The role of efficient causation in Aristotle’s philosophy: ensuring the continuity and coherence of the cosmos within a teleological framework

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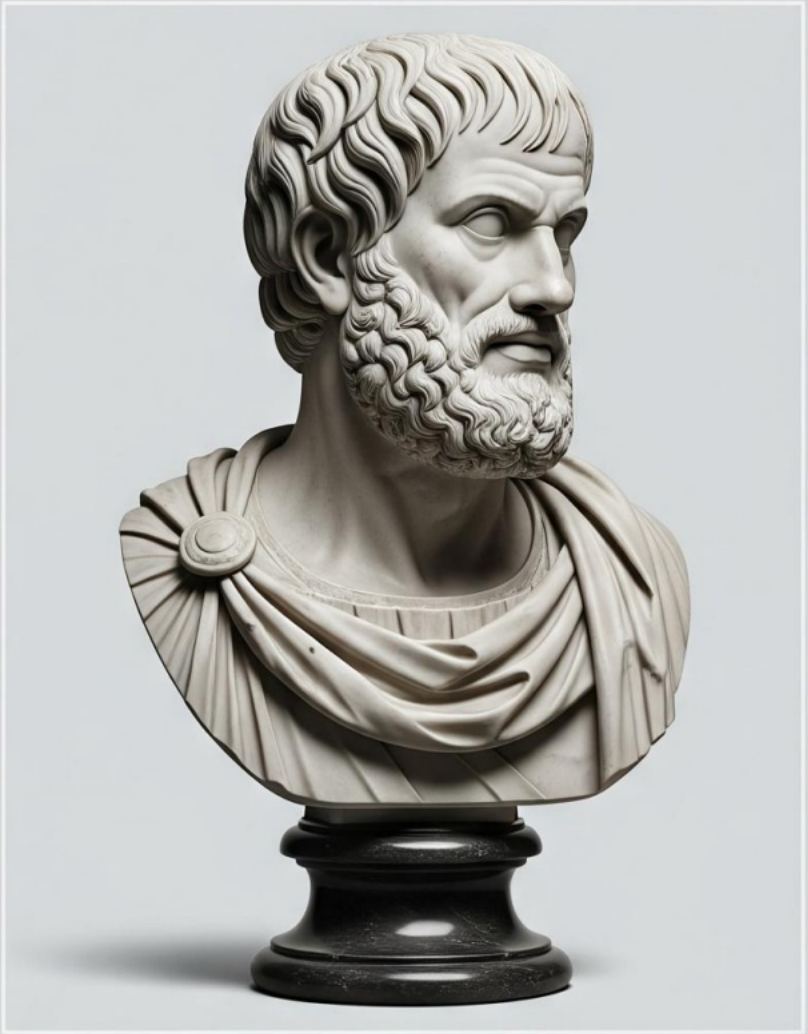

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Contents

Abbreviations

ARISTOTLE'S WORKS

DA	*De Anima (On the Soul)*
DC	*De Caelo (On the Heavens)*
EE	*Ethica Eudemeia (Eudemian Ethics)*
GA	*De Generatione Animalium (Generation of Animals)*
GC	*De Generatione et Corruptione (On Generation and Destruction)*
HA	*Historia Animalium (History of Animals)*
Juv	*De Juventute et Senectute (On Youth and Old Age)*
Meta	*Metaphysica (Metaphysics)*
Meteor	*Meterologica (Meteorology)*
Motu	*De Motu Animalium (On Animal Motion)*
Long	*De Longitudine et Brevitate Vitae (On Length and Shortness of Life)*
NE	*Ethica Nicomachea (Nicomachean Ethics)*
PA	*De Partibus Animalium (On the Parts of Animals)*
Phys	*Physica (Physics)*
Pol	*Politica (Politics)*
Post	*Analytica Posteriora (Posterior Analytics)*
Protr	*Protrepticus (Exhortation to Philosophy)*
Resp	*De Respiratione (On Respiration)*
Sens	*De Sensu et Sensibilibus (On Sense and Sensibilia)*
Somn	*De Somno et Vigilia (On Sleep and Waking)*

References to Aristotle's works are given in the following form: abbreviated title, followed by chapter, paragraph, page, column, and line. E.g., *Meteor* I.4, 341b18-22. All translations are mine, based on the editions in the Barnes, J. (ed.) (1984) *The Complete Works of Aristotle: The Revised Oxford Translation.* 2 vols. Princeton: Princeton University Press, unless otherwise noted.

