking is nothing but this. This is indeed now a common assumption, as one sees for example from the frequent reference to thinking as a matter of making ‘models.’” Talk of “idealized models” in physics textbooks seems attempts to capture, it seems, the philosophical distinctions elaborated here; Hugh D. Young, Roger A. Freedman, and A. Lewis Ford, *University Physics With Modern Physics*, 11th Edition (San Francisco: Benjamin-Cummings Publishing Co., 2004), 4–5.

of the demiurge.”²³³ This notion of how human reason attempts, starting out from its first known conception of being, to end up producing a representation adequate to understanding the universe, requires some discussion of limits and the dialectic of reason as De Koninck characterizes them.

25.3 *Limit concepts and the dialectic of reason*

De Koninck’s characterization of the progress of reason towards an adequate understanding of nature he characterizes as a type of limit process. While enunciated in only a few of his writings, the idea completes his account of the reconciliation of natural philosophy and modern physics.²³⁴ It will be adumbrated in its essentials here.

In general terms, the limit is a type of terminus: “the first outside which one finds none of the thing and the first within which one can find all.”²³⁵ A limit is that to which a series of quantities becomes “ultimately equal,” taking as many instances of the series as one pleases; the difference between the last member of the series and the limit can always be made lesser.²³⁶

233. De Koninck, *Writings, Vol. 2*, 144. For the full context, see above, end of §22.5.

234. See Charles De Koninck, “La dialectique des limites comme critique de la raison,” *Laval théologique et philosophique* 1, no. 1 (1945): 177–185; “Notes sur le marxisme,” *Laval théologique et philosophique* 1, no. 1 (1945): 192–199; “Concept, Process and Reality,” *Laval théologique et philosophique* 2, no. 2 (1946): 141–146. These are all published in *Writings, Vol. 2*.

235. Aristotle, *Metaphysics*, V.17, 1022a4–5; as translated in John Francis Nieto, “What Is a Limit?,” *The Aquinas Review* 13 (2006): 81–92.

236. Newton, *Principia*, 433: “Quantities, and also ratios of quantities, which in any finite time constantly tend to equality, and which before the end of that time approach so close to one another that their difference is less than any given quantity, become ultimately equal.” While the notion of a limit originates in the geometric understanding of motion, its formal definition is algebraic, thus abstracting from continuous or discrete quantity; Carl B Boyer, *The History of the Calculus and Its Conceptual Development* (New York: Dover, 1959), 272: “In giving his definition, in his *Cours d’analyse*, Cauchy divorced the idea from all reference to geometrical figures or magnitudes, saying: ‘When successive values attributed to a variable approach indefinitely a fixed value so as to end by differing from it by as little as one wishes, this last is called the limit of all the others.’” See *ibid.*, 7–8, and 287.

Take, for instance, the series of polygons inscribed in a circle: a 3-sided, 4-sided, 5-sided, 6-sided, . . . , etc. The circle is the limit of these successive inscriptions. In these successive comparisons, the imagination sees a type of unity (a “motion” by “steps” or “moves,” as it were) proceeding towards a terminus; the mind is able to supply the necessary distinction of the steps (by the opposition of their number of sides), as well as the distinction between the genus of those steps (they are all rectilinear figures) and the terminus (a curved figure, the circle). Likewise, the summation of the series 1, 1/2, 1/4, . . . , etc. (i.e., $\sum_{n=1}^{\infty} \frac{1}{2^n}$), tends

The concept of a limit allows us to understand the method which permits the human mind to overcome a conceptual “one and many” problem. A limit concept is the human attempt to achieve a concept that is universal *in repraesentando*.²³⁷ This type of concept is not our natural mode of thinking.²³⁸ Our concepts, universal *in praedicando*, must have recourse to more generic concepts in order to grasp distinct natures through one concept. Yet this necessarily causes our grasp to prescind from their specific differences (triangle and square are conceived indistinctly under the notion “figure”). This is not the case with separate substances; God knows everything through one Thought, knowledge of Himself. The other separate substances know the distinctions of things through concepts universal *in virtute* or *in repraesentando*. The more perfect separate substances know more distinct intelligibilities

towards 2 as a limit. However, the value of the variable (representative of the series of polygons or the sum of a finite set of the defined values) and the value of the limit are the same “in tendency” or “at infinity” only. Which is to say that their “sameness” is always in the state of being realized, but never completed. Indeed, their very notions prevent it. Their identification “in the limit” would destroy their distinction in species; a contradiction would result. See, in general, Juvenal Lalor, “Notes on the Limit of a Variable,” *Laval théologique et philosophique* 1, no. 1 (1945): 129–149. Lalor wrote a dissertation under De Koninck: “The Notion of Limit.” Given the contradiction which would obtain in the limit as the terminus of a type of conceptual process, one can understand why De Koninck’s thoughts on limits are often found in the context of critiques of Marxist dialectical materialism. See especially “Notes on Marxism,” in *Writings*, Vol. 2, 381–89. 237. De Koninck mentions this in De Koninck, “Introduction a l’etude de l’âme,” 32, and fn. See also McArthur, “Universal in Predicando, Universal in Causando,” 67–69.

238. De Koninck, “The Dialectic of Limits as Critique of Reason,” in *Writings*, Vol. 2, 367, remarking that “Our means of knowing are at the lowest degree of intensive universality,” points us to this text of St. Thomas, St. Thomas, *ScG*, II.98: “Summum autem huius universalitatis est in Deo, qui per unum, scilicet per essentiam suam, omnia cognoscit: infimum autem in intellectu humano, qui ad unumquodque intelligibile indiget specie intelligibili propria et ei coaequata. Non est igitur per formas universaliores apud substantias superiores imperfectior cognitio, sicut apud nos. Per similitudinem enim animalis, per quam cognoscimus aliquid in genere tantum, imperfectiorem cognitionem habemus quam per similitudinem hominis, per quam cognoscimus speciem completam: cognoscere enim aliquid secundum genus tantum, est cognoscere imperfecte et quasi in potentia, cognoscere autem in specie est cognoscere perfecte et in actu. Intellectus autem noster, quia infimum gradum tenet in substantiis intellectualibus, adeo particulatas similitudines requirit quod unicuique cognoscibili proprio oportet respondere propriam similitudinem in ipso: unde per similitudinem animalis non cognoscit rationale, et per consequens nec hominem, nisi secundum quid. Similitudo autem intelligibilis quae est in substantia separata, est universalioris virtutis, ad plura repraesentanda sufficiens. Et ideo non facit imperfectiorem cognitionem, sed perfectiorem: est enim universalis virtute, ad modum formae agentis in causa universali, quae quanto fuerit universalior, tanto ad plura se extendit et efficacius producit. Per similitudinem igitur unam cognoscit et animal et differentias animalis: aut etiam universaliori modo et contractiori, secundum ordinem substantiarum praedictarum.” (Leon.13.581) See also *ibid.*, I.50–54; *In II Sent.*, d. 3, a. 3, a. 2; *De Veritate*, q. 8, a. 10; *ST*, Ia, q. 14, a. 6; q. 55, a. 3; *De Causis*, lect. 10.

through fewer concepts.²³⁹ These more intensively universal concepts even suffice to know singulars, whereas our universal concepts cannot present to us the singular individuals of which they are the universals, for our minds know by abstracting from matter.

Nonetheless, our minds attempt to overcome this natural limitation.²⁴⁰ The mind attempts to represent the distinctness found in many natures through one concept. The circle is thus a limit-concept of a series of polygons.²⁴¹ De Koninck proposes that something similar occurs in concepts of the physical order.²⁴² This “effort of the intelligence toward unification is, at bottom, only an attempt to reduce the multiplicity, not of the natures conceived, but of the means of knowing them.”²⁴³ The human mind imitates a divine mode of knowing in this attempt.²⁴⁴ By overcoming our intellect’s natural mode of conception, we turn from universals *in praedicando* to universals *in repraesentando* to the degree which this is possible.

This attempt to represent through a single concept all the particular natures in distinction is an attempt to overcome the natural way of proceeding, viz., along the natural path in our knowledge.²⁴⁵ The intellect, finding difficulty in the path that is natural to it because of the multiplicity of concepts and extent of experience required to satisfy its natural desire to know, sees a manner of short-cut in limit concepts. This “dispersion of our means of knowing” due to the empirical nature of the human mind could be overcome by reaching a

239. McArthur, “Universal in Predicando, Universal in Causando,” 69.

240. De Koninck, “The Dialectic of Limits as Critique of Reason,” in *Writings, Vol. 2*, 369: “It is an incontestable fact that our intellect tends naturally to see one nature as the limit of another. This comes about most easily in mathematics. We are not content to see the elements—point, line, surface, volume—in their absolute and irreducible natures. We think we grasp them better when, besides, we can define them as limits; when, knowing quite well that we can never attain it without contradiction, we proceed nonetheless resolutely *as if* we wished to generate these elements one from the other in their proper and abstract nature.”

241. Analogously, Pascal’s projective geometry also uses limit concepts insofar as it conceives of the three classical conic sections (ellipse, parabola, and hyperbola) as “mapping onto” the circular base of a cone in various ways. See Nieto, “What Is a Limit?,” 86–87.

242. De Koninck, “The Dialectic of Limits as Critique of Reason,” in *Writings, Vol. 2*, 370: “This mathematical model can, to a degree, be extended to physical natures where we can conceive or artificially interpolate a comparable order, under some aspect, to that of infinite converging series.” Clear examples are not forthcoming in these articles. I will attempt to provide some below.

243. *Ibid.*

244. *Ibid.*, 370–71; Nieto, “What Is a Limit?,” 90–91.

245. De Koninck, “Concept, Process, and Reality,” in *Writings, Vol. 2*, 408.

point of noetic unity, an “intelligible species which represents distinct objects in their very distinction,” a concept of “universal power.”²⁴⁶ Yet we can only attain this point of noetic unity imperfectly, as De Koninck explains:

Why should we attempt any reduction of formally distinct natures at all? Why not rest in their essential and radical distinction?

Whatever is first and more easily known may be called “more rational to us,” whereas that which is known only by further application may be termed “less rational to us.” Yet, what is relatively irrational to us may be more rational in itself, such as that proper and formal distinction of things which requires the formation, through experience, construction or inference, of new and distinct concepts to be used in time-producing succession. Hence, the formal distinction of natures, requiring as it does restricted and separate means of knowing, takes on the appearance of an irrational gap between natures. Thus the irreducible givenness of objects, the distinction between straight and curve, polygon and circle, one and two, continuum and discrete, is conceived as a break, as an obstruction, to full understanding. And so it is, if by full understanding we mean a simultaneous, undivided and yet more penetrating view of such natures. However, this irrationality may be tentatively cleared by the insertion of a convergent series, for, whenever we can define a notion as the limit of a variable containing it in inchoation, as it were, we somehow overcome the givenness of that notion.²⁴⁷

That is, when trying to overcome the givenness of natural kinds and their consequent properties and activities (which order of being is more rational in itself but less so to us at first), the mind tries to take short-cuts. The “irrational gap between natures” is closed by the mind’s own insertions of what would show a type of unity between different species of things. De Koninck thinks of these insertions as limit concepts. When contemplating the use of such limit concepts, the human mind stands at a precarious point. To mistake the limits that overcome the rational distinction of natures for what is the more intelligible in itself is to mistake the human intellect’s means of knowing for the object which it knows: the very opposition between given natures is the reason why the intellect made progress from what was

246. De Koninck, *Writings*, Vol. 2, 408, 409. See Cassirer, *Substance And Function & Einstein’s Theory Of Relativity*, 19–20. De Koninck’s appropriation of Plato, Aristotle, Pseudo-Dionysius, St. Thomas, Nicholas of Cusa, Hegel, Bergson, Cassirer, Meyerson, and Weyl in this one article would require more exposition and assessment. It seems necessary to note, however, the eclectic scope of De Koninck’s approach.

247. De Koninck, “Concept, Process, and Reality,” in *Writings*, Vol. 2, 409.

more rational at first to what is less rational (but more rational in itself). The replacement of progress regarding the means with progress regarding the objects to be known is similarly dangerous, from a speculative vantage point. Such limit concepts can be made use of without *denying* the rational distinction of natures (as the known is in the knower according to the mode of the knower).²⁴⁸

How, then, does De Koninck's comparison help us to understand more fully his conception of the relationship between natural philosophy and the sciences? It should be recalled that this progress towards a limit in our knowledge played an important role in the provisory status of scientific theories (especially those which attempt to investigate the *partes speciei et formae* of the cosmos). The use of such a limiting process in theories as hypothetical reconstructions of the world animated the "revolution of the philosophers of nature" (§22.5, p. 379).

De Koninck relies on an analogy and relation between two kinds of limit: the "mathematical limit" and the "limit of noetic unity" towards which our concepts and theories of the natural order are tending. This is not unreasonable with regard to natural philosophy as a whole, since in its more determinate or concrete application it must turn towards mathematical physics and utilize the former kind of limits as constitutive parts of its progress towards the latter.²⁴⁹ Indeed, certain theories in mathematical physics relate to a successor theory as a mathematical limit (analogous to the case when successor theories capture what predecessor theories could only explain as coincidences).²⁵⁰ The modern mixed sciences of

248. De Koninck, *Writings*, Vol. 2, 411.

249. See above, end of §22.5. The relevant passage from De Koninck is: "Let us take note that the role of hypotheses increases to the degree that we approach things in their concretion. In the hypothesis, there is not only the aspect which calls for experimental confirmation, there is also the more profound tendency to get ahead of experience and to deduce it by way of a conclusion. Given the method we must employ on the road to that ultimate concretion, it would suffice to isolate this tendency in order that, at the limit, there would arise a world entirely of our own making. Seen in this respect, the limit toward which experimental science tends is the condition of the demiurge." *The Principle of the New Order*, in De Koninck, *Writings*, Vol. 1, 144.

250. Instances of the latter: despite the equipollence of appearances between the Ptolemaic and Copernican hypotheses, the latter could explain the coincidental equality, in the former hypothesis, of the number of

mathematical physics accomplishes its understanding of this tendency through the symbolic mode of conceptualization: “The tendency toward a limit can be no more than the symbolic expression of the identity found in that perfect concept which we have termed a universal in power.”²⁵¹

Since its universals are incomplete, being founded upon measurements that are incomplete inductions, modern science’s symbolic reconstructions (applicable but not adequate to the world) are always provisory: “These intermediary constructions have for their limit *nature*, the divine *logoi*, seminal reasons.”²⁵² This process of theory towards the reality of natures in their concretion is what was termed the “history” of an inquiry. “The physicist reaches toward knowing the whole universe,” in the order of intention and composition; just as “*artifex intendit totam domum perficere*.”²⁵³ This provisory and incomplete character, whose laws cut

solar revolutions about the earth (79) and, in the same time, the sum of Mars’ revolutions on its epicycle (37, or cycles of anomaly) and its epicycle’s revolution on its eccentric circle about the earth (42, or cycles of longitude); see Copernicus, *On the Revolution of the Heavenly Spheres*, in Ptolemy, Copernicus, and Kepler, *Ptolemy, Copernicus, Kepler*, 524–29. Relativity theory unites as a feature what Newtonian mechanics took as distinct, while coincidentally equal, viz., inertial and gravitational mass.

Instances of the former: Newtonian physics is the limit case of a system with no absolute signal speed *in vacuo*. Einstein, *Relativity*, 85–86, 86–87, also mentions two cases. Respectively: electrostatics is contained in electrodynamics as a limit case, and special relativity is contained in general relativity as a limit case. See *ibid.*, 86: “No fairer destiny could be allotted to any physical theory, than that it should of itself point out the way to the introduction of a more comprehensive theory, in which it lives on as a limiting case.” See also De Koninck, “Introduction a l’etude de l’âme,” 54, quoting Einstein: “He may also believe in the existence of the ideal limit of knowledge and that it is approached by the human mind. He may call this ideal limit the objective truth,” and Franco Rasetti: “We have often seen that the desire to synthesize the results of one branch of the physical sciences into a more simple theory led to the discovery of new phenomena.” In explaining why this is so, De Koninck maintains: “The answer is unanimous: the measures on which every scientific construction is established are always only approximations. On this subject, we must consider first of all the impossibility of an infinitely precise measure in the domain of the continuous. It would be necessary, in fact, that the standard of measurement had a length equal to zero. In reality, this standard, as small as it may be, is simple only by hypothesis—‘*accipitur ut simplex per suppositionem*.’ But so soon as it is a question of seeking universal and fundamental principles of this order, every imprecision is of consequence. In the second place, it is necessary to define physical properties by the description of their process of measurement, which, in order to be adequate, has to include and express all the circumstances of the mensuration. But, that is impossible; for that, it would be necessary already to know precisely the principles which govern the totality of the physical world: there would have to be a separated intelligence that would have no need of experience in order to know the world—‘a god contemplating the external world,’ as Eddington put it.”

251. De Koninck, *Writings*, Vol. 2, 411.

252. De Koninck, *Writings*, Vol. 1, 145.

253. De Koninck, “Introduction a l’etude de l’âme,” 59. See above, p. 391.

across natural kinds, can only regard a part of the universe: “Every particular physical law, by the very fact that it is physical, regards the parts of the universe as such; its sufficiency in a closed field can only be apparent.”²⁵⁴ Indeed, the laws of mathematical physics must always remain incomplete because they cannot capture the living as one of the cosmos’ *partes speciei et formae*.²⁵⁵

Does this mean De Koninck is an anti-realist about mathematical physics and the laws it discovers? De Koninck’s answer would be a qualification.²⁵⁶ That is, his account is realistic about the limits placed upon these discoveries by the methods and mode of symbolic construction used to obtain them. Indeed, because of its dialectical mode, mathematical physics is cut off even from *quia* demonstrations, since the partial applicability of mathematical physics as a neo-mixed science does not have the requisite completeness of universality which initiates a *quia* demonstration.

CONCLUSIONS AND OBSERVATIONS FROM CHAPTER 6

Using the notion of the limit concept, then, De Koninck completes his account of the natural path, the mode most conformal to the life of the empirical human mind. This path begins with what is better known to us at first, and proceeds through an analysis of mobile being—carried out in words—to certain first principles, vaguely grasped, about the genus of

254. De Koninck, “Introduction a l’etude de l’âme,” 59.

255. Ibid., 57, 58–59. See *ibid.*, 62: “In brief, these two branches of natural science, physics and biology, converge toward a common limit which they can approach indefinitely without, however, ever attaining it.” This was discussed above, §11.1. This explanatory gap between cosmology (the science of the locally mobile) and biology (the science of the living) existed even in Aristotelian natural philosophy with biology considered as a species under general natural philosophy.

256. See, for instance, *Ibid.*, 59–60: “Is that to say that everything experience teaches us in physics is uncertain? Not at all. One does not doubt observed regularities nor that they are natural. But it does not suffice to be certain that nature is cause of a phenomenon in order to have a scientific knowledge of it. Moreover, laws, such as physics expresses them, that is, under the form of algebraic relations between number-measures, are themselves provisory. It is certain that if we knew the nature which is the reason for the regularity that we express provisorily in such a form, this expression would have to be considerably modified. This nature being nothing other than that of the formal parts of the universe, we would not be able to account for regularities—but it is this that one attempts to do in hypotheses—unless we truly knew these parts. That is why we cannot even have a science *quia* in this domain. In fact, that would suppose at least the sufficiency of a closed system. But there is no closed system for the parts of the universe.”

mobile being. Further concretion seems to require methods that lead aside from the natural path and common experience to confined domains of experience. When properly used, the new mode of mathematical physics, or the symbolic mode of conceptualization more generally, allow for art to perfect our natural mode of knowing, at least in a qualified way. That is, while still belonging to natural philosophy as a subject of investigation, such branches out from the natural path are dialectical extensions of an Aristotelian scientific endeavor.

CHAPTER 7

The Sapiential Office of First Physics

INTRODUCTORY NOTE TO CHAPTER 7

Men who love wisdom must inquire into very many things. Wisdom is one thing. It is to understand the mind by which all things are steered through all things.

HERACLITUS, DK 35, 41

The purpose of this chapter is to bring together the elements of De Koninck's development of the traditions of Thomistic and Aristotelian natural philosophy. The general character of sapiential knowledge is defined in §26. Both that and why general natural philosophy is sapiential are defended in §27. Its architectonic role exists because it, as a speculative habit receiving the human mind's determinations from its first philosophical encounters with mobile being, ramifies throughout the remaining paths within the sub-domains of physics. That is, since general physics yields perennial results regarding the principles of mobile being, it possesses a sapiential view over the particular domains and methods within natural philosophy. This "first physics" possesses several sapiential functions, discussed in §28.

§26 AN ARCHITECTONIC OR SAPIENTIAL TYPE OF KNOWLEDGE IS DEFINED WITH REFERENCE TO WHAT WISDOM IS SIMPLY SPEAKING.

Indeed, those arts which rule over others are called architectonic, as being ruling arts: whence their practitioners, who are called master artisans, claim for themselves the name “wise.”

ST. THOMAS AQUINAS,
Summa contra Gentiles, I.1

In this section, I propose and defend a definition of what constitutes a sapiential or architectonic type of knowledge. The argument imitates Aristotle’s, in *Metaphysics* I.1, that the study of first principles is wisdom. It uses as its middle term the various traits which are generally accepted to be true about the wise man and wisdom. I first set out the marks of the wise man and of wisdom (§26.1), and from them propose a definition of qualified sapiential knowledge (§26.2).

26.1 *The marks of a wise man and of wisdom*

It belongs to the wise man to order; this is his office or duty, his proper work. De Koninck notes that every *scientia* involves order.¹ Since reasoning is a discourse, and scientific reasoning is a discourse from necessary, causal premises to a conclusion, there is always order in this kind of thinking. What distinguishes wisdom is that it oversees and provides order.² A sapiential knowledge is not merely orderly but ordering. If order implies distinction and a priority from first to last, then a sapiential knowledge is that which provides order using first principles. Knowledge of the cause, and especially first causes and principles, is thought by all men to belong to wisdom.³

1. De Koninck, *Ego Sapientia: The Wisdom That Is Mary*, in *Writings*, Vol. 2, 5–6.

2. *Ibid.*, 6.

3. Aristotle, *Metaphysics*, I.1, 981b25–982a2.

The architectonic type of knowledge

The operative image which illustrates this is that of a master builder: (ὁ ἀρχιτέκτων, *architectus*). This analogy from the realm of practical knowledge requires some adjustment to fit the realm of speculative knowledge.

Yet we think that knowledge and understanding belong to art rather than to experience, and we suppose artists to be wiser than men of experience (which implies that wisdom depends in all cases rather on knowledge); and this because the former know the cause, but the latter do not. For men of experience know that the thing is so but do not know why, while the others know the ‘why’ and the cause. Hence we think that the master-workers in each craft are more honourable and know in a truer sense and are wiser than the manual workers, because they know the causes of the things that are done (we think the manual workers are like certain lifeless things which act indeed, but act without knowing what they do, as fire burns,—but while the lifeless things perform each of their functions by a natural tendency, the labourers perform them through habit); thus we view them as being wiser not in virtue of being able to act, but of having the theory for themselves and knowing the causes.⁴

Now, within the domain of art, St. Thomas notes a three-stage hierarchy. There is an art that prepares the matter, an art that orders the disposed matter and constructs the artificial thing, and the art that uses the product. Thus, the carpenter (*carpentarius*) who prepares the wood, the shipwright (*navisfactor*) who constructs the ship, and the one piloting the ship (*gubernator*) all fall into a hierarchy of arts based upon a governing end. That art for

4. Aristotle, *Metaphysics*, I.1, 981a24–b9. See also St. Thomas, *In Meta.*, lib. I, lect. 1, nn. 24–28. The image finds a parallel in *Physics*, II.2, where Aristotle is arguing that it belongs to the natural philosopher to concern himself with both the form and the matter of natural things, since the matter is for the sake of form; Aristotle, *Physics*, II.2, 194a33–b8. St. Thomas borrows this very structure and notion of an “architectonic” in his *Summa contra Gentiles*, I.1 and expands the list of examples that involve types of knowledge subordinated to each other as ends. This very schema of knowledge, where the ends of the master arts are to be preferred, is most clearly discussed by Aristotle in the prefatory chapters of the *Nicomachean Ethics*, where politics “*it would seem*” is the “most authoritative art and that which is most truly the master art.” See Aristotle, *Nicomachean Ethics*, I.2, 1094a26–27, see also *ibid.*, I.1, 1094a14–15. Monte Ransome Johnson, “Aristotle’s Architectonic Sciences,” in *Theory and Practice in Aristotle’s Natural Science*, ed. David Ebrey (Cambridge/New York: Cambridge University Press, 2015), 170–75, is a recent defense of the classical resolution of this tension between these texts in *Metaphysics* and the *Ethics* as to which science is the “master science,” metaphysics or politics, although he claims, 171, that by calling the “most architectonic” sciences only “philosophy” in the *Protrepticus*, he again “blurs the distinction between the theoretical and practical sciences.”

the sake of which the other arts act or work is the higher art.⁵ This division parallels the composition of substances: matter is for the sake of form, and thus form is nobler. The form of a thing, however, exists for the sake of the end of that thing, which is expressed in its activity or operation: birds have wings so they can fly.⁶ Since a thing is good simply speaking through its perfect operation (not through merely existing), the schematic division of the three grades of art seems exhaustive.

The image borrowed from art is instructive insofar as it manifests a certain order of purview among artisans responsible for knowing both the form and the matter. Considered as possessing a certain habit or skill, the pilot or sailor clearly knows what is formal about the ship so as to use it; yet he must also know enough about the matter of his vessel to direct the shipwright (e.g., in building a ship or repairing it). However, he, *qua* pilot, does not possess knowledge of the specifics of what material is best. That a ship should be some type of buoyant material, e.g., wood, might be the pilot's expectation or demand.⁷ Yet his expectation that only wood could be used might be "overturned" or surpassed compared to his vague expectations. A metal ship is a possibility. However, he would not have erred in expecting the material to be buoyant. Thus, a craft knows its proximate matter, but not the more remote matter. The clinical physician knows about the chemical constituents of cells or organic systems and drugs only to a sufficient degree.⁸

5. This is similar to the reasoning in the *Ethics*, I.1–2. See also St. Thomas, *Sent Ethic.*, lib. I, lect. 2 (Leon.47.8:71–73): "Et huius ratio est, quia semper ratio eorum quae sunt ad finem, sumenda est ab ipso fine, ut etiam in II *Physicorum* probatur." See also Johnson, "Aristotle's Architectonic Sciences," 172–75.

6. See St. Thomas, *In Meta.*, lib. 1, lect. 1, n. 27: "Ex forma artificii sumitur causa operationum, quae sunt circa dispositionem materiae. Et ex usu sumitur causa operationum, quae sunt circa formam artificiati."

7. See Philoponus, *On Aristotle's Physics 2*, 42–45, 50–51; see in particular 44–45: "There is every need then for each craftsman to know the most proximate matter. . . . The same thing happens with the other arts. For as the art of steersmanship knows the form of rudder, in that way it knows the matter too. For it knows *tout court* that this [rudder] must be made of woods, but of which woods it belongs to the shipwright to know, since it is his job to cause the form to appear; and so as one who causes the form to appear he knows what kind of matter will receive it." See also Themistius, *On Aristotle Physics 1-3*, 59.

8. See Philoponus, *On Aristotle's Physics 2*, 45: "Every craftsman then knows the matter proximate to himself but not out of necessity that which is more remote. For this reason the smith knows the nature of iron and bronze, and what sort of bronze has been made from what sort of form, but he does not also know how it is mined, which is a more remote matter, but this belongs to the art which works on metal. . . ."

In transferring this image from the order of practical knowledge (about *technê*) to the order of speculative knowledge, this distance from one's inquiry into proximate matter corresponds to the order of determination. To complete the transfer, the comparison which St. Thomas makes between the speculative order and the practical order should be recalled (§11.1). In the orders of intention and composition, the more determinate sciences are tasked with knowledge of the proximate matter of natural substances—e.g., knowing the cosmos or a human being as to their *partes speciei et formae*. Now, analogous to the order of art, the order of determination allows knowledge of the whole to exist at first in a vague way; the account of the specific parts remains unknown. Only later is a determinate account provided of the specific parts. In the order of craft, which corresponds to the order of determination, “*artifex primo apprehendit formam domus absolute, et postea inducit eam in materiam.*” In De Koninck's interpretation of this passage, the study of the cosmos enters after this study of “the house (i.e., cosmos) absolutely,” or in generality. The cosmologist seeks an applied knowledge of the cosmos; *were his knowledge practical*, he would seek the operable principles required to produce a cosmos.⁹

The six marks of a sapiential type of knowledge

Besides this image of the architectonic art, Aristotle clarifies the notion of wisdom by arguing that the science which considers the first and universal principles and causes will most of all deserve the name “wisdom.”¹⁰ Using these “notions we have about the wise man,”¹¹ a nominal definition not only of wisdom simply speaking but also of wisdom qualifiedly speaking can be proposed. These notions are six.

Because of this Aristotle himself too, in saying that ‘it belongs to the same branch of knowledge to know both the form and the matter,’ added ‘up to a point,’ for the doctor knows that bodies consist of the four elements and that these are their matter, but he will not qua doctor know that these are not the prime matter but there is prior to them a different matter of bodies, which is formless.”

9. See, *Principle of the New Order*, in De Koninck, *Writings*, Vol. 2, 145, and also De Koninck, “Introduction à l'étude de l'âme,” 60–61.

10. Aristotle, *Metaphysics*, I.2, 982a3–b10.

11. Ibid., 982a5.

(1) *The wise man knows all things.*¹² This mark of wisdom comes with the qualification that the wise man knows all insofar as this is possible and without knowing the *details* of each individual thing. The science whose formal object possesses a universal scope will know all things, for this universal object will contain all things in some way. Traditionally, this science is metaphysics.

(2) *The wise man knows difficult things.*¹³ The mark of knowing difficult things sets the wise man apart from what is easily obtained through common means. Sensation is common to everyone and thus is not *as such* a distinguishing type of knowledge: the ability to tell the difference between water and wine does not make one a sommelier. The difficult type of knowledge which Aristotle and St. Thomas have in mind is knowledge of God, the analogous structure of being, and the various transcendental features of being with which the metaphysician concerns himself. These are the more difficult things to know precisely because they are intelligible, first causes.

(3) *The wise man also possesses knowledge that is more certain* (certior, τὸν ἀκριβέστερον).¹⁴ That science is more “certain” or “precise” that can explain what is the case through causes, or which is more abstract from matter (as geometry from optics), or which depends upon fewer elements or suppositions (as arithmetic compared to geometry). If all of these conditions are present, then the science would be unqualifiedly more certain.¹⁵ Consequently, a science which does not possess all three, or possesses all three in a degree less than the most precise science, would be wisdom qualifiedly.

12. Ibid., 982a8–9 and 982a21–22; these passages are, respectively where Aristotle first lists the characteristic and then ties this mark to the science which knows the first universal principles and causes. See also St. Thomas, *In Meta.*, lib. I, lect. 2, nn. 36, 44.

13. Aristotle, *Metaphysics*, I.2, 982a9–11, 982a24–25; St. Thomas, *In Meta.*, lib. I, lect. 2, nn. 37, 45–46.

14. Aristotle, *Metaphysics*, I.2, 982a13, 982a25–27; see St. Thomas, *In Meta.*, lib. I, lect. 2, nn. 38, 47. Here, Aristotle’s use of τὸν ἀκριβέστερον parallels other texts noting that the precision demanded of a science must organically correspond to what the subject matter is able to provide. See Aristotle, *Nicomachean Ethics*, I.3, 1094b12–27; II.2, 1104a1–10; see also *Metaphysics*, II.3, 984a9–15.

15. Aristotle, *Posterior Analytics*, I.27, 87a30–34.

(4) *The wise man can teach from causes.*¹⁶ Here, order is given by a teacher precisely because they lead a student from what they know only vaguely at first to the causes of that thing. That science which can most of all teach will therefore consider what is most of all a cause, and consequently be wisdom to the highest degree. It is an immediate inference, then, that a qualified form of wisdom would teach through causes that are secondary or not as universal in their causality. However, like metaphysics, it may rely upon other sciences for details about these secondary and less universal causes.

(5) *The wise man's knowledge is sought for its own sake.*¹⁷ St. Thomas' explanation of this mark notes that those are known for their own sake which are most intelligible in themselves, and these are first causes. Metaphysics meets this requirement unqualifiedly insofar as it studies God as a principle of being. Some qualification would be in order for those sciences which study universal conditions or causes of a more material order or material agency.

(6) *The wise man's knowledge is of a superior or nobler type.* The higher and more general sciences are more remote from the concrete, particular causes. Thus, the more determinate sciences are tasked with knowledge of the proximate matter of natural substances—knowing the cosmos or a human being as to their *partes speciei et formae*. Now, analogous to the order of art, the order of determination allows knowledge of the whole to exist at first in a vague way; the account of the specific parts remains unknown. Only later is a determinate account provided of the specific parts. By contrast, wisdom considers the highest causes, and most of all the highest good.¹⁸ St. Thomas makes a similar qualification when comparing the orders

16. See Aristotle, *Metaphysics*, I.2, 982a14, 982a29–30; St. Thomas, *In Meta.*, lib. I, lect. 2, nn. 39, 48.

17. See Aristotle, *Metaphysics*, I.2, 982a14–16, 982a31–b4; St. Thomas, *In Meta.*, lib. I, lect. 2, nn. 40, 49.

18. See Aristotle, *Metaphysics*, I.2, 982a16–19, 982b4–10: “The superior science is more of the nature of wisdom than the ancillary; for the wise man must not be ordered but must order, and he must not obey another, but the less wise must obey him. . . . And the science which knows to what end each thing must be done is the most authoritative of the sciences, and more authoritative than any ancillary science; and this end is the good in each class, and in general the supreme good in the whole of nature. Judged by all the tests we have mentioned, then, the name in question falls to the same science; this must be a science that investigates the first principles and causes; for the good, i.e. that for the sake of which, is one of the causes.”

of art and speculation.¹⁹ Now it is clear that St. Thomas applies this name “wisdom” to sacred theology without qualification. In the natural order, metaphysics or natural theology receives the name wisdom without qualification. Thus, qualified forms of wisdom in the natural order will exist to the degree that they fall short of considering the ultimate end (or good) and principle (or agency) of the created order.

26.2 *The definition of qualified sapiential knowledge*

In conclusion, I collect the marks of wisdom and qualified forms of wisdom deduced above to form the definition which will be used in the next section. (1) From the mark that wisdom has a universal conception, it is clear that those sciences which have a more universal scope than others will be more of the character of wisdom, but falling short of considering being as such. (2) From the mark that the wise know more difficult things insofar as they know things removed from the senses, and hence universal in causality, it is clear that a manner of knowing secondary or subordinate universal causes is a qualified form of wisdom. (3) From the mark that the wise man possesses knowledge that is most certain or precise (where this is understood with respect to what is precise in itself, explaining what and why, not merely being abstract or possessing fewer elements), it is clear that a qualified form of wisdom will only possess one or two of these three features. (4) From the mark that the wise man can teach through the highest or most universal causes, it is clear that a qualified form of wisdom would teach through causes that are secondary or not as universal by relying upon other sciences for details about these secondary and less universal causes. (5) From the mark that wisdom studies things for their own sake precisely because they are most intelligible in

See also St. Thomas, *In Meta.*, lib. I, lect. 2, n. 41, and n. 50.

19. St. Thomas, *ScG*, I.1: “Quia vero praedicti artifices, singularium quarundam rerum fines pertractantes, ad finem universalem omnium non pertingunt, dicuntur quidem sapientes huius vel illius rei, secundum quem modum dicitur 1 Cor. 3–10, *ut sapiens architectus, fundamentum posui*; nomen autem simpliciter sapientis illi soli reservatur cuius consideratio circa finem universi versatur, qui item est universitatis principium; unde secundum philosophum, sapientis est causas altissimas considerare.” (Leon.13.3) See also *ST*, IIa-IIae, q. 45, a. 1.

themselves, it is clear that qualified forms of wisdom may study fundamental causes that are not as intelligible in themselves. (6) Finally, the sixth mark brought our consideration back to the notion of a practical “master builder.” Those speculative sciences bear more of the mark of wisdom which consider higher ends. Correlatively, they must also consider more ultimate or first agent principles. Thus, qualified forms of wisdom in the natural order will exist to the degree that they fall short of considering the ultimate end and principle.

Therefore, wisdom qualifiedly speaking (1) has a secondary degree of universality, (2) knows subordinate universal causes, (3) possesses imperfect precision but is not completely without it, (4) teaches about subordinate universal causes through a reliance upon more determinate modes of knowledge, (5) may study fundamental causes that are not intensively intelligible, and (6) falls just shy of studying the ultimate good and agency of the cosmos. We can now apply this definition to general natural philosophy.

§27 GENERAL NATURAL PHILOSOPHY IS A QUALIFIED, SAPIENTIAL TYPE OF KNOWLEDGE WITH RESPECT TO THE SPECIFIC PARTS OF NATURAL SCIENCE; ALTERNATIVES ELIMINATED AND OBJECTIONS ANSWERED.

It is there at the very basis and outset of our human knowledge that the great law concerning the hierarchical and dynamic organization of knowledge, on which our intellectual unity depends, first comes into play; there, at the heart of the sensible and changing multiple.

JACQUES MARITAIN,
Philosophy of Nature

In this section, I will argue both that and why general natural philosophy is a qualified form of wisdom. First, in §27.1, I will make the argument itself, and then show how the need for this type of knowledge was clear from historical antecedents to De Koninck’s proposals, and that De Koninck himself defended an account of natural philosophy conceived as a qualified form of wisdom, answering this need. Then, in §27.2, I will address the question why *this* architectonic type of natural philosophy is needed, viz., one of an Aristotelian-Thomistic

type as countenanced by De Koninck's position, in place of other types which could be or have been proposed. Finally, in §27.3, I will answer various objections against this proposal of the existence, nature, and necessity of a sapiential general natural philosophy.

27.1 *General natural philosophy is architectonic or sapiential*

In his early position, De Koninck thought that natural philosophy could be sapiential only if it were formally distinct from the modern sciences. However, even though the mark which distinguished the two in De Koninck's earlier position is now only a difference in mode, natural philosophy is still separate enough so that it can rule. One part which is "separate enough" is the general part of natural philosophy, the study of mobile being in general, such as one would find in the type of inquiry contained in Aristotle's *Physics*. The proof of this fact will be guided by the definition of a qualified form of wisdom, defended in §26.

(1) *General natural philosophy possesses a secondary degree of universality.* This premise is clear from some of the things said above, viz., that general natural philosophy's subject is *ens mobile*, which is a more contracted subject than *ens qua ens*. Yet the former is also a more general subject than those of the other specific parts of natural philosophy. This much is clear from what St. Thomas states in his *prooemium* to his commentary on Aristotle's *Physics*.²⁰

This qualification can be seen by comparing general natural philosophy to cosmology. General natural philosophy provides arguments that ground the conception of the object of cosmology, the universe of locally movable things. It does this through an argument discovering the existence of all mobile being's necessary limits and order in size, place, time, and causality. Discovering the *primum mobile* allows general natural philosophy to define the natural foundations for the formal object of cosmology.

20. St. Thomas, *In Phys.*, lib. I, lect. 1, n. 4 (Leon.2.4).

The qualification can also be seen “from above.” Were there no beings “invisible” (so to speak) to the light of the formal object of “mobile being,” then general natural philosophy would be coextensive with the genus of whatever science studies all things universally.²¹ Furthermore, insofar as the “being” first conceived by the mind is drawn from sensible being, general natural philosophy is true wisdom’s forerunner. The claims of naturalism offer a sign that this is true; in the absence of immaterial beings, naturalistic physics claims to be wisdom.

(2) *General natural philosophy knows subordinate universal causes.* The difficulty general natural philosophy has in meeting this requirement is that it is most of all characterized by its universality and indeterminateness in the predicable order. That is, knowing “mobile being” is the easiest of all. St. Thomas raises this objection:

. . . . That science is the most difficult, which is most concerned with universals.

Against this seems to be what is maintained in *Physics* Book I. For there it is said that the more universal things are known to us first. However, those which are first known are easier. Yet it should be noted that more universal things [known] by simple apprehension are known first, for being first falls into the intellect, as Avicenna says, and animal before man. For just as in natural being, which proceeds from potency to act, animal is prior to man, so also in the generation of science animal is conceived in the intellect prior to man.

But with respect to the investigation of natural properties and causes, the less common are known beforehand, because through particular causes (which are of one genus or species) we proceed to universal causes. However, those which are universal in causality are known by us afterwards (granted they are known prior by nature), although universals in predication are in some way known by us prior to the less universal (granted they are not known before the singulars). For sense knowledge which is cognizant of singulars precedes in us the intellectual knowledge of universals.²²

However, general natural philosophy still knows universals in causality, but it knows them with a proportionate level of generality.²³ Prime matter is one of its first discoveries, and

21. Aristotle, *Metaphysics*, VI.1, 1026a24–32.

22. St. Thomas, *In Meta.*, lib. I, lect. 2, nn. 45–46.

23. This is a tension which commonly inflicts the interpretation of Aristotle’s proposed natural path. See above, §22.2.

prime matter must be universal in causality insofar as *any* secondary matter is present in it in potency. Furthermore, general natural philosophy discovers the first moved mover, whose causality with regard to local motion, place, and time is universal. This shows in what way it is a qualified type of wisdom with respect to metaphysics.

(3) *General natural philosophy possesses imperfect precision but is not completely without it.* The qualified precision of natural philosophy becomes clear when compared with mathematical physics. Mathematical physics does not possess its own particular type of abstraction, but is a formal object constituted and sustained by an act of judgment. This formal object of mathematical physics is a constructed object (number measures defined with reference to sensible matter and signified symbolically). Nonetheless, its symbolic and quantitative character gives rise to a type of precision.

The certainty which mathematical physics allows one to obtain is “precision” in the sense of “exactitude,” or a perfect match between calculation and observation.²⁴ This precision exists only because it was called for ahead of time, as it were, by the hypothetical grounded in mathematics. The mathematical physicist interrogates nature on the witness stand to obtain precise “yes” or “no” answers—ideally reducible to digits with precisely defined margins of error.²⁵ Yet the subject matter nature provides cannot yield indefinite precision—were the ideal, “most accurate” mathematical physicist to come into being he would, contrary to the hope expressed in the Preface to Newton’s *Principia*, immediately cease to study nature.²⁶

24. Jacob Klein, “On Precision,” in *Lectures and Essays*, 305: “[Mathematical physics] thrives on *exactitude* It is bent on *matching* the consequences derived mathematically from hypotheses with observations dictated by these hypotheses. The endeavor to accomplish such a matching is called an *experiment*. The mathematical derivation by means of differential equations or other equating devices is exact. Only slightly less exact or, as we usually say, precise or accurate are the experimental measurements made to verify the mathematical results and thereby the hypotheses. These measurements, in turn, depend on the efficacy, precision, or exactness of the instruments used. Precision and exactitude are indistinguishable in this context.” See also Hassing, “History of Physics and the Thought of Jacob Klein,” 221 and fn. 13; 240, fn. 59.

25. See *ibid.*, 247–48.

26. See Isaac Newton, *Philosophiae naturalis principia mathematica*, 3d ed. (1726), ed. Alexandre Koyré and I. Bernard Cohen, vol. 1 (Cambridge, MA: Harvard University Press, 1972), 15: “But as artisans [*artifices*] usually work with insufficient accuracy, it comes to pass that mechanics is so distinguished from geometry that what is accurate is referred to geometry, what is less accurate, to mechanics. Yet the errors belong not to

In the limit, there is no organic match between the precision of mathematical physics and the material world due to the indeterminacy of matter.

However, as De Koninck argues, mathematical physics is used for the sake of determinations in natural philosophy. The mathematical physicist as such is not concerned with the essences of things. Natural philosophy is more certain because it sees more of the “why,” and it does this because it is ordered to knowing the definitions of natural wholes, and is therefore ordered to what is “precise in itself.”²⁷ For Aristotle, at least, these are the natures of things. Therefore, general natural philosophy is more precise than mathematical physics.

Since the coordinate species of natural philosophy “add” further to its general subject, it is clear that they are less precise in the sense in question. Insofar as it contains more general reasons which the more particular sciences make use of as explanations taken for granted, general natural philosophy also qualifies as a type of wisdom in this respect.²⁸ However, the fact that the specific sciences tell the natural philosopher in more determinate details about the particular causes present in the natural world is a telling feature.

(4) *General natural philosophy teaches about subordinate universal causes through a reliance upon more determinate modes of knowledge.* General natural philosophy does suffer

the art but to the artisans. He who works with less accuracy is the more imperfect mechanic; and if one could work most accurately [*accuratissime*], he would be the most perfect mechanic of all.” (Translation my own.) See also Hassing, “History of Physics and the Thought of Jacob Klein,” 239, fn. 59. As Niccolò Guicciardini, *Isaac Newton on Mathematical Certainty and Method* (Cambridge, MA: MIT Press, 2009), 314–15, notes, to Newton’s thinking, God has already done so, viz., generated natural things and their forces with the most precise, mathematical accuracy.

27. See Klein, *Lectures and Essays*, 302–303, referring us to Plato’s *Statesman*, 284d. This notion of “precision” is mentioned, for instance, in Aristotle, *Physics*, I.8, 191b27–30. He is discussing the determination of the principles of change that is made “with greater precision” (δι’ ἀκριβείας μᾶλλον), contrasting the determinations provided by natural philosophy and by metaphysics; see §2.3. Also, Simplicius agrees that the demonstrations in Book VIII of the motor causality principle, for instance, receive “more exact demonstration,” (ἀκριβεστέρως . . . ἀποδείξεως) than the argument in Book VII, but this does not detract from the value of Book VII.

28. An interesting example of this is given by Herbert A. Ratner, “William Harvey, MD: Modern or Ancient Scientist?,” in *The Dignity of Science: Studies in the Philosophy of Science presented to William Humbert Kane, O.P.* Ed. James A. Weisheipl (Washington, D.C.: The Thomist Press & The Albertus Magnus Lyceum, 1961), 64–65. Harvey’s demonstration of the circularity of blood flow relies upon the more general proof, analogous to one found in *Physics* VIII, that a finite quantity in continuous motion must possess a circular motion.

from the vagueness of its conception. Since it conceives of mobile being with the greatest level of indetermination, it cannot provide a full causal explanation of the natural order. However, it does not fail to discover causes of things in the natural order (e.g., prime matter, the first moved mover), although it must conceive them indeterminately. Consequently, sciences that are more determinate in the order of predication are better teachers in respect of discovering determinate accounts of particular causes.

A trade-off, however, comes in the fact that ultimate explanations require tracing particular causes to universal causes in the natural order. Yet, the human mind conceives of universal causes only at the same time under generalities.²⁹ The methods of the particular sciences, particularly the mathematical ones, provide a progression towards universal causes in nature that is like the progression towards a limit. However, the limits themselves (the human soul, or the first mobile being), are conceived of under a generality that is never quite eliminated. The use of limit concepts is the way in which the human mind makes up for the fact that it lacks concepts that are universal in representation. A general habit of knowledge, therefore, makes use of and benefits from more particular studies (in the order of predication and causation) and their limit concepts, precisely because its more general level of conception is required to relate these concepts to the limit itself. The main example for this has been the *primum mobile*, which mathematical cosmologies approach with ever-increasing precision (in the physico-mathematical sense).

(5) *General natural philosophy studies fundamental causes that are not intensively intelligible.* This qualification applies to those sciences which study universal conditions or causes of a material order or physical agency. The difficulty of understanding the being of the first moved mover does not seem to be due to a greater intrinsic intelligibility on its part but because of a lack of it. As necessary a condition as it is for the cosmos, it is not “being” in the highest sense, even among cosmic beings. However, it is still a first principle in the cosmos,

29. See the text on “the revolt of the philosophers of nature,” quoted at the end of §22.5, and see §25.3

and since we have no operable control over the *primum mobile*, the science that studies it studies fundamental causes that are not intensively intelligible but which we seek to know for its own sake.

(6) *General natural philosophy falls just shy of studying the ultimate good and agency of the cosmos.* It belongs to wisdom simply speaking to discuss the ultimate good and absolutely first agent cause of the cosmos. As a consequence, we can readily see that general natural philosophy is a qualified form of wisdom because it discovers and determines certain general properties about the first moved mover.³⁰ Furthermore, general natural philosophy does not provide determinate details about the good for the sake of which this first intracosmic agent acts. The instrumentality of the *primum mobile*, as argued in Chapter 4, is conceived of only vaguely. If De Koninck is correct in his adherence to a strong anthropic principle, then one must study the human soul in order to grasp the good for the sake of which the heaven moves. In this respect, the general study of the soul is also a qualified form of wisdom, because it leads one into the study of this cosmic good, viz., the intracosmic form which is in a way all things. The general part of natural philosophy, therefore, is further qualified in the fact that it does not determinately study that penultimate good of the cosmos, intellect.³¹

From the above we can see *that* general natural philosophy is a qualified form of wisdom. Since it belongs to the wise man to order, one can ask about how general natural philosophy exercises its sapiential function. I will discuss these functions (to judge, use, defend, and order) in §28.

Now, it can readily be seen *why* general natural philosophy is a qualified form of wisdom. The middle term in this argument is drawn from the nature of the human mind and general

30. Insofar as it discovers the First Mover, but cannot study it because this mover lacks matter, general natural philosophy's final moment, as it were, is to express its own qualifiedly sapiential nature. However, as this position is more contentious and less central as an example in this project, I pass it by.

31. Further, it should be noted that the *primum mobile*, while a necessary condition for all cosmic motion, is not a sufficient condition. The human animal is, in his intellect and will, a self-contained *primum mobile* moved immediately by God; see St. Thomas, *ST*, Ia, q. 115, aa. 4 and 6; Ia-IIae, q. 9, a. 6.

natural philosophy as a habit which perfects the human mind. First, we should recall that natural philosophy is the mode of knowledge that is maximally conformal to the human mind. Since the initiation into all natural philosophy is overseen by general natural philosophy, this part of natural philosophy is temporally first. Furthermore, as argued just above, the specific branches of natural science return to further inform it of particular causes verging towards limiting concepts of universal causes in the natural order. Consequently, general natural philosophy is the habit by which the human mind knows mobile being both at first and later in more informed detail (by dependence upon other sciences), the habit which possesses the fundamental understanding of ultimate principles (but not absolutely ultimate) in the mode maximally conformal to the human mind. It is the habit that most of all overcomes the epistemological and ontological gap between what is better known to us at first to what is better known in itself in the cosmos.³² This expresses the notion of wisdom *secundum quid* as explained in the preceding paragraphs. Thus, general natural philosophy is a qualified form of wisdom because it perfects the human mind as a theoretical capacity trained, by nature, upon the ultimate intrinsic principles of the natural order.

The integration of particular causes into a higher level of generality does not mean that general natural philosophy *becomes* those specific sciences any more than metaphysical reflection upon the material object of another science makes that science metaphysics. The “general part” of natural philosophy is at first the “vestibule” of the sciences. Later, after a study of many subordinate topics, it is a type of wisdom.³³ Natural philosophy is, in this

32. See St. Thomas, *In Phys.*, lib. I, lect. 1, n. 7 (Leon.2.5).

33. See the Coimbra commentary, *Commentarii Collegii Conimbricensis Societatis Iesu, In Octo Libros Physicorum Aristotelis Stagiratae, Pars Prima*, ed. Peter Fonseca (Coloniae: Lazarus Zetznerus, 1625), 37, where the commentators raise as an objection that this general physics is merely a vestibule—a temporary room for knowledge; one either departs to enter metaphysics and study first causes, or leaves it to the study of cosmology and physics proper. See also Averroes in *Aristotelis de Physicu Auditu Libri Octo. cum Averrois Cordubensis Variis in Eisdem Commentariis*, proem., 4; see also Steven Harvey, “The Hebrew Translation of Averroes’ Prooemium to His ‘Long Commentary on Aristotle’s Physics,’” *Proceedings of the American Academy for Jewish Research* 52 (January 1985): 80–81, “The relation [of this book], i.e., the relation of natural science to the other theoretical sciences is the relation of the part to the whole. The theoretical sciences are of two kinds: one kind is reckoned for the most part as propaedeutic and it consists of the

latter respect, “first physics.” Such an idea is not without precedent, at least in name.³⁴

De Koninck recognizing the need for general natural philosophy

The separation between the philosopher’s contemplation of nature and the scrutiny of nature by the scientist was sealed in the work of Immanuel Kant.³⁵ No intervening philosopher through the 19th century—continental or otherwise—could fully resurrect the philosophy of nature. Is a new conception of the philosophy of nature needed?³⁶

An affirmative answer is given—almost as a matter of course—by Thomists. Jacques Maritain maintains that natural philosophy is a qualified form of wisdom.³⁷ It is only due to

mathematical sciences; the other kind is reckoned for the perfections for which the propaedeutic sciences exist, and it consists of natural science and divine science. The relation of this book within natural science is the relation of the elements of a thing to the thing. This book includes those things that are the principles and roots, which are common to whatever the student of this science wishes to discuss.”

34. See Simplicius in *On Aristotle’s Physics 1.5-9*, 142: “[I]t is not the task of the natural philosopher to present the elements of natural things with precision [ἀκριβείας]; rather it is the task of the first philosopher, just as it is the task of the first natural philosopher [τοῦ πρώτου φυσιολόγου], not the medical specialist, to present the theory of the four elements [with precision].” See Simplicius, *In Phys.*, CAG I.258.

35. Ivor Leclerc, “The Necessity Today of the Philosophy of Nature,” *Process Studies* 3, no. 3 (1973): 158–59. Such is also Reichenbach’s judgment, see *The Rise of Scientific Philosophy* (Los Angeles: University of California Press, 1951), xi–xii.

36. Leclerc, “The Necessity Today of the Philosophy of Nature,” 159: “In our time, however, I wish to maintain, the situation has completely changed. The reason for this is to be found in the development of science in the past hundred years. This development has had the consequence that the conception of nature which had originated in the seventeenth century and thenceforward constituted the foundation for science down into this century has now been entirely destroyed. No other conception of nature has replaced it. We today stand in need of a new conception of nature, for this is indispensable to the conception by man of himself and his place in the universe, a conception of fundamental importance to every sphere of man’s life and activity. Moreover, a new conception of nature is requisite for science itself.”

37. Maritain, *Philosophy of Nature*, 155–56: “By casting philosophical light upon the universe of the sciences, the philosophy of nature discerns therein an intelligibility which the sciences themselves cannot reveal to us. Disclosing, in sensible being known as mutable, analogical beginnings of the more profound truths and realities which are the proper object of metaphysics, the philosophy of nature, precarious wisdom *secundum quid*, holds at the first degree of abstractive visualization, in the generic sphere of intelligibility nearest to the senses, the office of regulator and unifier of wisdom. Indispensable mediator, it brings into accord the world of the particular sciences, which is inferior to it, and the world of metaphysical wisdom which is above it. It is there at the very basis and outset of our human knowledge that the great law concerning the hierarchical and dynamical organization of knowledge, on which our intellectual unity depends, first comes into play; there, at the heart of the sensible and changing multiple.” See also Jacques Maritain, *Science and Wisdom* (London, New York: G. Bles, Scribner, 1940), 35: “We ought not to neglect the problem of the philosophy of nature. Of all speculative wisdom it is the humblest, the nearest the world of sense, the least perfect. It is not even a form of wisdom in the pure and simple sense of the word, it is wisdom only in the order of mobile and corruptible things. But this is precisely the order most proportioned to our rational nature.

its being forgotten that the sciences treat natural philosophy as a metaphysical intruder and, conversely, why the metaphysicians consider it lost and cede its place to science.³⁸ As for De Koninck himself, he would agree substantially with Maritain. However, while De Koninck learns this notion of a qualified form of wisdom from Maritain, the completion he adds to this position is the fact that the specific natural sciences and natural philosophy are not in sundered realms of knowledge.³⁹ This view of the sapiential role is retained by De Koninck not just early in his career, but throughout his writings in natural philosophy. While his early description of the philosophy of nature as a sapiential knowledge along with its various functions is not answered by further articles or books that explicitly explore these various functions, his subsequent writings nevertheless practice them.

In “The Unity and Diversity of Natural Science,” published in 1961, De Koninck uses “time” as an example of the sapiential role of natural philosophy.⁴⁰ The general definition of time found in the *Physics* fails only with regard to the particular subject in which Aristotle thought all time was to be united: the outermost celestial sphere. Finding the new motion

This wisdom, which is not even purely and simply wisdom, is the first which is offered in the progressive ascending movement of our thought.”

38. See Weisheipl, “Medieval Natural Philosophy and Modern Science,” in *Nature and Motion in the Middle Ages*, 273.

39. An early formulation of his views is found in De Koninck, “La philosophie des sciences,” 316: “This sapiential function by which metaphysics branches out of itself as a science (even while itself remaining in the domain of being) is that in which the philosophy of nature participates. The latter will not be wisdom *simpliciter*, since it cannot reflect upon itself, nor can it reach the root of its object, mobile being—being that it only attains under the angle of *mobility*. But this mobility entails two aspects: the one necessary which it can attain as science, the other which escapes the science *cognitio certa per causas*, but which the experimental sciences recapture. Just as the quidditative intuition of the divine essence by the blessed does not give a comprehensive knowledge of all possibles, just as metaphysics which attains the quiddity of being cannot tell us all the manners in which it can be realized, so also the philosophy of nature cannot tell us all the manners in which mobile being, the *fluxibile et non semper eodem modo se habens propter materiam*, can be realized. But once this aspect which escapes the philosophy of nature as science is brought out by the experimental sciences, it can reflect on it without coming out of the domain of mobility which is its object. It can judge, defend and use the experimental sciences. It is, doubtless, not wisdom *simpliciter*, but *secundum quid*. It is this sapiential function of the philosophy of nature that we call philosophy of the sciences.” See also De Koninck, “Thomism and Scientific Indeterminism,” 75, fn. 32. A very similar expression of the following position can be found in *ibid.*, 75–76.

40. De Koninck, “The Unity and Diversity of Natural Science,” 18–19. Republished: “The Unity and Diversity of Natural Science,” *Logos: A Journal of Catholic Thought and Culture* 17, no. 1 (2014): 146–171.

that measures time “is a question specifically pertaining to mathematical physics.”⁴¹ Yet this does not mean that time in the scientific world and time in the natural philosophical world are forever sundered. To stress, as Eddington does, the difference between his “two tables,” or between the elephant sliding down a grassy hillside and two tons of whatever else you please, is to stress too much a difference in method.⁴² Instead, De Koninck refers with approval to Max Born’s assessment that scientists “have hitherto shown much skill and ingenuity but little wisdom.”⁴³ To be sure, De Koninck correctly notes that Born is speaking of what the Aristotelian would call practical wisdom in this passage—but he presses for a deeper meaning to Born’s observation.⁴⁴ Practical wisdom recognizing the limits of science is empty talk unless it is based upon a speculative awareness of what man is derived from philosophy.

The problem De Koninck addresses is a pragmatic one. It is a pragmatic limitation that divides natural philosophy from the sciences and not one based upon the nature of those disciplines formally speaking. As a consequence, “To call attention to the extreme relevance of our first and vague knowledge of reality, the sort that we express in ordinary language, may be the self-imposed task of some people, whom we call philosophers.”⁴⁵ This task,

41. De Koninck, “The Unity and Diversity of Natural Science,” 18–19.

42. Ibid., 19. See the introduction to Eddington, *The Nature of the Physical World*, for his discussion of his “familiar” and “scientific” tables.

43. De Koninck, “The Unity and Diversity of Natural Science,” 20. See Max Born, *Natural Philosophy of Cause and Chance*, The Waynflete Lectures 1948 (Oxford: Clarendon Press, 1949), 2.

44. De Koninck, “The Unity and Diversity of Natural Science,” 20: “I think [Born] has more in mind than this. Practical wisdom is one that follows upon awareness that man, being what he is, cannot be looked upon indifferently by the physicist, for the simple reason that the true physicist must be a philosopher who realizes the limitations of his particular branch of science. Belief that his part is the whole, or that it is a self-contained whole, would be preposterously unscientific. What Born means, as I understand it, is that, no matter how skillful or ingenious, no one can be a true scientist without being a philosopher.”

45. *ibid.*, 21; the entire context: “The man who putters in a laboratory may not have time to concentrate upon the outcome of his convenient generalizations. Yet there ought to be someone able to warn us of logical consequences that clash with the whole of experience. No one may possess a head big enough to contain all the knowledge of nature now available; but general, though vague, knowledge, we do have, knowledge which can be explored up to a point without moving on to further concretion. To call attention to the extreme relevance of our first and vague knowledge of reality, the sort that we express in ordinary language, may be the self-imposed task of some people, whom we call philosophers. Still, my contention is that if, in this restriction of their work, they see anything more than a limitation forced upon them by the shortcomings of

rooted as it is in knowledge drawn from “our first and vague knowledge of reality” which can nonetheless be philosophically explored “up to a point without moving on to further concretion” clearly denotes general natural philosophy, what I have called “first physics.” It is this level of speculation which retains a fundamental grasp of the whole.

Perhaps the clearest expression of De Koninck’s position is found in his 1959 Whidden Lectures at McMaster University.⁴⁶ He comments:

Whatever may be the tactics of this or that science of nature, it remains true that all should converge upon the single, though infinitely varied, whole which is their subject. *Now, to hold this general objective steadily in view, and in its light, to pass judgement on the conclusions of specialized branches of research, is the business of natural philosophy—which should be the concern of each and every scientist.* The fatal consequences of abandoning all thought of the subject as a whole, to become absorbed and lost in independent investigation of single aspects of it, is illustrated everywhere. The absence of coordination between the sciences, the failure of each to reflect constantly upon the scope and significance of the others, have brought all to a state of hollowness and shapelessness, like the grin without the cat or the cat without an outline.⁴⁷

This single, infinitely varied whole which is their subject, what Leslie Armour calls “the concrete object,”⁴⁸ is forever outside the human mind’s utterly complete comprehension. This is not an assertion of skepticism but a recognition that the mode of knowledge which the human mind possesses (the natural abstractive modes and the artificial symbolic modes) are taken from this concrete source and are drawn further and further into knowing it.

the human brain, they are projecting this limitation upon nature as if real things stood in different worlds according as they are seen by philosopher or scientist. Small wonder if minds convinced of such a doctrine want to reduce all philosophy to a hopeless metaphysics in the empty air of unqualified verbal ‘being.’ So far as I am concerned, I refuse to renounce myself for a mere swarm of electrical charges, no matter how much I may stand in need of them and know that I cannot exist without them.”

46. See Charles De Koninck, *The Hollow Universe* (Québec: Presses de l’Université Laval, 1964). Despite the pedagogical constraints of these lectures, they contain a thorough overview of De Koninck’s philosophy of nature. In the three lectures, De Koninck addresses the philosophical foundations, content, and implications of three modern inquiries: modern mathematics (“The World of Symbolic Construction, or Two is One Twice Over”), mathematical physics (“Mental Construction and the Test of Experience”), and biology (“The Lifeless World of Biology”). The epilogue to the book, “Reckoning with the Computers,” extends the theme of the “hollow” universe from the realm of mathematics, physics, and biology to the account of man himself.

47. *ibid.*, 112–13. My emphasis.

48. Armour, “The Philosophy of Charles De Koninck,” in De Koninck, *Writings*, Vol. 1, 24.

Were the human mind to plumb the depths of the cosmos in a human concept, we would require a godlike comprehension, a universally representative concept of the cosmos as such. This “general objective” of knowing this cosmic whole can only be kept in view by natural philosophy—here opposed to the particular parts of natural science—and therefore belongs to first physics.⁴⁹

27.2 *Why this architectonic is the one needed by the sciences*

In order to show the logical relationship between De Koninck’s proposals and other possibilities, some schema is necessary. I will utilize one proposed by Ernan McMullin.⁵⁰ He argues that those who defend the existence of a philosophy of nature must answer two questions:

49. Further texts which can be cited from De Koninck’s work to support the consistency of this insight are plentiful. For instance, consider again the passage cited above, p. 428, that one must keep “the total aim of natural science in view.” (See De Koninck, “The Unity and Diversity of Natural Science,” 23.) However, keeping the “total aim of natural science in view” can be done by no other part of natural philosophy than its most general part, first physics.

De Koninck makes similar comments on this very passage of Heisenberg’s in an essay also included in a collection edited by V. E. Smith, “Is the Word ‘Life’ Meaningful?” published in 1962: “It is sometimes said that we should pay no attention to the scientist when he expresses himself in ordinary language; that in doing so he is merely popularizing; and any serious appreciation of his work, we are told, should remain confined to what he says in technical language. Eddington disagreed with this superficial view. Heisenberg goes so far as to say that ‘even for the physicist the description in plain language will be a criterion of the degree of understanding that has been reached.’ To achieve such understanding is wisdom as distinguished from mere skill. The scientist without wisdom is like the skillful rhymester who has nothing to say.” See De Koninck, “Is the Word ‘Life’ Meaningful?,” 87; De Koninck also makes use of Heisenberg’s remark in another context, cited below, p. 462. Pressing Heisenberg for such a point makes sense, on De Koninck’s part, provided he has in mind the notion that the great scientists attempt to speak in a language of “first physics” that has not lost contact with the reality most known to most men.

In “Natural Science as Philosophy,” De Koninck furthers these themes. The true philosophical temperament finds unity within the whole of philosophy—it becomes a quasi-practical problem of how to manage the disparate departments of science and learn about, study, or teach the coherent whole: “But what can the mathematical physicist do with definitions of that kind, or with their consequents? Nothing whatsoever. And the reason is that the ‘mathematical physicist’ may be construed as a kind of abstraction, whereas *the complete physicist bears in mind the concrete whole of nature—at least as an ideal*. . . . But if a man confines himself to the special problems of mathematical physics as if they alone were relevant, he is like a brick-maker who would ignore bricklaying. The brick-maker is indeed a specialist, but if he does not know what bricks are for, if, in his mind, bricks have nothing to do with building, he is a specialist of a rather specious kind—like a mathematical physicist who would believe that nature raises no problems other than the kind he works on. The mind that diverts bricks from what they are for, is performing a negative abstraction, no matter how solid and well-shaped the bricks may be: such a mind does not grasp *why* they should be that way; it is satisfied that they should in fact be so and so,” “Natural Science as Philosophy,” 11–12, my emphasis.

50. Ernan McMullin, “Philosophies of Nature,” *The New Scholasticism* 43, no. 1 (1969): 29–74.

first, does this philosophy of nature assume a source of evidence or warrant other than that of the natural sciences, and second, what is meant by “philosophy”?

De Koninck’s approach among logically available options

If the first question is answered affirmatively, then one has a “strong” philosophy of nature—one that is prior to science and can judge it to some degree. It is a philosophy of nature of the first order (PN1). If one answers negatively, then philosophy of nature is posterior to the sciences as to its own evidential warrants and is a reflection on the sciences; it is thus a second-order philosophy of nature (PN2). A qualified answer gives you a “mixed” result: such a “mixed” philosophy of nature (PNM) is, in different respects, independent of and dependent upon the sciences of nature.⁵¹ His survey of contemporary options leads McMullin to tentatively suggest that a PNM is the best option. Yet any PNM leads to questioning whether there is a distinction between natural philosophy and science at all—

51. McMullin, “Philosophies of Nature,” 32–33. Descartes, Kant, and Hegel provide examples of PN1-type philosophies of nature. McMullin argues that Descartes provides the example *par excellence*, see *ibid.*, 43. Kant aim is to transform the PN2 of Newton into a PN1 of the Cartesian stripe; *ibid.*, 48 (and see also McMullin, “Realism In Modern Cosmology,” 142–43). The antecedently inflexible apriorism of a Descartes or a Hegel suffers directly from new discoveries, whereas the learned inflexible apriorism of a Kantian system suffers by being left behind. While a PN2 does not suffer these defeats by definition, it seems in the end to be nothing more than mere reflective work upon science.

Furthermore, when we speak of the philosophy of science, McMullin notes, we often move between two distinct ideas: a philosophy of science which is a meta-language for reflecting upon the *method* of the sciences (PSM) and a philosophy of science which utilizes science to make claims about *what nature is* (PSN); see *ibid.*, 32. Now, De Koninck distinguishes between metaphysics as the philosophy of science and logic or mathematics contributing to an understanding of the method of scientific inquiry. So I will focus on how De Koninck would locate his position with respect to McMullin’s PN1, PN2, and PNM.

When he turns to survey his contemporary options, 51–56, McMullin discusses the British analytics, the phenomenologists, and the neo-Aristotelians. Among the last group, he lists as examples Renoirte (De Koninck’s dissertation director), Maritain, Van Melsen, and De Koninck himself; McMullin, “Philosophies of Nature,” 55. McMullin dismisses this option—“the popularity of this approach has recently been on the wane”—with three reasons that will be dealt with in the §27.3. He also pegs Eddington as a neo-Kantian; *ibid.*, 51–52. (It is interesting to note that De Koninck, in his 1934 dissertation, defends Eddington against the usual “idealist” reading of his philosophy of science, e.g., even by Jacques Maritain; see “The Philosophy of Sir Arthur Eddington,” in De Koninck, *Writings, Vol. 1*, 179–80, 210–12; e.g., 210: “Therefore, it is more profound than the physical real of M. Maritain. Eddington, contrary to what Maritain thinks, knows quite well that his number-measures are a real aspect of a real more profound but not as such made explicit by these numbers. The symbols are perfectly known as symbols, as being only the metric aspect of some thing.” De Koninck reads Eddington as a scientist straining to use the vocabulary of his trade to defend realism.)

“the boundary between the two is a hazy one.”⁵² Nonetheless, McMullin contends that even in a PNM, “the ordinary work of science” is clearly demarcated from acts of philosophy, and “in times of ‘scientific revolution’” philosophy “will inevitably enter into the discussion.”⁵³

How would have De Koninck answered McMullin’s questions? There a clear passage in De Koninck’s works where he satisfies McMullin’s demands. His strategy is to make McMullin’s second question the priority: what is philosophy, such that we can have a philosophy of nature? This allows him to explain how the source of warrant in general natural philosophy differs from the sources of warrant in its specific parts. Furthermore, this allows De Koninck to explain the “hazy” unity which McMullin ascribes to a PNM which he suspects must be the true solution. First, let us review the three modes of investigating nature that De Koninck identifies:

It should now be plain that our study of nature can proceed on three different levels: that of science, that of opinion, and that of terms that are themselves provisional—whose meanings are accordingly unstable. There is no doubt that in point of certitude there are radical distinctions between these various modes of investigating nature: between vague knowledge that is certain and definitive, such as knowledge of what the word “man” stands for; knowledge that is tentative, of the kind we have in dialectical propositions; and knowledge that is both tentative and known to be provisional, provisional even as to the very terms we use to express it. The latter kind is nothing short of paradoxical, since greater exactness is paid for by increasing instability. These distinctions are quite relevant, but our great question is, do they divide the purpose of the study of nature? Will the three different methods require that science be formally divided in accordance with them? Do these provide us with different subject-terms?⁵⁴

Here, De Koninck reviews what we have previously examined as the levels of certainty available to natural philosophy as a whole: the scientific conclusion (in Aristotle’s sense), the dialectical conclusion, and the dialectical investigation. De Koninck then asks if this difference in method—between what McMullin would describe as a PN1 and various stages of “the

52. McMullin, “Philosophies of Nature,” 59.

53. Ibid.

54. De Koninck, “The Unity and Diversity of Natural Science,” 16.

ordinary work of science”—makes for a difference in the unity of a discipline. From Chapter 6, we already know the answer to this question.

De Koninck continues:

It may be useful to consider two extreme positions on this question. Some hold that if there is to be a natural philosophy it must remain confined to certain generalities, such as the conditions of absolute becoming, the definitions of motion, infinity, place, time, etc.; and that when we carry our investigations further, we then practice experimental science, as in seeking to know what the speed of light is. Others, again, believe that natural philosophy presupposes the experimental sciences, and is no more than a reflection on their method and on their present achievements and implications as compared to those of earlier science. Natural philosophy and philosophy of science would be much the same.⁵⁵

Here De Koninck provides the distinction between a natural philosophy confined to generalities (a PN1) and a natural philosophy that is purely reflective (a PN2). A PN1 or general natural philosophy that simply applied its general conclusions to more specific areas—or whose general conclusions were too specific to begin with—would be like a Cartesian or Kantian system. De Koninck avoids this “game of concepts” by distinguishing between the orders of determination and demonstration. The *Physics* or the *De Anima* possess a level of determination that is more general than and prior to cosmology or the study of the human brain. Implicitly at work here is the distinction between common and proper experience, and the distinction between the orders of determination and demonstration. One cannot *demonstrate* the organic substrate of human memory from a general consideration of the memorative faculty, nor can one *demonstrate* the expansion of physical space to be the *primum mobile* from general natural philosophy. In this respect, De Koninck’s position qualified the “PN1” position.

We continue:

Both of these conceptions are partly true, for there is no doubt that we must examine first of all the things we first name, and these are vague generalities.

55. De Koninck, “The Unity and Diversity of Natural Science,” 16.

They are, in a sense, the most important, and to neglect them will eventually spell disaster. The doctrine of prime matter, for instance, is essential to save the unity of the human individual. For if we held that a man is no more than an accidental superstructure made up of electrical charges, a human person would be no more of an individual than an individual pile of bricks.⁵⁶

Here De Koninck defends the truth contained in the first extreme (PN1). The natural path of the human mind is first faced with “original questions,” such as the principles of change, which do guide and inform all subsequent inquiry. However, he then asks:

But is it the sole function of the natural philosopher to be stubborn about the validity of such problems, about their possible and even definitive solutions? Does he cease to be a philosopher when he asks more concretely what a man is? When he asks what is the anatomy and physiology of the human brain? Or what are its chemical components? Why should the mind interrogating nature rest in vague generalities, no matter how important and how certain these may be? Yet no matter how general or how particular, how certain or provisory, knowledge about nature will always be derived from, and must return to, experience, external or internal. In each and every case, if the knowledge is to be of nature, the descriptions and definitions, no matter of what kind, must in the end include sensible matter. It does not seem possible therefore to set a rigid frontier between philosophy of nature and science of nature.⁵⁷

The PN1 also partially false because the mind is not satisfied by vague generalities—the natural philosopher does not cease to be a natural philosopher by descending to more determinate levels of investigation. The reason for this is that “in each and every case” he will be defining with sensible matter. This line of reasoning was examined extensively in Chapter 6 in regard to the hardest case, viz., mathematical physics. In this respect, De Koninck’s position clearly rejects PN2 as an adequate account. However, we can recognize an aspect of truth regarding PN2’s:

The second opinion we described is likewise partly true. For if philosophy is to deserve its name, it will never confine itself to one narrow domain of nature or

56. De Koninck, “The Unity and Diversity of Natural Science,” 16.

57. *ibid.*, 16–17.

become indifferent to findings achieved by a particular method of research. A man may be a skillful investigator, but he will never be master of his science until he knows just what it is that he knows, the status of his own mind with regard to his particular subject; and until he comes to realize, if only vaguely, how much there is that he does not know. But the great shortcoming of this opinion, that philosophy of nature must be simply philosophy of science, is its inevitable failure to pay explicit attention to the vague generalities with which all thinking about reality must begin, and to which all later knowledge must be related. To rest in vague generalities is unsatisfactory to the inquisitive mind, but to rest in “man is a swarm of atoms” is no less reprehensible, for the simple reason that intelligence must demand a connection between this statement and the knowledge we already have of man, as expressed in ordinary language; when we ask what man is, for example, or what he is made of, and how. Heisenberg puts it this way: “Even for the physicist the description in plain language [as distinguished from that of theoretical physics] will be the criterion of the degree of understanding that has been reached.”⁵⁸

Here, De Koninck turns to the other extreme (PN2). This extreme is true insofar as the integral natural philosopher, as an ideal, cannot be realized in one man. Any given natural philosopher, then, must rely upon a reflective mode of philosophizing about nature because he cannot be an expert in every domain. The natural philosopher in one domain (where he is an expert and has proper experiences) can still understand the expertise of another domain by the light of a common experience and corresponding general natural philosophy than unites them both—at least ideally. The falsity of a PN2-type position lies in the fact that it cannot regain the common level of experience of philosophizing about nature which De Koninck maintains is the function of his version of a PN1. In this respect, De Koninck’s thesis about the unity between natural philosophy and the modern sciences explains why PN2 can seem so uninteresting as a mere reflection—viz., because the natural philosopher in De Koninck’s mind already possesses substantial knowledge of nature that is epistemically independent of the specific sciences, but nonetheless uses them to further its desire to know.

58. De Koninck, “The Unity and Diversity of Natural Science,” 17. See Heisenberg, *Physics and Philosophy*, 168.

Therefore, by answering McMullin's second question first, De Koninck provides clarification regarding McMullin's first question. Elsewhere, McMullin asks whether or not philosophies of a PN1 type—he again lists the Aristotelian, Cartesian, and Kantian—can provide regulative principles for cosmology.⁵⁹ He notes:

Those who defend a philosophically-elucidated *a priori* which is supposed to be normative for the cosmologist tend to be committed to a sort of *linguistic foundationalism*, an assumption that the concepts, categories, forms, in terms of which the general principles governing the physical world (or our conception of, or our experience of, the physical world) are to be formulated, are *somehow* themselves given to us.⁶⁰

This linguistic foundationalism, a structure of nature that is somehow given to us, is precisely the ground defended above as De Koninck's understanding of the natural path of the mind into nature. McMullin seems to find Aristotle's linguistic foundationalism most evident in the "ordinary language" based analysis of the principles of change—in his interpretation, *Physics* Book I provides the necessary and sufficient conditions for correctly using the word "change."⁶¹ As De Koninck's comments about prime matter in the passage just quoted make clear, he would take this as an insufficiently complete interpretation. While it is true that the first three books of the *Physics* manifest the conceptual coherence of general natural philosophy (they completely answer Parmenides' and Heraclitus' dilemmas and show that one can know changing being), Aristotle only does this by elucidating an ontology that coheres with our predications. The principles arrived at are vague only in our conception. This basis has profound implications if true: the first physicist can provide speculative parameters for

59. See Ernan McMullin, "Is Philosophy Relevant to Cosmology?," in *Modern Cosmology & Philosophy*, ed. John Leslie (Amherst, N.Y.: Prometheus Books, 1999), 50–51. This is a reprint McMullin's "Is Philosophy Relevant to Cosmology?," *American Philosophical Quarterly* 18, no. 3 (July 1981): 177–189. In the reprint, 56, fn. 39, he cites his own "Philosophies of Nature" as providing a fuller explanation, so it is clear he intends the same PN1.

60. McMullin, "Is Philosophy Relevant to Cosmology?," 51. My emphases.

61. McMullin, "Philosophies of Nature," 41–42. See also his "Matter as a Principle," 173–212 in McMullin, *The Concept of Matter*.

cosmology regarding its fundamental principles and object. He cannot do the cosmologist's work, but he gives him a job.⁶²

De Koninck among the Thomists

It is worthwhile to briefly note how De Koninck's position compares and contrasts with that of other Thomists. I will consider positions in decreasing order of similarity.

Thomas McLaughlin argues that astronomy is the queen of the specific natural sciences.⁶³ What McLaughlin means by astronomy is substantially similar to the subject of the *De Caelo*, viz., the science of the universe. Thus, astronomy would contain modern cosmology as a part; astronomy is the study of the universe as such, and cosmology is the study of its genesis, development, large-scale structure, and end.⁶⁴ The success or failure of McLaughlin's specific claims about astronomy as "queen" over all the specific sciences need not be contended in this context. The crux of the matter comes to the claims astronomy can make against general natural philosophy. McLaughlin notes in this regard:

Considered with respect to Aristotelian cosmology [historically in the *De Caelo*], metaphysics and the general philosophy of nature are insufficient for unifying the specific natural sciences because metaphysics and the general philosophy of nature are quite compatible with Aristotle's cosmology. Thus, they cannot, of themselves, show whether the kind of unity in nature is that of Aristotle's

62. It bears noting that McMullin's other work in the philosophical interpretation of cosmology are closer to De Koninck's views in other respects. For instance, in McMullin, "Realism In Modern Cosmology," he provides an account of "qualified realism" for the purpose of interpreting modern cosmology (between the extremes of conventionalism or constructionalism) that follows Maritain's interpretations of symbolic construction as converging on by never fully exhausting the real object. De Koninck's understanding of the symbolic constructions of mathematical physics is very much in line with this.

63. McLaughlin, "Astronomy: Queen of the Specific Sciences," 105: "Astronomy, I will argue, is preeminent among the specific physical sciences. With respect to modern physics, chemistry, and the biological and earth sciences, it is an overarching, unifying, and governing science. . . . Astronomy is not, however, an overarching and governing science absolutely speaking. It is subordinate to mathematics, metaphysics, theology, and to a general philosophy of nature, such as that found in Aristotle's *Physics*. Astronomy, on this model, occupies an intermediate position among the intellectual disciplines. It is a governor governed." I thank Dr. McLaughlin for his comments in private correspondence replying to my questions, and for a copy of an unpublished addendum to the article. Dr. McLaughlin agrees that general natural philosophy does possess an architectonic role.

64. *Ibid.*, 1040.

cosmology or is that now shown to us by the modern specific sciences. Some further, though subordinate, unifying discipline is necessary and that discipline is astronomy.⁶⁵

I grant the first sentence as true. However, regarding the inference drawn in the second sentence, I will distinguish the major term. (Implicitly the argument is that general natural philosophy is essentially compatible with an unsound specification, and what is essentially compatible with an unsound specification cannot discriminate between sound and unsound specifications, therefore, etc.)

McLaughlin maintains that modern astronomy actualizes, in a certain way, what is contained only potentially in modern physics.⁶⁶ However, this “actuation of what is potential in [modern mathematical] physics”⁶⁷ is also a notion utilized by De Koninck in his discussion of the subject of the *De Caelo*.⁶⁸ Does this feature apply to the general philosophy of nature? Is it the case that what is essentially compatible with an unsound specification (first physics vis-à-vis Aristotelian-medieval cosmology) cannot discriminate between sound and unsound specifications?

Here I distinguish the major term. First physics is incapable of discriminating between sound and unsound specifications insofar as they are specific. However, it *is* capable of distinguishing between them in general. That is, while first physics cannot “show whether the kind of unity in nature is that of Aristotle’s cosmology or is that now shown to us by the

65. McLaughlin, “Astronomy: Queen of the Specific Sciences,” 1016. I note that the functions which McLaughlin identifies as the architectonic exercises of astronomy are very similar to De Koninck’s own list for natural philosophy, *ibid.*: “[A]stronomy is an overarching and governing science in at least three closely related ways: first, by, so to speak lifting the other sciences off the Earth and thereby generalizing them; second, by showing that the subjects of these sciences are parts of and are ordered to a larger astronomical context; and, third, by unifying these sciences with astronomy.”

66. *Ibid.*, 1038: “Thus, when astronomy uses physics, it uses it as something potential, partial, and material to understand an astronomical object in a way that is actual, whole, and formed. The application of physics to astronomical phenomena is not merely physics writ large but is an actuation of what is potential in physics and is a unitary grasp of something formed by using principles of physics that are relatively partial and serve as a kind of raw material.” In the unpublished addendum, provided privately, McLaughlin argues that this partial and potential aspect applies even to general relativity.

67. *Ibid.*

68. See De Koninck, “Introduction a l’etude de l’âme,” 25–26, cited above, p. 360, in §22.2, on the order of determination as distinguished from the order of demonstration.

modern specific sciences,”⁶⁹ it can show, in a general way, that there is unity in nature and the general foundations upon which any specific study must build. This is precisely what it does when it provides astronomy with its object, viz., the universe as a unity of order (see above, §20.1).⁷⁰ Further, as argued previously in this section, general natural philosophy is what studies the *primum mobile* as a fundamental agent cause in the cosmos. Consequently general natural philosophy provides the directives to astronomy for studying this world-agency in greater detail, a task which cosmology (as a part of astronomy) takes up most of all. If astronomy is the best contender among the specific sciences for an architectonic and it still depends upon first physics, then first physics truly is first and architectonic among natural philosophy taken as a whole.

Various Dominican philosophers, including those of the River Forest school, have various points of in-house disagreements with De Koninck. Benedict Ashley maintains that, while the modern sciences do exhibit dialectical elements, this does not prevent them from achieving demonstration in the strict sense.⁷¹ He cites De Koninck as maintaining an opposing view. However, it is unclear that De Koninck would be forced to disagree with Ashley’s contention that the specific sciences can approach the essences of things *a posteriori*, just as it is also unclear that Ashley can maintain that the mathematical conceptions of nature—dialectical due to their very nature—reveal the ultimate specifications of natures required by an Aris-

69. McLaughlin, “Astronomy: Queen of the Specific Sciences,” 1016.

70. Thus, the science that studies that whole as such, viz., the universe, is prior. As McLaughlin notes, *Ibid.*, 1038: “In a multiplicity of things ordered together into a totality, the form of the whole is their order.” McLaughlin is paraphrasing St. Thomas and here De Koninck would agree; see *In Meta.*, lib. XII, lect. 12, n. 2627: “Oritur autem ista quaestio ex hoc, quod supra dictum est, quod primum movens movet sicut bonum et appetibile. Bonum enim, secundum quod est finis alicuius, est duplex. Est enim finis extrinsecus ab eo quod est ad finem, sicut si dicimus locum esse finem eius quod movetur ad locum. Est etiam finis intra, sicut forma finis generationis et alterationis, et forma iam adepti, est quoddam bonum intrinsecum eius, cuius est forma. Forma autem alicuius totius, quod est unum per ordinationem quamdam partium, est ordo ipsius: unde relinquitur quod sit bonum eius.”

71. See Ashley, *The Way toward Wisdom*, 220, and fn. 37; 53 and fn. 103; Benedict M. Ashley, “Does Natural Science Attain Nature or Only the Phenomena?,” in *The Philosophy of Physics*, ed. Vincent E. Smith (New York: St. John’s University Press, 1961), 65, 81–82; and finally, Ashley, “The River Forest School and the Philosophy of Nature Today,” 6–8.

totelian science.⁷² James Weisheipl argues that the modern sciences can be understood as *scientiae mediae*, but still emphasizes their hypothetical character and distinction from natural philosophy.⁷³ Nonetheless, this does not prevent him from maintaining a quasi-sapiential role for natural philosophy, as Ashley does.⁷⁴ William Wallace also defends the capacity of the modern sciences for demonstration in the strict sense, as well as the unity between the sciences and natural philosophy.⁷⁵ Furthermore, he defends the role of natural philosophy as a sapiential “philosophy of science” within the domain of the natural sciences, a view he attributes to De Koninck.⁷⁶

However, as Echivard notes, citing De Koninck with approval, natural philosophy possesses an ever-incomplete form because of the pragmatic difficulties posed when investigating the essences of natural things.⁷⁷ Both general knowledge and more specific knowledge of natural things provides Aristotelian demonstration *only* at those levels of determination. For instance, one can be certain of the definition of motion and demonstrate (in the Aristotelian sense) that every mobile must be a body, but this is a general conception of the natural principles involved. What Ashley and Wallace both enunciate on this point, therefore, De Koninck would find himself in agreement with: if one proposes that only upon knowing ev-

72. De Koninck is not opposed in principle to the idea that natural philosophy aims to know the essences of things; indeed he defends it at length—and would agree substantially with the notion of “natural units” or essences and formal parts of essences that Ashley describes as the goal of the natural scientist’s inquiry, see Ashley, “Does Natural Science Attain Nature or Only the Phenomena?,” 66–69.

73. James A. Weisheipl, “The Relationship of Medieval Natural Philosophy to Modern Science: The Contribution of Thomas Aquinas to Its Understanding” in *Nature and Motion in the Middle Ages*, 262–63, 264–66, 273, 275–76

74. Benedict Ashley defends the “epistemologically prior” status of natural philosophy, and provides a similar argument the one I give in §27.1, viz., that natural philosophy is not wisdom simply speaking only because separate substances exist; Ashley, *The Way toward Wisdom*, 90–91, 122–24.

75. Wallace, *The Modeling of Nature*, 292–97, 221–227; see also “Demonstrating in the Science of Nature,” Wallace, *From a Realist Point of View*, 131–59.

76. Wallace, *The Modeling of Nature*, 227, fn. 17; 234–37; and “Toward a Definition of the Philosophy of Science,” in Wallace, *From a Realist Point of View*, 1–21, originally published in Gagné, *Mélanges à la mémoire de Charles de Koninck*, 465–85.

77. Jean-Baptiste Échivard, *Une introduction à la philosophie. Les proemes des lectures de saint Thomas d’Aquin aux oeuvres principales d’Aristote. I: L’esprit des disciplines philosophique fondamentales*, vol. 1 (Paris: François-Xavier de Guibert, 2004), 166–67, and fn. 66.

everything will one know something, scientific knowledge in any sense is impossible.⁷⁸ This is the fruit of the distinction between what is better known to us and what is better known by nature. Progressing along this natural path still results in various grades of scientific knowledge with proportionate levels of specificity.

The differences which De Koninck has with various other positions—such as Maritain’s, concerning the formal unity between natural philosophy and the sciences—does not harm the judgment that general natural philosophy possesses a sapiential character.⁷⁹ Fellow Laval professor Henri Grenier disagrees with De Koninck’s unity thesis but still defends the sapiential character of general natural philosophy.⁸⁰ However, Joseph Owens argues in a 1955 article that the three *propter quid* ways of knowing the natural world (modern science, natural philosophy, and metaphysics) are completely independent of each other. Consequently neither “the natural philosopher [nor] the metaphysician [has] any commission to organize the results of modern science or to unify the physical sciences. That has to be left to those sciences themselves.”⁸¹

As a proponent of the view that some other discipline like metaphysics unifies the modern sciences, Owens points to Renoirte, De Koninck’s dissertation director.⁸² Renoirte’s view,

78. Ashley, “Does Natural Science Attain Nature or Only the Phenomena?,” 66; Wallace, *The Modeling of Nature*, 379.

79. See Maritain, *Science and Wisdom*, 35, 48–49, 68–69; Maritain, *Philosophy of Nature*, 155–56; Maritain, *Degrees of Knowledge*, 186, 189–90;

80. Henri Grenier, *Thomistic Philosophy*, 2nd ed., vol. 2 (Charlottetown, CA: St. Dunstan’s University, 1950), 5–6, 8–9.

81. Joseph Owens, “Our Knowledge of Nature,” *Proceedings of the American Catholic Philosophical Association* 29 (1955): 82. Owens cites with approval the views of Joseph T. Clark, “Comments on Maritain,” *Proceedings of the American Catholic Philosophical Association* 27 (1953): 55, that the sciences of themselves provide their own unity; Clark is commenting on Jacques Maritain, “Philosophy and the Unity of the Sciences,” *Proceedings of the American Catholic Philosophical Association* 27 (1953): 34–54. Below, I return to Clark’s later views in “The History of Science and the Enterprise of Philosophy: A Prelude to Partnership,” *Proceedings of the American Catholic Philosophical Association* 38 (1964): 23–35. McMullin, later that day, criticized this view of Owens, see McMullin, “Realism In Modern Cosmology,” 137–38, questioning whether the *propter quid* status of the modern physical sciences is an accurate description, and whether Owens attributes this to them *per accidens*, viz., in view of the certainty of the mathematics which the physical sciences use.

82. See Fernand Renoirte, *Cosmology: Elements of a Critique of the Sciences and of Cosmology*, 2nd ed., trans. James F. Coffey (New York: J.F. Wagner, 1950), v, viii–x.

however, is not De Koninck's developed position. Renoirte's organization of the sciences provides no place for general natural philosophy that is distinct from philosophical cosmology. The architectonic, according to Renoirte, is metaphysics.⁸³ Neither does Owens' criticism hold up if De Koninck's position is correct concerning the formal unity of natural philosophy and the modern sciences. As Owens himself notes, natural philosophy by its own lights can judge and use the findings of the sciences, just as metaphysics can.⁸⁴ Thus, little would prevent general natural philosophy from being sapiential with respect to the specific parts of the natural sciences if it is unified with them. What is needed is merely to recognize that the specific sciences possess a difference in method and, consequently, a level of scientific subsidiarity proper to them.

27.3 *Objections & replies; untangling various difficulties*

To conclude this section, I will consider seven objections.

(1) *Objection that first physics is false and inadequate*

A difficulty that first arises upon hearing the proposal that Aristotelian natural philosophy is architectonic over the modern sciences is that this is impossible because such a natural philosophy is false or primitive; if it is valuable at all, it is valuable for the history of philosophy.⁸⁵ There is an underlying assumption of the progress of science in this objection: either

83. Renoirte, *Cosmology*, viii–x, 175–76. In his prefatory remarks, Renoirte proposes two similar extremes to the ones De Koninck outlines in “Unity and Diversity,” quoted at length above, but the mean Renoirte seeks is found in a proper understanding of the relationship between metaphysics and the modern sciences, not general natural philosophy. See also the critique of Ashley, “Does Natural Science Attain Nature or Only the Phenomena?,” 79–80.

84. Owens, “Our Knowledge of Nature,” 83.

85. This seems to be the view of Lang, see Lang, *The Order of Nature*, 4–5. This of course denies any perennial value to Aristotle's *Physics*, see *ibid.*, 26. See also Clark, “The History of Science and the Enterprise of Philosophy: A Prelude to Partnership,” 35: “Is all this learned and animated discourse . . . about a general science of nature anything more serious or more important than a physics, faulty from the start, and now forever fossilized as an allegedly permanent achievement of the human intellect? Is it . . . really the case in intellectual conscience that Aristotle's general science of nature is in substance still acceptable in our own day—no matter what happens to be the records of the history of science?” This article of Clark's

Aristotle's *Physics* is false outright or its ideas are inadequate. Their strictures are like a cocoon or molted skin, set aside once science matures.

To reply, we must appeal to common experience and the idea that first physics is first because it is universal. The path into our knowledge of nature, and the general natural philosophy arising from this knowledge, is first because it is a natural progression. Basic realizations—even if vague or indeterminate—such as the principles of change are required for a rational comprehension of natural philosophy as a type of knowledge and not mere opinion (as Cratylus and Plato would have it). These scientific determinations are drawn from common experience as a basis and establish answers to universal topics in natural science. The principles about change, motor causality, and the integrity of the universe have been defended previously, and show the conclusions of which first physics is capable.

(2) Objection that first physics is aprioristic

The “doctrines” of natural philosophy are ossified or crystalized and, as such, incapable of development, correction, or progress. Their scientific edifice is inflexible; Aristotle's physics is like a great oak—it cannot bend or break, and once it is found out to be rotten in its roots there is no saving it. It must fall. That is, the rigor of an Aristotelian science demands deductive certainty from true, first, and unmiddled principles, without which there is no science to be had. In contrast, the corrigibility of modern science is its strength; what need has such a project of an inflexible, overseer?⁸⁶

and also that of MacKinnon were both presented at the ACPA meeting of 1964, when De Koninck was awarded the Aquinas Medal; see Edward MacKinnon, “Aristotelianism and Modern Physics,” *Proceedings of the American Catholic Philosophical Association* 38 (1964): 104, where he terms the norms of Aristotelian physics too primitive.

86. De Koninck himself suggests this difficulty, see *Writings, Vol. 1*, 445. MacKinnon, “Aristotelianism and Modern Physics,” 104, also notes: “I think that the methodology actually employed—though rarely defended—by these scholastic Neoaristotelians is wrong. This methodology is an *apriori* approach to the problem, judging modern science by the imposition of scholastic norms established long before and quite independent of the development of modern physics. The actual use of such an *apriori* approach might well be denied rather than defended; yet it can be induced, in a rather subtle way, by *the ordering involved* in a particular process of education.” This “ordering involved” in the instruction of scholastic physics is nothing

The reply to this objection is that it conflates the order of determination with the order of demonstration. The Aristotelian-Thomistic natural philosopher does not, in Hegelian style, deduce from the general notion of “mobile being” the existence of the keyboard on which I now write.⁸⁷ The more general determinations of natural philosophy are not aprioristic because they enter into the specific sciences with determinations that only investigation at that proper level of science can provide—it is a scientific subsidiarity of sorts. Indeed, the architectonic role of general natural philosophy requires the sufficient *independence* of the specific sciences.⁸⁸

(3) *Objection that first physics is only reflective*

The opposite objection is also raised. General natural philosophy is held to be merely an *a posteriori* reflection upon the deliverances of modern science. The Aristotelian of the book or the Thomist of the strict observance merely alters his interpretation of his hallowed texts in the light of new evidence.⁸⁹ By “grounding ourselves on experience”⁹⁰ furnished by modern science, our flights into natural philosophy will no longer be contentless dreams of empty concepts. The Baconian ascent to first principles would be properly completed this time. What is dependent, however, cannot direct what is before it.

other than the “natural path” of moving from general to particular subjects. Compare MacKinnon’s objection with De Koninck, “Introduction a l’étude de l’âme,” 24.

87. De Koninck, *Writings*, Vol. 2, 161, n. 106; and see De Koninck, “Introduction a l’étude de l’âme,” 24: “Now it is possible that a certain kind of pseudo-scholastic has founded this rumor. But among the masters, one finds nothing at all like it. Indeed, one finds quite the contrary.”

88. De Koninck, “Thomism and Scientific Indeterminism,” 76; De Koninck, “La philosophie des sciences,” 361.

89. From MacKinnon, “Aristotelianism and Modern Physics,” 104, we note that at the worst, this could lead to a distortion, that is, “what it [the Neoscholastic application of the norms of Aristotelian natural philosophy to modern physics] really explains is—not physics as it is—but a philosophically re-orientated residue extracted from physics.” At best, this posteriority makes general physics a mere spectator, unconcerned with the operations of science as such, content to unify on its own terms the scientific conclusions currently available. Again, De Koninck is aware of this objection, see De Koninck, *Writings*, Vol. 1, 445.

90. *Ibid.*

The answer to this concern is to distinguish between the universal in causality and the universal in predication, thereby admitting the partial truth behind of Baconian dream of finding universal operative principles in nature:

If the philosophy of nature were only an extension of experimental sciences . . . , it is understood that it would be purely dialectical, even more conditioned and provisory than scientific theories. Let us remember that even the first parts of the philosophy of nature are based on experience, although their principles are very general and still confused. It seems that the very widespread position that we consider here is only an expression of the desire to go to the most universal principles and causes in the order of concretion, and in this respect, provided that one has not neglected or denied the parts logically prior to the experimental sciences, this attempt responds to the ultimate aim of the philosophy of nature. When the scholastics say that in the experimental sciences are sought the most proximate causes of things, whereas the philosophy of nature seeks the ultimate causes, they are quite right, provided that by ultimate causes one means, not causes most universal in their predicable community . . . , but the ultimate causes which are first by reason of causality, and which we do not know save by way of the more proximate causes. And if one often confuses the two, this is because the properly ultimate causes can be known only in a confused way. So it is that in the *De Anima* we can demonstrate that man is the natural end of all natural species. But this knowledge, although certain, remains very confused. Theories of evolution are only an attempt to rejoin this end in the order of concretion. It is only by means of the latter that we can attain the ultimate cause in itself absolutely. But we have recalled that the experimental sciences remain in a state of motion toward a term that one approaches nearer and nearer without ever attaining it in itself. Thus, the reflections of the philosophy of nature, insofar as they are based on the experimental sciences, themselves remain in a state of dialectical movement toward a term which is no less the ultimate aim of all our knowledge of nature.⁹¹

It is this precise distinction which has been expanded upon with regard to the *primum mobile*, in place of De Koninck's example above of biological evolution. De Koninck's answer captures both the formal unity and distinction in method defended in Chapter 6, as well as the approach to universal causes through particular causes defended above, for which conception general philosophy is necessary. This reflection is one of its sapiential functions,

91. De Koninck, *Writings*, Vol. 1, 454–55.

for the contemplation of a whole as such is a type of wisdom. Correlatively to the answer to the previous objection, just as first physics does not deduce all specificity in the natural sciences *a priori*, so also does it not suffer by learning from below, *a posteriori*.

(4) *Objection that first physics is too vague and confused to rule*

The problems that first physics seems at once aprioristic and also reflective can be united in one objection, viz., that, remaining as it does in vague and confused knowledge, first physics cannot be a ruling form of knowledge.⁹² It seems aprioristic and potentially misleading if we rely too much on these vague and confused notions, and it seems reflective and superfluous when we return to enrich them. In neither case is first physics “first” in the sense of being a type of wisdom.

The solution to this problem is found at two levels. First, the objection forgets two lessons of *Physics*, Book I, ch. 1. First, our initial knowledge of nature, while indistinct, is more certain; second, there is in our knowledge an order of concretion or determination that allows our more specific researches to better fulfill the aim of natural philosophy but which does not eliminate the certitude of the fundamental common experience with which we began. To identify the two modes of general natural philosophy and the experimental sciences would entirely miss “the point of the ancients and of wisdom.”⁹³ That is to say, the goal even

92. De Koninck, *Writings*, Vol. 1, 445: “Moreover, it indeed seems that the experimental sciences better realize the end the ancients themselves proposed for the study of nature, which is achieved in the *Meteorology*, the treatises on the animals, and the *Parva Naturalia*; the earlier treatises such as the *Physics* and the *De Anima* remain in generality and confusion.” McMullin also voices this objection, at two distinct levels, in “Philosophies of Nature,” 59: “It is difficult to justify in a rigorous epistemological way the isolating of the structures of pre-scientific experience at no matter how high a level of generality; it would seem that the precisions worked by science on key natural categories like *force* and *time* have got to be taken into account in any adequate [philosophy of nature]. And the notion of a ‘common core of experience,’ independent of linguistic or cultural changes, runs into a host of difficulties Furthermore, there is a danger that the pushing of a [philosophy of nature] to higher and higher generality will end either by making it completely trivial, or by making it an analysis of predication about nature instead of nature. Thus, instead of ‘substance’ we end with ‘subject of predication,’ ‘whatever is being talked about;’ instead of ‘form,’ we have a ‘predicate,’ ‘something that is said of something else.’ It is easy enough to make this sort of analysis invulnerable, but also totally vacuous.”

93. De Koninck, *Writings*, Vol. 1, 453.

of the ancient physicists was a complete knowledge of nature. General natural philosophy, therefore, is a wisdom insofar as all the discoveries it achieves are foundational to an ordered whole of knowledge about the world. For this reason, De Koninck states that “To identify the philosophy of nature with the experimental sciences which are only its dialectical extension is to destroy it in its root, to deny the most certain part of our knowledge of nature, as well as its most noble natural subject [viz., the human being].”⁹⁴ General natural philosophy is based upon a prior source of fundamental experience which later studies cannot overturn—if anything, motion, act, and potency as words denote realities common to any culture. Consequently, I deny McMullin’s inference outright.

The second level requires us to see just what it means for Aristotle’s *Physics* to depend upon categories of predication. All parties of interpretation admit this. However, the ontological claim which the categories as logical tools make is that they allow the philosopher to see the categorical structure of being; thus, from the substance and principles of mobile being, one investigates its quantity, qualities, relations, time, place, and action and passions—what are called the concomitants of mobile being.⁹⁵

(5) *Objection that first physics is not missed*

Why, if natural philosophy is logically prior, does everyone not feel its absence?⁹⁶ That is, few people miss Aristotle’s *Physics*. If its subject matter were so foundational, it seems that a greater number of rigorous and intelligent minds would notice the need to study this subject matter.

A general reply to this objection is that many scientists are forced by their very inquiries to turn to philosophical reflection to more fully understand the object of their inquiry. The

94. De Koninck, *Writings*, Vol. 1, 453. In “Thomism and Scientific Indeterminism,” 61, De Koninck calls man “the principal subject, or *subjectum attributionis*, of Philosophy of Nature.”

95. Ashley, *The Way toward Wisdom*, 76–84, also notes this categorical structure of the investigation in the *Physics*.

96. De Koninck, *Writings*, Vol. 1, 452.

claim which general natural philosophy adds is that what they perform as a reflection is of the same order as the type of inquiry that can be carried out first in the sequence of discovery. The specific reply to this objection has two parts. First, De Koninck reasons that the absence of general natural philosophy is not keenly felt because its beginning is easy to miss, since this beginning is taken up “from the point of view of intelligence and not of sensation.”⁹⁷ That is, the first difficulties in philosophical physics are already such as to require an abstract or intellectual mode of proceeding. These difficulties strike the modern mind with its empirical sensibilities as “purely philosophical questions”—such as the solution to the Parmenidean dilemma about change, the basic insights into the principles of change, the definition of nature or motion, etc. By contrast, the experimental sciences treat of the sensible singular itself using empirical methods of measurement. Furthermore, this rigorous sense-knowledge (the experimental method) is also coupled with a mode of knowledge “which is most proportioned to our intelligence,” namely mathematics.⁹⁸ Thus, the mind is distracted from the entry into natural philosophy by a mode of conception of far greater clarity and precision.

(6) Objection that first physics is useless

Yet if natural philosophy is still present even if ever unnoticed, another objection arises. As Sachs articulates, “Perhaps the strongest motive for the resistance to opening [modern] physics to philosophic examination is the plain fact that there is no need for physics to do anything differently.”⁹⁹ If general natural philosophy is foundational and prior in the intellectual order, what good would it do the modern physicist to take up the “original questions” in the study nature?

97. De Koninck, *Writings*, Vol. 1, 452.

98. *ibid.*, 452–53.

99. Aristotle, *Aristotle's Physics*, 12.

De Koninck answers this with another question: “Would the bricklayer be a better bricklayer if he were an architect?”¹⁰⁰ Well, in a way yes and in a way no. The bricklayer has knowledge proper to his own domain; he is, to some degree, an independent contractor. However, what De Koninck wishes to avoid is an ignorance of what is essential between the prior and posterior parts of natural philosophy. What is first studied in general natural philosophy is furthered in its details by cosmology, chemistry, and biology. Inattention to order, “if only to that which is imposed on us by the very nature of intelligence,” does “violence to wisdom, and hence to the science of nature insofar as it is philosophical.”¹⁰¹

(7) *Objection that natural philosophy is formally separate*

It is worth emphasizing that it is really claims about the disunity of the sciences which prevent the conclusion about the sapiential office of general natural philosophy. While thinkers on the side of Maritain maintain such formal disunity while retaining this sapiential role, they do so by defining the exercise of natural philosophy’s sapiential function as productive of some form of unity.¹⁰² Here, the analogy that this position uses to metaphysics is too strong.¹⁰³

100. De Koninck, *Writings*, Vol. 1, 452. Here, De Koninck anticipates his description in “Introduction a l’etude de l’âme,” 60–61, of the notion of the specific natural sciences acting as “the bricklayers” in a larger project; he also uses this image in “The Unity and Diversity of Natural Science,” 11–12, 16–17, the latter pages are quoted above, beginning on p. 460.

101. De Koninck, *Writings*, Vol. 1, 452.

102. See Maritain, *Science and Wisdom*, 35, 48–49, 68–69; Maritain, *Philosophy of Nature*, 155–56; Maritain, *Degrees of Knowledge*, 186, 189–90. De Koninck follows this line of thinking early in his career: see De Koninck, “Thomism and Scientific Indeterminism,” 74–75; De Koninck, “La philosophie des sciences,” 361; and “Reflections on the Problem of Indeterminism” in De Koninck, *Writings*, Vol. 1, 437–38.

103. That is, as Aristotle implies in *Metaphysics*, III.2, 997a15–25, there must be a way to distinguish the specific sciences, or otherwise a “monistic” account of theoretical philosophy would result. Consequently, if sciences are distinct, how they study their objects may bear relationships to the other sciences or even to themselves (due to the nature of the principles of those sciences). See De Koninck, “Thomism and Scientific Indeterminism,” 75: “[M]etaphysics, from the very fact that it has being as its object, it also covers somehow all the inferior sciences which treat of particular beings or particular aspects of beings, and may judge them, defend these sciences and use them, just as theology uses philosophy in general. Reflecting on mathematics, metaphysics becomes philosophy of mathematics, which is only materially mathematical, even though the date used be formally mathematical. And just as there is a metaphysics of mathematics, there is a metaphysics of philosophy of nature. Philosophy of nature participates in this second sapiential function of metaphysics in which it goes beyond its limits as a science, and *as a wisdom relative to itself*.” That is, since the formal object of natural philosophy is being as mobile, natural philosophy cannot reflect upon itself as metaphysics

That is, metaphysics must “come out of itself” to rule the other sciences precisely because metaphysics possesses a unique degree of abstraction, viz., *separatio*. Yet as De Koninck realized later, the prior question is whether or not natural philosophy and the sciences are formally different. A defense of their formal unity still leaves room for the old qualified sapiential functions at the level of general natural philosophy.

If one formally separates the speculative disciplines too sharply, the only dignity left to natural philosophy, thus reduced to the role of a mere spectator, would be to claim its own independence within a space that it marked out for itself. It may, to be sure, learn *per accidens* from the modern sciences by way of details, but would retain to itself its own proper roots or origins which would as such be incommensurable with those of the natural sciences. This basal independence of metaphysics, physics, and natural science is proposed by Owens.¹⁰⁴ Indeed, in view of such radical independence, Owens suggests that (in the *a*

can. Metaphysics, because its mode of conception is being qua being, can measure the truth of its principles by measuring them against that of which they are the principles: being as such. Natural philosophy, by contrast, “cannot touch on the absolute ground of its subject, mobile being: the being that it grasps only under the angle of mobility.” (De Koninck, “Reflections on the Problem of Indeterminism” 437) Its mode of conception, studying being as mobile, cannot be used to measure the truth of the principles of mobile being, for the principles are not themselves mobile. (This does not prevent the natural philosopher from resolving to immobile principles; he merely cannot study them in a mode commensurate to his inquiry. For instance, Aristotle concludes to a negative thesis about the first underlying, namely, that it is not subject to generation and corruption; see *Physics*, I.9, 192a26–34.).

104. Owens, “Our Knowledge of Nature,” 85–86: “Each of the three, then—the modern scientist, the natural philosopher, and the metaphysician—has his role to play in providing mankind with knowledge of nature, from the radically different viewpoints respectively of a sensible thing’s being, substance, and quantity, the only three viewpoints which have furnished *propter quid* knowledge of natural things. Each has a procedure which is in itself radically independent of the others. An outside worker, as the moralist or the theologian, may have occasion to call upon all three procedures to furnish data for the solution of his problems. But in themselves the three procedures have no intrinsic interdependence.” McMullin strenuously objects to this overall view, see McMullin, “Realism In Modern Cosmology,” 137–38.

The claim that the modern sciences provide *propter quid* knowledge is introduced previously by Owens, see his *ibid.*, 79–80 and fn. 59, where Owens disagrees with De Koninck’s claim that the modern sciences are best characterized as dialectical extensions of natural philosophy. Owens cites the two studies of De Koninck’s, Charles De Koninck, “Les sciences expérimentales sont-elles distinctes de la philosophie de la nature?,” *Culture* 2, no. 4 (1941): 465–476, and De Koninck, “Introduction a l’étude de l’âme.” Owens maintains this position in an appendix to his later “Matter and Predication in Aristotle,” in McMullin, *The Concept of Matter*, 94–95. He states there: “It is true that before physics was developed through quantitative procedure as a special science, its problems had in point of historical fact been given over to the non-mathematical treatment of natural philosophy. That way of dealing with its problems was entirely illegitimate. The specific *differentiae* of natural things remain unknown and impenetrable to the human mind. They cannot be made the source

posteriori mode just mentioned) the modern sciences themselves develop their own natural philosophies or systems of metaphysics along with the process of their own development.¹⁰⁵ The Aristotelian philosophy of nature is left out in the cold of its own speculations, warmed by no essential fire from modern science.¹⁰⁶

The brunt of Owens' objection, that natural philosophy and the modern sciences are formally distinct in a strong sense, has been shown (in Chapter 6) to be incorrect. The priority of common to proper experience shows this. The priority of general terms to particular terms shows this. The priority of words to symbols shows this. The nature of a middle science—defining as it does with sensible matter with a goal of knowing mobile and not mathematical beings better—shows this. Ultimately, however, the admission Owens makes at the end regarding “new types of metaphysics” can be used to show the opposite point. Such science-inspired metaphysics is either mere scientism or, just like the unexamined terms of Cartesian or Kantian metaphysics of natural science, are subject to all manner of objections that require one to enter into the natural path overseen by general natural philosophy.¹⁰⁷ Indeed, insofar as the best of the scientists in the 20th century practiced it (and as De Koninck recognizes when he learns from their philosophical musings), they are in fact returning to the general

for scientific knowledge of the specific traits of corporeal things. For this reason any new attempt to treat the experimental sciences as a continuation of natural philosophy, e.g., C. de Koninck, . . . , cannot hope to be successful.” The limiting approach to natures known in their concretion that De Koninck advocates shows something of the truth of Owens' points here. It should be noted that the position ascribed to De Koninck by Owens saddles him with a reason which Ashley denies De Koninck when accusing him of making the natural sciences *merely* dialectical (see fn. 72). *Both* cannot be right.

105. Owens, “Our Knowledge of Nature,” 80: “Moreover, new types of metaphysics, from the Cartesian First Philosophy on, and new types of natural philosophy, have successively arisen in correspondence to the different stages in the development of this newer knowledge of nature, and usually have been conditioned to a large extent by the contemporary stage of physical research.”

106. This point of Owens' should be related to the position of Van Melsen, see Van Melsen, *The Philosophy of Nature*, 15–17; see also MacKinnon, “Aristotelianism and Modern Physics,” 107–108.

107. To take one example, which would actually require sustained proof but is illustrative: Kant's definition of motion is mere succession of one predicate by its contradictory opposite; see Kant, *Critique of Pure Reason*, B48–49, and B291–92. Thus, his account of motion, while subtle and depending upon the reality and continuity of the intuition of time, is no more advanced than the Pre-Socratic; he has not in fact discovered the principles of change, and he cannot on his terms explain the continuity of motion, topics Aristotle resolves in the *Physics*.

realm of knowledge of nature to locate their particular study within the whole. They are yearning for first physics.

§28 GENERAL NATURAL PHILOSOPHY JUDGES, DEFENDS, USES, AND ORDERS THE SPECIFIC NATURAL SCIENCES.

It is in this sapiential function into which metaphysics comes out of itself as science even while remaining in the domain of being, that the philosophy of nature participates. The latter will not be wisdom *simpliciter*, since it cannot reflect on itself, nor can it reach the root of its object, mobile being—being that it only attains under the angle of mobility. . . . It can judge, defend, and use the experimental sciences. It is not wisdom, no doubt, *simpliciter*, but *secundum quid*. It is this sapiential function of the philosophy of nature that we call philosophy of the sciences.

CHARLES DE KONINCK
 “Philosophy of the Sciences:
 Sapiential Function of the Philosophy of Nature”

With the understanding established previously in Chapter 6 that philosophy of nature does not “come out of itself” as a formally distinct discipline when it exercises its sapiential functions, we can now note some examples of these functions. Attempting to follow De Koninck, I will briefly indicate some of its sapiential functions: to judge, defend, use, and order the more determinate sciences in natural philosophy. Just as metaphysics would judge the soundness of particular conclusions reached in the parts of philosophy with respect to the whole of knowledge, defend their principles against doubt, use or reflect upon their specific conclusions in its own light, and provide a speculative principle of order between the disciplines, so also does the general part of natural philosophy function with regard to the specific disciplines within natural science. De Koninck himself, it seems, sought to

demonstrate through practice the possibilities of these various roles throughout his work on natural philosophy.¹⁰⁸

28.1 *Sapiential function: judge*

Natural philosophy could judge whether or not a science was in harmony with the certainties of common experience, for instance, by critiquing biology when it takes a reductive approach to the study of life. We should begin the study of the living through what is more obviously alive (e.g., a horse) than the more obscure cases (e.g., a virus). De Koninck does this himself, defending the claim that one must begin with the certainty of the interior experience of being alive and the clear identification of this in other animals in order to grant the subject under study (“life,” “living beings”) any meaning.¹⁰⁹

In cosmology, examples of this sapiential role would be when proofs concerning the non-existence of the void and the finitude of the universe are used to exclude certain proposals made by cosmology. The hyper-realism of mathematics is another critique which the natural philosopher can make at least negatively. The natural philosopher can say that mathematics is not adequate to understanding the natural world. (The reason why—because it leaves out sensible matter—is given properly only by the metaphysician.)

28.2 *Sapiential function: defend*

It would be a function of first physics to defend a methodological principle such as the relativity of measurement, which De Koninck took up in his dissertation on Eddington.¹¹⁰

In brief, his argument is as follows. Mathematical science is a study with a formal object

108. De Koninck, “La philosophie des sciences,” 361–62, provides De Koninck’s early interpretation of these various functions; he describes, in order, the functions of defending, ordering, judging, and using the particular sciences. His “provisional division of the philosophy of the sciences,” *ibid.*, 362, shows the earmarks of a early, unelaborated idea, and that before he shifted his view to the formal unity of natural philosophy and the experimental sciences.

109. See De Koninck, “Introduction a l’etude de l’âme,” 11–17; De Koninck, *The Hollow Universe*, 83–87; De Koninck, “Is the Word ‘Life’ Meaningful?,” 82, 85–87.

110. De Koninck, “The Philosophy of Sir Arthur Eddington,” De Koninck, *Writings, Vol. 1*, 124–27.

constructed by measurement. Yet a formal object constructed by measurement is a relativistic object, because we cannot abstract from the concrete mobility of the system, and hence must introduce simultaneity as a factor. The middle term here (a formal object constructed by measurement) defends why relativistic simultaneity must be used in science. This reasoning is natural philosophical because it recognizes the conditions under which the mathematical physicist must construct his formal object.

General natural philosophy would also defend the methodological principle of indeterminism and explain why objective physical indetermination exists.¹¹¹ The basic line of reasoning here is that natural forms are themselves contingent—they possess an intrinsic “margin” of indeterminacy.¹¹² As a consequence, they do not completely determine the prime matter of which they are the form. Hylomorphism is, therefore, the general philosophical basis for the indeterminacy of events.

The central example of a “defense” which natural philosophy provides is to cosmology, the study of the universe. Through the arguments for a first principle of place, time, and motor causality within the cosmos, natural philosophy discovers mobile being to be a unified system of ordered, causal interactions. Yet this is a universe—vaguely conceived, of course, but for precisely this reason is it then handed on to another science at a greater level of determination.

111. See “The Problem of Indeterminism” and “Reflections on the Problem of Indeterminism,” both in De Koninck, *Writings, Vol. 1*. Consider also his last published work on this topic, “Nature of Possibility: Some Meanings of ‘Chance’ and ‘Indeterminacy’.”

112. McMullin, “Realism In Modern Cosmology,” 141, accuses De Koninck of taking a “Platonic” view of form. This seems unfair, for it is against the “angelism” of form that De Koninck is explicitly arguing; see De Koninck, “Thomism and Scientific Indeterminism,” 61: “Our Philosophy of Nature reeks with *péchés d’angélisme*, it is often no more than bad angelology.” If McMullin is right, and Aristotle’s natural forms are perfect sources of determination, then De Koninck’s innovation is a great one indeed. However, his essays make clear that he finds himself drawing out a consequence of what Aristotle means by natural forms when comparing it with Aristotle’s doctrine of chance events. See also above, Ch. 6, fn. 140.

28.3 *Sapiential function: use*

The function of “use” also implies a type of command, viz., that the higher sciences asks for speculative results (as it were) of a more determinate type than it is able to provide for itself. Thus, first physics could also make use of the results of work in evolutionary biology to make its general philosophical account of the teleological order of all natural species to the human species more determinate.¹¹³

The example in this project is the dialectical proposals which modern physico-mathematical cosmology offers to general natural philosophy concerning the specific nature of the *primum mobile*. Just as metaphysics draws upon the determinate findings of the specific disciplines for instances of act and potency, unity, or goodness, so also general natural philosophy learns from cosmology about the first moved mover. The key difference here, of course, is the fact that metaphysics possesses a mode of definition that is unique among the other parts of philosophy (speculative or practical), whereas first physics possesses the same mode of definition as the specific parts of natural science. The light of metaphysics in its use of lower sciences would be more penetrating; but the light of general natural philosophy—which can keep the whole in view precisely because of its generality—is still capable of a like use.¹¹⁴

28.4 *Sapiential function: order*

General natural philosophy also serves as a principle of order. One instance can be taken from De Koninck’s study of the nature of symbolic signification. Because symbols are posterior to words, that habit of knowledge which understands the meaning of the symbols possesses a sapiential role in fitting their meaning to a larger pursuit within natural philosophy. The

113. De Koninck, *Writings*, Vol. 1, 235–54, and “Are the Experimental Sciences Distinct from the Philosophy of Nature?” *ibid.*, 454–55.

114. Thomas J. McLaughlin, “Astronomy: Queen of the Specific Sciences,” *Angelicum* 87 (2010): 1015–1041, also provides examples of how astronomy uses the other specific sciences for its own ends; he discusses geology, biology, chemistry, and physics.

reason for this is that the combined mode of definition (a mathematical measurement applied to sensible matter and symbolized) is a tool for the sake of understanding mobile and material beings; therefore the habit of knowledge which conceives this *telos* is an architectonic form of knowledge.¹¹⁵ This is precisely what first physics does, for instance, when attempting to understand the formalisms of general relativity when used as a tool in cosmology. Further, that entropy is a *per accidens* unity is seen only by the natural philosopher and not by the mathematical physicist as such.

The habit of first physics would also be the means to see the relationship between the meaning of particular systems in the sciences and the meaning of terms used in more general studies. This would lead to an undertaking similar to the study of analogous terms. De Koninck maintains that the great scientists also see this as a function of a study more general than their particular science.¹¹⁶ In this respect, first physics uses primary experience itself and orders secondary, private data from experiments to itself. De Koninck makes similar remarks about the analogous uses words in biology, e.g., the word “life” and “organ.”¹¹⁷

These, however, are examples akin to the office of ordering analogous meanings that the first philosopher would possess simply. What about being a principle of order when it comes to knowing the principles of being? This project, following De Koninck’s suggestions, has attempted to develop the connection between first physics and cosmology, and the principle in being investigated was the first moved mover.

While Aristotelian cosmology incorrectly identified the particular being in question as the outermost celestial sphere (and its ethereal subordinates), it was, as a specific science, still being guided by general natural philosophy as a principle of order with regard to investigating

115. See De Koninck, *The Hollow Universe*, 112–13, quoted above, on p. 457, where the key line is as follows: “[T]o hold this general objective steadily in view, and in its light, to pass judgement on the conclusions of specialized branches of research, is the business of natural philosophy—which should be the concern of each and every scientist.”

116. See De Koninck, “The Unity and Diversity of Natural Science,” 23.

117. De Koninck, “Is the Word ‘Life’ Meaningful?,” 86–88; De Koninck, *The Hollow Universe*, 86–87, 95–98.

the principles of mobile being. Thus, De Koninck would have us maintain that Aristotle's was an error in the order of concretion. The general arguments do not conclude to the species or number of the *primum mobile*—they are too indeterminate. However, since the general arguments concluding to its existence are correct, the natural philosopher has merely failed to call the right man “Dad.” He must therefore use a more particular investigation to identify the specific agent in question and determine how the features ascribed to it (in answer to investigations about void, place, time, and causality) actually obtain. Thus, insofar as the general part of natural philosophy would discover that such an agency is required for motion but could not identify its specific nature due to a lack of determinate experience, such a discovery would function as a principle of investigative order—a command within theory—to a more particular science to find out exactly what this being is and what features it possesses. First physics is, indeed, sapiential or architectonic.

CODA TO CHAPTER 7

Pieper notes that it is the mark of leisure to find contemplative rest in things, while it is the work of reasoning to scurry around, figuring things out.¹¹⁸ A similar division can be found in the natural sciences. When it is claimed that first physics is architectonic over the specific parts of natural science, immediately one might ask what first physics “does” or what it “proves” that the more specific disciplines cannot. Yet this is to think that first physics enters as *reasoning* or as a proof structure into the latter. This is not the case. General natural philosophy does not function demonstratively through the lower disciplines, but as a general determination of them; this determination gives them order, proscribes certain conclusions, and only prescribes certain conclusions in the manner of directives. A similar confusion can result when thinking that the “practice of science,” or the acts devoted to discovery and figuring things out is equivalent to the act of science itself: viz., the insight

118. Josef Pieper, *Leisure: The Basis of Culture; with The Philosophical Act*, trans. Alexander Dru (San Francisco: Ignatius Press, 2009), 28–30.

grounding a demonstration or proof. But these differ as the work of dialectic and reasoning to the rest of insight or understanding.

What is more, speaking about the sciences with respect to each other too easily translates to thinking about them as different individuals. Is *the philosopher* going to tell *the scientist* what to do next? While this mode of speaking is certainly useful at times, what we are really speaking about (when not discussing the logical structure of a science or its mode of defining) are speculative habits, the perfections of someone's soul insofar as they have a ready ability to contemplate the natural order. First physics, ideally, would be the foundational speculative habit of the practicing scientist. By defending the sapiential office of first physics, or general natural philosophy, I wish to establish, if nothing else, the place of this contemplative attitude.

Conclusion

When I was a young man I was wonderfully keen on that wisdom which they call natural science, for I thought it splendid to know the causes of everything, why it comes to be, why it perishes, and why it exists.

PLATO
Phaedo, 96a

In the course of this project, I have shown that general natural philosophy is a qualified form of wisdom by expanding on Aristotle's insight in *Physics* I.1 that natural philosophy follows an investigative arc along the natural path in our knowledge that proceeds from what is better known to us to what is better known in itself, or by nature. The whole of the project was guided by the work of Charles De Koninck, and aimed at developing, as a concrete example, De Koninck's idea that general natural philosophy can prove the existence of the *primum mobile* but requires a specific science to determine its nature and properties. This exhibits general natural philosophy in its sapiential role.

This project therefore required that we begin by showing that physics defends the reality of motion and thereby defends its own existence while discovering its first ultimate cause. Its beginnings also include understanding nature as a *per se* cause of motion; the question therefore arises whether or not *per se* efficient causality and *per se* intelligibility are prior to chance causes in the whole. The burgeoning natural philosopher, after defending the existence of nature and its general notion as a principle and cause, defines motion itself. In the course of this definition, a demonstration that action exists in the mobile shows that

the mobile as such is passive; this motivates further investigation into the efficient causes of motion. However, before investigating the mover, the natural philosopher investigates the concomitant properties of mobile being, since his inquiry is *a posteriori*. The natural path of investigation in physics leads from the principles, causes, subject, and definition of motion to consider the primary concomitants of mobile being.

Along this route, the natural philosopher discovers further indications about the causal closure of the cosmos. The existence of place requires an ultimate principle of immobility for being placed. The existence of time as a measure of absolute simultaneity depends upon the unity of a cosmic measure of time. Indeed, absolute simultaneity demands that a single cosmic measure of time must exist. The impossibility of the void indicates that some cosmic plenum must exist. Furthermore, since every mobile subject to motion *per se* must be a body, if there is a first moved mover, then the nature of the first moved mover must share in corporeality in some way.

These prior indications about the concomitants of mobile being prepare the mind for inquiring after the agent causes in the cosmos as part of the overall *a posteriori* investigative arc of general natural philosophy. The argument for a first mobile provides the necessary integrity for the general inquiry into mobile being as such. The first moved mover exists, and this was shown as a corollary to three arguments involving the First Mover: from the nature of the mobile continuum, from the priority of act to potency, and from the conditions required for generation and corruption. The more specific determinations of these conclusions made by Aristotelian and medieval cosmology, however, are severable from the general conclusions of these three arguments. This allowed the investigation to turn to ask modern cosmology about the more determinate nature of this being, the fundamental instrumental agency in the cosmos. Its dialectical answer is “physical space.”

§29 THE HUMAN MIND IS COMMENSURATELY ORDERED TO KNOWING THE SENSIBLE COSMOS AND ITS FIRST PRINCIPLES, FIRST CAUSES, AND PRIMARY ELEMENTS.

We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time.

T. S. ELIOT
"Little Gidding"

After following out this investigative arc, it becomes clear that, to the speculative human mind, the cosmos is its road to knowing all being. This is because natural philosophy is maximally conformal to the human mind and the "natural path" is the proper expression of this conformal character. De Koninck observes, following St. Thomas:

Our intellect can only live in the shadows. The necessity of the shadows of the sensible world has its origin in the weakness of our intelligence. By its nature, our rational life is the least perfect intellectual life it is possible to conceive.¹

Indeed, seen teleologically, the material order exists for the sake of the human intellect. The human intellect needs not only an apt environment for learning but also an apt material principle precisely because it, as an intellect, must turn "outward" to find its perfection as a knower.² Whether or not this teleological order must also be achieved through an evolutionary history is not the issue, only the intrinsic demands of the human type of intellect.³ De Koninck sees in this hierarchy and teleological necessity the reason for the existence of

1. De Koninck, *Ego Sapientia: The Wisdom That Is Mary*, in *Writings*, Vol. 2, 25. For instance, see St. Thomas, *De Veritate*, q. 8, a. 3, ad 3: "Intellectus angelicus dicitur esse speculum purum et incontaminatum et sine defectu, quia non patitur defectum intelligibilis luminis, considerata natura sui generis, sicut patitur intellectus humanus, in quo intelligibile lumen obumbratur in tantum ut necesse sit a phantasmatis accipere, et cum continuo, et tempore, et discurrendo de uno in aliud; propter quod Ysaac dicit, quod «ratio oritur in umbra intelligentiae»; et ideo potentia intellectiva eius potest intelligere omnem formam intelligibilem creatam quae est sui generis." (Leon.22/2.226)

2. St. Thomas, *ScG*, II.46, II.90; *Q. De Anima*, a. 7; see also De Koninck "The Problem of Indeterminism," in De Koninck, *Writings*, Vol. 1, 392; and Pieper, *Leisure*, 104–105.

3. For instance, see St. Thomas, *Q. De Anima*, a. 8, where he is concerned with the proper material and bodily dispositions that are required for the human soul and its intellectual operation. See also De Koninck, "Thomism and Scientific Indeterminism," 59–60, and also *The Cosmos*, in *Writings*, Vol. 1, 287–89, 296.

matter, contingency, and even temporality.⁴ God has no need to pursue an end because He is goodness and perfection itself. Since the goodness and perfection of intelligible species belong to an intellect as subject, the separate substances or angels, possessing knowledge innately, can pursue the highest good from their own internal resources. Their durations are not measured out with respect to an existence or conditions external to themselves. They are each, as it were, their own miniature universe.⁵ It is only in the human intellect that we find a need for a common “exteriority” or a principle that is non-intellectual, viz., matter: “To speak absolutely, prime matter in its very essence answers to the need of spirit; the body is implicated in the idea of soul, it is in the soul rather than the soul in it.”⁶ Consequently, the material cosmos is for the sake of the human intellect insofar as the intellect is ordered with all other created intellects to their first principle. The natural path of the human mind into nature is maximally conformal to the human mind for this reason. It is the route by which the mind—in speculation straining every nerve—is led back to God.

In this light, should the various rejections of the natural path (§II) be judged harshly? Insofar as the rejection of nature warrants such condemnation. This modern turn replaces the speculative end of natural philosophy with a practical end. The natural origin of knowledge along the “natural path” is replaced by an artificial or conventional one. The form of the investigation (in predicable wholes or universal words, from the general but vague and confused to the specific and more distinct) is replaced by a symbolic one, prizing clarity

4. De Koninck, “Thomism and Scientific Indeterminism,” 60–61.

5. See De Koninck, *The Cosmos*, in *Writings*, Vol. 1, 320, where De Koninck defines the cosmic universe in reference to “the universe” as the created order: “The inorganic world and the human species are alone part of the ultimate perfection of our cosmos. But their specific difference is not sufficiently profound to be of the essence of the universe. In corporeity they have a common natural genus. It is this insufficiency of unity of essential order that enables St. Thomas to formulate an argument for the existence of the angels who are specifically different from one another and exist outside any natural genus. Our cosmic universe is only the bottom rung of the whole of creation, of the universe in the full sense, where a pure and essential unity of order reigns. Like an isolated angelic species, our whole cosmos is only a degree, the lowest, of the universal hierarchy. It is only in the ensemble of the created universe, that is, in the ensemble constituted by all the specific universes that are the angels and the cosmos, that we find that pure hierarchy which is of the very essence of the work of God.”

6. *Ibid.*, 288.

and distinctness. The traditional sapiential character of philosophy is changed into a new character of critical evaluation and limitation. Yet De Koninck's proposals, bringing to bear the resources of perennial philosophy, answer these rejections. They correct the pragmatizing "revolt of the natural philosophers." The artificial tools of inquiry (experiments) and symbolic constructs can be reintegrated into a view of the cosmic whole possessed by first physics. This type of wisdom, instead of closing in on itself as an unconditioned transcendental insight, discovers its own incompleteness and openness to a higher form of wisdom.

§30 WHILE THE INTEGRAL 'PHYSICUS' IS AN IDEAL, THE CONSOLATION OF NATURAL PHILOSOPHY COMES THROUGH REESTABLISHING THE PRINCIPLES UPON WHICH SUCH AN IDEAL IS BASED.

The integral *physicus* has become an impossible being. Certainly, we should rejoice at this. But not without regretting these limits of the individual intelligence.

CHARLES DE KONINCK
"Introduction to the Study of the Soul"

If general natural philosophy discovers itself to be a qualified form of wisdom with respect to a higher form of knowledge that it understands only by negation, it nonetheless helps the human mind to realize its own limitations with respect to more specific areas of natural philosophy. The "integral *physicus*" is a practical impossibility. Thus, first physics is also a form of wisdom insofar as it provides a moderation of the speculative appetite and would check any special science by reminding its practitioners of the nature of the certainty they possess. This dissertation attempted to exhibit the exercise of such a sapiential function, following De Koninck's cues, with respect to modern physical and mathematical cosmology. This exercise allowed us to see the qualified wisdom general natural philosophy possesses.

As a corollary, the recognition of a type of "first physics" would help avoid various strains of scientism so prevalent in our culture. Indeed, the pedagogical consequences of general natural philosophy as sapiential should not be passed over without some note, especially

since education was a pressing concern for De Koninck.⁷ This is evident most of all in the pedagogical character and context of so many of his works. This proposal has not gone unnoticed, especially among De Koninck's students. But the sapiential role of natural philosophy as part of a liberal education is noted by others as well.⁸ De Koninck would have us realize "mutual gifts" between philosopher and scientist throughout all the disciplines that study nature. Indeed, the universal character of first physics demands it. The root of its conviction comes down to the claim with which Aristotle begins his *Physics*, namely, that there is a "natural path" the human mind takes into its knowledge of nature. If it is a natural path, then the human mind must establish first physics prior to its more determinate researches. The excellence of such a beginning is critical.

7. See Charles De Koninck, "Philosophy in University Education," *Laval théologique et philosophique* 8, no. 1 (1952): 123–129, and "La philosophie au Canada de langue française," *Laval théologique et philosophique* 8, no. 1 (1952): 103–111. Here one is also reminded of the place that Robert Maynard Hutchins, *The Higher Learning in America* (Piscataway, N.J.: Transaction Publishers, 1945), 94–97, proposes for metaphysics as a principle of unity and order in the modern university. He proposes metaphysics as the neutral, natural supplement in place of theology (the architectonic knowledge of medieval universities). Since I distinguish between metaphysics and natural philosophy as types of wisdom, the pedagogical role of natural philosophy as a form of wisdom ought to be qualified with respect to metaphysics, which in turn (in Catholic colleges and universities) ought to be qualified with respect to what St. Thomas calls *sacra doctrina*.

8. Christopher O. Blum, "The Prospect of an Aristotelian Biology," *Proceedings of the American Catholic Philosophical Association* 87 (2013): 95, 96: "Monsignor Robert Sokolowski, for one, has suggested that Catholic higher education would profit from the attempt to revive a 'streamlined Thomism' that would 'focus on the human soul.' And it is interesting to speculate about the complexion of a new generation of biology majors formed in part by the close reading of Aristotle's *Physics* (say, books I–III.3) and *De Anima*, as well as selections from his biological works, all against the background of the *Nicomachean Ethics* and the *Organon*. . . . Imagine young biologists able to read De Koninck's *Cosmos* with understanding and equipped to dedicate themselves to empirical studies that might follow out some of the indications made in that astonishing work. Is the prospect utopian? Why should we consider it to be so when it is the biologists themselves who are knocking at our door? . . . The philosopher's gift to the biologist is precisely his reflection upon form as a principle of being, and what flows from that reflection, a steady conviction of the priority of the whole to the part and the form with respect to the matter. The philosopher also has much to offer by way of methodological reflection. For the biologist will from time to time look up from his bench, and say what is on his mind: 'The antics of a troop of monkeys in the forest canopy are doubtless consistent with all of physics and chemistry, but this knowledge supplies no insights that will be useful to a student of animal behavior.' When the biologist blurts out uncomfortable truths like that one, the philosopher should be ready to point out that the distinction he has just made is as at least as old as the *Phaedo* and is luminously explored in Aristotle's *Parts of Animals*. What do biologists have to give us in return? The example of their attentiveness to form." Blum refers us to Robert Sokolowski, "Soul and the Transcendence of the Human Person," in *Christian Faith & Human Understanding: Studies on the Eucharist, Trinity, and the Human Person* (Washington, DC: The Catholic University of America Press, 2006), 164.

Building upon such a beginning on the side of greater specificity, the general philosophy of nature yields itself to the specific natural sciences. Scientific subsidiarity requires at the lowest levels of determination or specificity that the architect-like first physicist does not tell the bricklayer how to do his job. Yet the architect would still redirect the bricklayer were the general plan not being followed. Our “architect” and “bricklayer,” of course, are metaphors for habits and modes of consideration. Indeed, if possessed as a theoretical habit, first physics allows a scientist to contemplate the place of his own more determinate theory as a part within the larger whole of knowledge. Such a habit preserves for him the world most known to all men. Conversely, such a habit could allow some men—in the character proper to a liberal education—to begin to integrate the knowledge which those specialists possess robustly back into the primary experience of the whole. On the side of greater generality, the philosophy of nature yields to metaphysics insofar as the latter has the more penetrating and encompassing formal object. For instance, metaphysics would more perfectly exercise the role, only begun by natural philosophy, of considering analogous terms.

Yet even if the philosophy of nature leads the mind to metaphysics, the philosophy of nature (as a habit of knowledge) must remain as a permanent mediator, for its object (mobile being in general) and our primary experience of the same remain perennially available to the human mind.⁹ Consequently, the qualified form of sapiential natural philosophy would mediate between three things: first, the origin of our knowledge of being (mobile being) in our primary experience; second, the descent of our inquiry into the details of the cosmos—for “even in [the] kitchen divinities [are] present,”¹⁰—; and lastly, but most importantly, our speculative ascent to the Origin of all things.

9. For this last point I borrow from a source that, in this connection, De Koninck would have fully agreed with: see Maritain, *Philosophy of Nature*, 155–56. I quote this above, Ch. 7, fn. 37.

10. Aristotle, *Parts of Animals*, I.5, 645a20.

End Matter

APPENDIX: MARCUS BERQUIST, “ON SUBSTANCE AND SUBSTANTIAL FORM”

The following text is an excerpt of a letter written by Marcus R. Berquist (1934–2010). It is undated and no recipient is included in the excerpt. Confirmation of its authenticity and permission for its use were obtained from Mrs. Laura Berquist. Mr. Berquist was a student of Charles De Koninck and one of the co-founders of Thomas Aquinas College, Santa Paula, CA.

To begin with, as you note in your discussion, the notion of *substance* must be clarified before one introduces the notion of *substantial form*. But it is radically mistaken to suppose that there must be an argument to prove that substance exists. It is the *per se* object of the understanding (and, in a way, of the *vis cogitativa*), just as color is the *per se* object of sight. You seem to recognize this in your letter, when you mention “a reductio argument based upon Aristotle’s *Categories*.” One can indeed argue that there is substance, but such an argument would be rather a defense of a principle than a demonstration of a fact, and would quite naturally be a sort of *reductio ad absurdum*. (I sometimes wonder whether those who find such difficulty in granting that substance is a given of experience haven’t entirely failed to notice how their children recognize and name things, just as they have forgotten the beginnings of their own experience. For we name things as we know them, and the names of substances (and substantive nouns) are universally the first to be used by children. Well, maybe they have no children, or have turned the over to the care of “professionals”) By way review, you might take a look at St. Thomas, *In II De Anima*, lect. xiii, nn. 395–398.

The notion of *substantial form*, on the other hand, requires a certain analysis and argument. Substantial form, when considered universally, is manifested by way of an analogy (i.e. a proportion), and that there are such forms is supported by arguments both inductive and deductive.

Let us turn now to the argument for the existence of substance which you offer. It is conclusive, I think, given the premises. For if something is in a subject (e.g. red in a surface), and that subject is in something else (e.g. surface in body), and so on, there must still be some first subject—a subject which is not in a prior subject. For wherever there In an order of dependence, there must be a first, and I think this is generally granted by all as

regards material causality (which is the sort involved here). This is not only because material causality is impossible to deny—it is undeniably obvious that things depend upon what they are made of—but also because the matter is a cause both in coming to be and in continuing to be, unlike familiar agents, which seem to be causes of becoming only. Thus, those who investigate constituents of things all agree that there must be *primary* constituents, though they disagree about what they are.

However, the denials of substance that I am familiar with are not along this line, but rather consist principally of the denial of one of your premises: “the very notion of ‘red’ implies a dependence on something which has the color red . . .” To quote the inimitable Lord Russell: “The ‘accidents’ have no more need of a substance than the earth has need of an elephant to rest upon.” Defense of a first principle must be accommodated to the *way* in which it is defined.

What is asserted, then, is that what ordinary folk assume to have existence only in a subject, and what the tradition names “accidents”, simply exist, and do not exist *in* anything *as in a subject*. Thus, such things as length, color, heat, and the like exist, but do not exist in a subject, and we have no reason (they say) to suppose that anything exists except what Aristotle calls the *per se* objects of external sense. All the rest is mere hypothesis and “mind-spinning.” So there is a paradox here: what is denied is accident, not substance, for it is asserted that these characteristics are neither in a subject nor of a subject. Or (put in another way) what is denied here is not substance as it is defined in Aristotle’s *Categories* (for that would be witless), but substance understood as a *subject of inherence*.

Now it is worth noting that accident is not denied universally, with respect to all the categories. I don’t think that even Russell would maintain that *shape*, or *action*, or *movement*, or *being somewhere*, exist by themselves, rather than in a subject. Those who assert the subsistence of what had been regarded as accidents usually confine themselves to quantity and some of the qualities: e.g. length, volume, point, number, color, heat, smell, and so forth. Maybe some of them somewhere have noticed that their denial is selective; I can’t say, for I don’t know “the literature” very well. I wonder what they would make of such qualities as *temperance*, or *bravery*; are there subsistent realities which go by these names, or are there only names here?

But let us defer for now the question of why these fellows think what they think and say what they say. What might one say, dialectically, to their position? Three general lines of argument occur to me.

(1) Logical. If such objects as *color* and *heat* are substantial, none of them could be truly predicated of anything else except, perhaps, as an essential predicate. For example, one could say that red is a color, and color is a quality, and so forth, but one could never say *red* or *em color* of anything else. Thus, how could one interpret such a statement as “blood in red”? Given the position, “blood” could only name a *collection* of realities—*em red*, *wet*, *warm*, *shapeless*, etc. But one cannot predicate a member of a collection of the collection (or vice versa), nor one member of the other (e.g. “wet is red”). Further, if “blood” names a collection, what makes it a collection—what is the principle of unity? Do the individuals touch? are they tied together? How can the wet (thing) be red also unless redness and wetness both

belong to the same subject?

Furthermore, predicamental relations would have to be regarded as unreal, for if such relations exist—if *to be double* and *to be a father* are anything real—they cannot be thought as existing by themselves. And *what* would be related?

(2) Physical. There would be no *change* or *em* becoming of any sort. For these need a subject: something is changing when change occurs, and something is becoming (something) when there is becoming. Thus, nothing would *become* red; there would only be the non-existence, and then the existence, of red. All “coming to be” would be from nothing and instantaneous, and all “passing away” would be instantaneous annihilation. (Russell recognizes that this as a consequence of his position, but, as he would say if he were an American, so what?) Further, there would be no *em* getting hotter, conceived as a single process—each degree of heat would be something totally new, and there would be no *thing* which gets hotter.

Perhaps, along with this position goes another denial: the denial of all change except change of place. Let it be so; but then, what changes place? *Red? Hot? Sweet?* Given all the attributes which are “there”, it seems that one must allow that a nearly infinite multitude of changes are occurring simultaneously. Everything which ordinary thought and the tradition regarded as simply accidents of the mobile subject must now be regarded as a distinct thing undergoing its own proper motion. Or else, as argued above, there would not really be any such thing as movement, for the red which is now here would not be the same red as was there before the “change of place”.

(3) From internal experience. It is evident from one’s own experience that one suffers *heat*, *pain*, *anger*, and the like. Both what is alike and what is different in these examples bears out the general principle that substance is a spontaneously evident object of understanding. *Heat* is perceived directly as an affection, now of oneself, now of another, without inference. But *pain* is perceived directly only in oneself, and as belonging to oneself, while it is perceived in others only through signs, and *anger* likewise. In all these cases, the subject of the affection is as evident to us as the affection itself. On the hypothesis that the object of experience is simply “a cluster of momentary and independent realities”, what could a man mean when he says, “I’m thirsty”? If this statement is not the statement of a fact, I do not know what could be.

An regards substantial form, however, the difficulties are more rational. The early Greek naturalists did not deny that there are such forms; it did not occur to them that there might be such principles. Thus although one can regard their positions as implicit denials of substantial form, the notion of such forms does not arise in their considerations, even as something to be refuted. This is a probable sign that the notion of substantial form is not spontaneously evident, but needs to be reasoned to in some way, perhaps as a conclusion to which one is forced by the evidence. But once it has been proposed by a later philosopher (Aristotle) as an essential principle of generable and corruptible beings, the issues which such a proposal raises cannot be ignored.

You note in your letter that we do not *see* (or otherwise sense) substantial forms. This is quite true if restricted to the sensible *per se*, and if one supposes that nothing but the

sensible *per se* can be the object of immediate (i.e. unreasoned) knowledge. But this universal negation does away with the knowledge of many things other than substantial form: “I see a man”, “I see my brother”, “I see that this is bigger than that”. If we are not to rule out all such statements as either mere invention or questionable hypotheses, we must grant that many notions (rationes) are grasped without discourse by the internal senses of the intellect, yet not independently, but through the external sense. Memory is a manifest example: we recognize something seen or imagined as if having been perceived in the past, spontaneously rather than by step-by-step inference; I hear a piece of music, for example, and immediately recognize it as something I have heard before.

What, then, does the tradition mean by “the sensible *per accidens*”? According to St. Thomas:

. . . ad hoc quod aliquid sit sensibile per accidens, primo requiritur quod accidat ei quod per se est sensibile, sicut accidit albo ease hominem Secundo requiritur quod sit apprehensum a sentiente: si enim accideret sensibili quod lateret sentientem, non diceretur per accidens sentiri. Oportet igitur quod per se cognoscatur ab aliqua alia potentia cognoscitiva sentientis . . . non tamen omne quod intellectu apprehendi potest in re sensibili potest dici sensibile per accidens, sed statim quod ad occursum rei sensatae apprehenditur intellectu. Sicut statim cum video aliquem loquentem, vel movere seipsum, apprehendo per intellectum vitam eius, unde possum dicere quod video eum vivere. (*In II De Anima*, lect. xiii, nn. 395–396)

So, we may ask: Is substantial form one of such objects, grasped at once by an internal power of knowing—in this case, the understanding—and thus something to be elucidated or defended by argument, but not to be established thereby? What follows is my suggestion.

It seems that at least some substantial forms are sensible *per accidens*, but not explicitly as substantial forms, but rather intrinsic principles, and perhaps also *as subjects*, of certain characteristic properties, movements, or activities found within natural things.

Take the most forward example—which you mention in your letter—the *soul*, and in particular, the *rational soul*. Grant that the soul is the substantial form of the living body; is it sensible *per accidens*, and if so, is it apprehended spontaneously as the *substantial form* of that body? The most likely account (I think) is this: the soul is apprehended at once, when one encounters a living thing, but not as the substantial form of that thing, but as the intrinsic principle of its vital activities. St. Thomas, in speaking of the science about the soul, says “[Haec scientia] certa est; hoc enim quilibet experitur in seipso, quod scilicet habeat animam, et quod anima vivificet.” (*In I De Anima*, lect. i, n. 6) “Soul” here does not mean “substantial form” or even “first actuality etc.,” but rather “first principle of life within the living”. Given this understanding, few (if any) deny that there is a soul, though they may reject the name. Thus, even mechanistic philosophers, who maintain that the living differs from the non-living only in “scheme and degree of complexity” (as one of them has put it),¹

1. Editor: Sir Charles S. Sherrington, *Man on His Nature* (Cambridge: Cambridge University Press, 1951) 75.

are not in fact denying that there is a first principle of life within the living thing; they are simply advancing their own view of what that principle is. They are in the general tradition of Empedocles and his school, who maintained that the soul is a *harmony*. (For Empedocles realized that not just any proportion in the constituents of living things would result in life, but only some—those in which the constituents somehow fit together or could act together.)

But if to apprehend the soul as a principle of life is spontaneous and undeniable, to see also that it is a substantial form is something more, and more difficult, and seems to require analysis and argument, especially if one is to “nail it down.” This is borne out by Aristotle’s procedure in Book One of his *De Anima*. He takes as his *point of departure* that there is a first principle of life within the living, and pursues an inquiry about *what* it is. In this enquiry, he considers a number of opinions, all or most of which he must regard as reasonable, but none of which maintain that the soul is the substantial form of the living thing. The opinion of the atomists (for example)—that the soul is round, smooth atoms—is not rejected out of hand, and there is no suggestion that it is self-evidently false. So, even if the soul is spontaneously apprehended, it is not apprehended as the substantial for of the living body.

How then do we come to the conclusion that some forms are substantial, and that all material substances are composites of form and matter? In two ways, it seems to me, both of which are found both in Plato and in Aristotle, though one is more characteristic of the former, and the other of the latter. We find that there are many substances which are the seam in kind, though they are different individuals, and that substances come to be and pass away. Both of these facts of experience (granted that they be such) lead to the conclusion that some forms are substantial.

Socrates, as Aristotle says, “was busying himself about ethical matters and neglecting the world of nature as a whole, but seeking the universal in these ethical matters, and fixed thought for the first time on definitions”, and “Plato accepted his teaching”. (*Metaph.* I, 987b1–5) These philosophers were concerned with discovering the one in the many, but not the one material which underlies the temporary forms as were the early naturalists), but rather the one *form* or *species* which all the particulars share, and from which they receive their common name, (as in answer to the question “what is it?” A good and familiar example is found in *Meno*, especially 72a–73c. This is to recognize a different sort of intrinsic principle—not what a thing is made of, but what makes it what it is, and answers to the question “what is it?” If one has also seen that the common names of existing individuals (such as ‘man’, ‘tree’, ‘earth’) signify what they are, and not just some condition or arrangement which they undergo, one has seen that some forms are substantial—i.e. constitute the very substance of the things they belong to. This, then, is one way of coming to the realization of substantial form.

The other way of coming to see that there are substantial forms is through a consideration of substantial change. If substances do indeed come to be and pass away, and if becoming *universally* requires a composite of matter and form, then some forms must be substantial. For a substance cannot be constituted by a form which is an accident of what it belongs to. And if these two antecedents be granted, and clearly understood, I do not think that the philosophers would disagree. However, these antecedents are not always granted, and when

they are granted in some way, they are seldom clearly understood.

From the beginning, or nearly so, philosophers have found themselves maintaining that substances do not come to be or pass away. The earlier philosophers did not say this in opposition to other philosophers whose views they thought mistaken, or to correct the misadventures of upstart sophists. They realized that what they said was a *paradox*—contrary to what common understanding had always accepted as immediately and undeniably obvious: that not only did substances become different in this way and that, but also came to be and passed away. Out in their attempt to understand the givens of experience, they were driven to modify these givens in order to accommodate what they considered the only possible explanation of becoming.

Empedocles, among the naturalists, speaks most explicitly to this issue:

There is no origination [*physis*] of anything that is mortal, nor yet any end in baneful death, but only mixture and separation of what is mixed; but men call this ‘origination’ [*physis*]. . . . But when light is mingled with air in human form, or in form like the race of wild beasts or of plants or of birds, then men say that these things have come into being, and when they are separated, they call them evil fate. This is the established practice, and I myself also call it so in accordance with the custom.

And he also gives his reasons:

Fools! for they have no far reaching studious thoughts who think that what was not before comes into being of that anything dies and perishes utterly. . . . For from what does not exist at all it is impossible that anything come into being, and it is neither possible nor perceivable that being should perish completely; for things will always stand wherever one in each case shall put them. (Does he have kids?)

To be sure, Empedocles does recognize implicitly that the elementary materials are not sufficient to explain things in their variety and uniqueness, even when combined with those indiscriminate agents love and strife.

The kindly earth received in its broad funnels two parts of gleaming Nestis [water] out of the eight, and four of Hephaestus [fire], and there arose white bones fitted together by the divine gluing of harmony.

Under this name ‘harmony’, Empedocles recognizes that compounds in nature require a different kind of principle—a principle which Aristotle generalizes under the name ‘form’ [*morphe* or *eidōs*]. But Empedocles does not list this among his principles, probably because it is not a principle of substance, and because the manifest *dependence* of accidental forms upon their subjects prevents his from seeing them as principles. Further, Empedocles, in common with the other early naturalists, does not try to first identify the *general kinds* of principles which natural becoming and change require, but seek at once for something quite specific

which can explain everything. Since, therefore, he does not conceive that an underlying nature (i.e. primary matter) might be anything other than a substance having a definite and actual nature of its own, he cannot come to a conception of substantial form. Aristotle, on the other hand, refuses to abandon the givens of experience in order to accommodate an explanation, and thus is led to conclude that “the underlying nature is knowable by analogy; for as the bronze is to the statue, the wood to the bed, or the matter and the formless before receiving form to something which has form, so is the underlying nature to substance and the ‘this something’ and the being.” (*Phys.* 1 191a7–12) The necessary correlative of this conclusion is that some forms—the forms which are the *terms* of substantial becoming—are intrinsic causes and constituents of substance, i.e. substantial form.

You may well remark here that the foregoing is *dialectical*—taking the position of an adversary as he presents it, and showing that there is no need to draw the conclusion he does from what he has conceded as facts of experience. That is, an account of substantial change is possible, in accord with common experience, and involving no internal contradiction. And such an account is *most probable*, inasmuch as it does not require a departure from our common understanding of the facts to be explained. And (in confirmation), given that substances do indeed come to be and pass away, what other account has ever been given than this: that the underlying nature in such becomings has no actual nature of its own, and is only potential thereto, and that the forms which it receives cause it both to be and to be what it is? In sum, one may say against the position of Empedocles and his many (unwitting) modern followers, that their position does not arise from any original doubt (from experience or inferences directly therefrom) but from the failure of their attempts to explain what they (and we) experience—a failure which has led them, not to correct their explanations, but to revise the givens of experience and purge those which are not conformable to the kinds of explanation they allow.

Nevertheless, even if it be granted that the philosophers who deny substantial change have accommodated the appearances to their theories rather than revising their theories to fit the appearances, one may still ask: how firm are our suppositions here? Are we justified in taking the *fact* of substantial change as an immovable starting point for our reasonings? Could we be making the mistake of some of the older astronomers, who assumed that the sun’s revolution about the earth was an obvious and undeniable fact?

Let us begin by gathering together what we have dispersed above. We had said that a second way of seeing that some form must be substantial is through a consideration of substantial change. Here, it seems to me, there are two crucial premises: (1) that things cannot come to be unless they are composites of matter and form, and (2) that substances come to be and pass away. The former of these premises is seldom if ever contradicted directly. Another way of stating it is this: if a substance does come to be and pass away, there must be an intrinsic principle which compares to it as the *art of music* does to the *musician* (to take the example from *Phys.* I, Ch, 7). In other words, given substantial change, we must generalize our notion of *form*. For just as our familiar examples of shapes and qualities, insofar as they are *in* a subject, cause it to *be* in some way and to be what it was not before, so also must there be an intrinsic principle which causes a thing to be *simply*, and

to be *what* it is *simply* (and not just make it be so *big* or so *hot* or so *heavy*, or something of the sort). Otherwise nothing which is generated could be a real and single substance. But most naturalists do not get this far—so far as to ask *what sort* of principle would be required for the coming to be of a substance. They forsake this question (even though it is the *original* question) and retreat to the theoretically simpler assumption that there is in truth no substantial becoming. But they cannot do this without asserting that nothing generable and corruptible is a substance. They must say, with Empedocles, that all such things are only mixtures or incidental arrangements. (I omit here the more radical position of Lord Russell and others that there is no such thing as becoming of any sort, so far as we know.)

The second of these premises—that substances come to be and pass away—is the one commonly denied, sometimes implicitly, sometimes explicitly. It is clearly the more fundamental of the two; one would never wonder about the principles of substantial, change, or ask whether a general account might be given which applies to both it and to accidental change, if one were not convinced that substances do indeed come to be and pass away. Accordingly, we ask how do we become assured of the truth of this premise? Is it immediate (an instance of the sensible *per accidens* which we discussed above), or rather the conclusion of an argument? And in either case, from which particular substances do we derive our certitude: from any and all equally, or from some rather than others? (For even if substantial change is an evident fact in some cases, it may well be obscure and questionable in others, such that an attempt to treat all cases in the same way might lead to doubts about what would otherwise be obvious.)

Now it is evident at once that the question of whether there is substantial becoming reduces to the question of whether among the familiar objects of our experience which we name there are some which are substances. For who would deny that these objects, all or nearly all of them, come to be and pass away? Not only men and brutes and plants, in all of which complexity and contrariety invite corruption, but even relatively simple things like *salts* and *acids* and *water* are undeniably generated and corrupted. So those of us who maintain that substantial change is an evident fact must regard some or most or all of such things as substances. But why do we think so, and is our knowledge immediate and of the self-evident (though manifested and defended by reasonings), or the conclusion of an argument, or (perhaps) simply an hypothesis?

“Mes anciens maitres”, Roman Kocourek and Charles De Koninck, used to say that a principal cause of difficulty about the *fact* of substantial change is that philosophers tend to examine the least evident cases—those which occur at the elemental or near-elemental level. For at this level of formation, the evidence is the least compelling and the most ambiguous. Given Lavoisier’s observations and arguments, it is altogether reasonable to regard *water* as a substance which is generated and corrupted. But it’s much more evident that a plant and an animal and a man (above all) are generable and corruptible substances. For in these latter cases, even for common experience, generation and corruption are undeniable, and the substantiality of the term of becoming is beyond reasonable doubt. Why is this so? And is our understanding in these cases *immediate*?

Here we must attend both to *what* is experienced, and to the *way* in which it is experienced. Since understanding depends upon sensation, and yet is primarily of substance, what we first grasp in understanding is *that in which* the perceived attributes exist. (As mentioned above, our basic language testifies to this.) If therefore an experienced object is perceived as a distinct and unique substance, it must be because it has been shown to be such through the uniqueness of its perceived attributes. In every case, then, what we perceive is *substance*—the “underlying something” at least. But if we also perceive *this kind* of substance and *this individual* substance, it must be because the perceived attributes bring us immediately to such an apprehension, insofar as they are obviously (without argument) unique and irreducible.

If this is so, it is evident that substantial change is more known to us in living things, for here we are more certainly aware both of *specific difference* and of *individuality*. In perceiving the former, we see that we have a different kind of thing (‘secondary substance’) and not merely *another condition* in the same kind of thing; in perceiving the latter, we see that we no longer have the same individual subject (‘primary substance’), since what is perceived as the individual has either come to be or passed away.

Thus, as one moves (in thought) from the less perfect to the more perfect, from the simple to the complex, from the non-living to the living, from plant to animal to man, it becomes more and more difficult to explain the peculiarities of a being from its material constituents and their arrangement—or from the kind and degree of perfection existing at a lower level. And this much is universally conceded. For example, the biological dispute between the ‘mechanists’ and the ‘vitalists’ about the proper principle of life has no counterpart in physics or chemistry, and the “origin of species”, as it is argued or conjectured regarding simpler forms of life is far less controversial than the “descent of man”. Even those who assume as a matter of principle that the *reduction* of the higher to the lower is possible realize that reduction becomes harder and harder as one studies the higher forms. The situation here is similar to that which obtains for the premise that nature acts for an end; it is only in living things that this premise is unmistakably obvious, and those who wish to put it in question recognize that their primary task is to explain living things adequately without this premise.

Likewise, one is more certainly aware of the *individual* in living things, especially in the higher living things. This simple fact of experience is somewhat obscured by plausible theories which appeal to an abstract imagination. For since living things are the most complex, and since a complex consists of *many units*, it seems that a living thing is least of all a unit. The imagination can only represent a complex (explicitly) as an actually divided multitude, and cannot at once also represent it (if indeed it ever can) as a single being with its own unique integrity. To the extent, then, that the naturalist resolves his arguments to the picture in his imagination, he can never regard the composite as anything other than an arrangement of distinct entities.

But if one looks back beyond these imaginary representations, and consults the direct experiences which stand at the beginning of natural philosophy, quite a different reality comes into view. We then see that the very concept of individuality arises from our internal experience of unity. (In ordinary usage, “an individual” means “an individual man”.) This experience does not arise in spite of the distinction and spatial separation of our bodily parts,

but in our very experience (i.e. sensation) of these bodily parts. For they are perceived as parts, as we experience various passions within them. And this internal experience of them as parts fits with our external experience that they come to be as parts. There is a perfect harmony between what one experiences in oneself (and in others, by signs) and what one observes in the coming to be and passing away of others.

From this one can see that the views of many moderns arise from a false abstraction and an arbitrary selection from the evidence. They take the notion of *individuality*, which they (and we) have derived from an experience of themselves as living beings, and apply it exclusively to certain hypothetical, imaginary entities (“atoms”), while denying or forgetting that those very things from which they derived their notion are individuals. At the same time, they make the question of whether there truly is substantial change depend upon those cases (the elemental and near-elemental) where the evidence that something different *in kind* has come to be is most obscure and questionable. And further, is it not evident that as one descends (in thought) from the animal to the plant to the mineral the individual becomes more and more difficult to discern? How much water is one water? And is a rock one thing, or more likely a cluster?

You observe: “But this kind of argument does not show that every mobile being has a substantial form.” Well, yes and no. If the mobile being comes to be and passes away, and if it is an individual of a kind, it must have such a form, given what we have argued above. But whether all or most of those chemical changes which we obscurely witness are substantial, and whether everything which has a stable name (e.g. ‘brine’) is a substance, are questions quite distinct from the question of whether there are substantial changes at all. To be able to discern that something occurs does not depend upon the ability to judge in every particular instance whether that something has occurred. I know that men tell lies—that is a fact beyond question; but does that mean that I can fudge with certainty whether what you Just said was a lie or not? Here it is enough to see at first that living things, which are manifestly substantial, come to be and pass away—this establishes the fact of substantial change, and brings us to recognize that at least in these cases there must be forms which are substantial. But implicit in this recognition is another: that the simpler substances which go to make up living things must also be generable and corruptible, for they could not otherwise become a single, specifically unique (living) being unless they were substantially corruptible, and thus composed of matter and substantial form.

The view of Locke that you cite seems to be one of those all too common examples of a theorist maintaining a position in spite of the evidence rather than because of it. It’s been a while since I’ve had to consider Locke in detail, and pay attention to the particulars which lend support to his position, so I’m probably not doing him justice. Nevertheless (to concentrate on just one assertion), to say that “each material being is a bundle of accidents residing or inhering in a substantial subject or matter, but with no substantial form” is to leave unexplained the “bundle” What, one may ask, is the principle of unity here? And can one reasonably regard this unity as an accident, given that it is persistent and recurrent? Like Lord Russell, who regards the “material thing” as just a “bundle of events”, but neglects to tell us what makes the bundle a bundle, the position you cite simply regards the presence

of all these co-ordinated properties (e.g. reason and the power of speech and the vocal chords and hearing and memory) as a fact for which no account need be given—i.e. as an accident for which there is no *per se* cause in the things we see. It is no better than the position which holds that purposeful behavior in living things is an accident, and then tries to conceal the paradox (for what could ‘accident’ mean, once the universal and consistent has been called “accidental”?) in myriads of imaginary variations.

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