Introduction

Aristotle consistently upholds the notion that the entire cosmos is characterized by inherent goodness, a quality intrinsically tied to its teleological structure. For Aristotle, the natural world is not a collection of arbitrary occurrences but a domain of purposeful activity, where all natural substances operate with an intrinsic goal, as they exist "for the sake of" something good. This teleological framework is foundational to Aristotle's philosophy, underscoring his belief that reality as a whole tends toward the good.[1] However, despite this overarching teleological order, there are instances where the goodness or purposiveness of certain parts of reality, or specific phenomena, is not immediately discernible.[2]

[1] For instance, see *DA* II.4, 415b15–17; *GA* I.1, 715b15–16; *DC* I.4, 271a34; *Phys* II.7, 198b4–9; 198a22–24; *DC* I.4, 271a34. These interpretations also emphasize the centrality of the final cause in Aristotle's philosophy as the foundational principle that underpins both natural and metaphysical order. Rist (1965, 342) identifies an overarching teleology in Aristotle's thought, suggesting that final causation functions not merely in isolated contexts but as a principle governing the entire cosmos. Similarly, Owens (1968, 167) characterizes Aristotle's teleology as a "teleology of nature," oriented "towards something above and outside itself." This interpretation points to the transcendent aspect of Aristotle's teleological framework, with the Unmoved Mover serving as the ultimate goal (telos) that directs all motion and change toward a higher purpose. Kahn (1985, 193) advances the view that Aristotle's final causation offers an explanation of the universe, encompassing both inanimate and biological realms. He describes this as a "cosmic teleology reaching down from the outer heavens," which aligns the patterns of immanent teleology observed in living organisms with the broader cosmic order. This perspective highlights the interconnectedness of all entities in Aristotle's universe through the hierarchical operation of final causes. Sedley (2000, 327–329) identifies a single ultimate principle of final causation in Aristotle's *Metaphysics*, which he argues pervades the entire cosmos. This principle, according to Sedley, serves as the foundational cause that integrates all aspects of reality into a cohesive whole, providing a teleological explanation for the universe's inherent order and purpose. Furley (2002, 76) underscores the universality of Aristotle's final cause, suggesting that it offers a comprehensive framework for explaining the unity of the world. By linking individual phenomena to the overarching teleological structure of the cosmos, final causation ensures that the universe operates as an integrated system. Johnson (2005, 133) echoes this view, emphasizing that Aristotle's final cause contributes to a overall vision of reality by connecting diverse natural processes within a coherent framework. These interpretations converge on the idea that Aristotle's final causation functions as the ultimate explanatory principle, capable of integrating the multiplicity of phenomena into a teleological system.

[2] Many commentators argue that Aristotle's final cause is inadequate as a principle for providing an explanation of the universe as a whole, as its applicability is limited to certain domains. For instance, Nussbaum (1978, 93–94) contends that Aristotle's final causal explanations cannot be extended to meteorological phenomena or the motions of the elements. She states, "the idea that I think natural phenomena—eclipses, rainstorms, the downward motion of earth, the upward motion of fire—are best explained teleologically is a misconception that I frequently try to avoid." Nussbaum further argues against a universal application of final causation in Aristotle's thought, claiming (1978, 60) that "Aristotle neither applies teleology to nonliving natural bodies nor gives any evidence for believing in a universal teleology." Similarly, Ayala (1970, 49) asserts that Aristotle's error lies not

These moments raise the question of whether such aspects of nature can be reconciled with the broader teleological orientation, and if so, how they might be comprehended within the structure of Aristotle's causal framework. This thesis is an attempt to address such complexities by focusing on the role of Aristotle's efficient cause, particularly its function in sustaining the continuity of the cosmos. While final causation establishes the teleological grounding of the universe, efficient causation operates as the mechanism through which continuity—both spatial and temporal—is maintained across diverse phenomena. By examining efficient causation, this study tries to answer the question of how even those parts of reality that appear less evidently aligned with goodness or purposiveness contribute to the continuity and coherence of the universe.

For Aristotle, the primacy of the final cause[3] is beyond dispute, as it serves as the ultimate explanatory principle in his teleological framework.[4] The final cause, epitomized by the Unmoved Mover, is fundamentally distinct from the other causes in its role and operation. It functions as an object of desire, engaging in "pure activity (actuality)", which is entirely self-sufficient and does not result involve direct action or causal interaction. The Unmoved Mover, as the highest actuality, draws the cosmos toward itself as the ultimate end, providing the teleological grounding for all motion and change. This transcendent primacy

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in his use of final causation within biology but in extending the concept to the nonliving world, such as the motions of the elements. Gotthelf (1987b, 210) supports this view, maintaining that Aristotle does not employ final causation in the realm of elemental motions. He provocatively asks, "Can one account for a particular living process in terms of the element-potentials involved in the process, making no mention of the overall end or goal of the process?" Other scholars, including Wieland (1975, 150) and Byrne (2002, 19–21), have similarly noted the limited applicability of final causation in explaining the motions of elements. Furthermore, Balme (1991, note at HA 591b27) critiques Aristotle's teleological framework by pointing to the behavior of certain large sea creatures that turn over while eating, an activity that inadvertently benefits the survival of smaller fish. Balme argues that this example contradicts Aristotle's teleological explanations, as the activity of these larger creatures serves not only their own purposes but also the survival of other species. These criticisms collectively highlight the perceived limitations of Aristotle's final causation in providing a universal explanatory framework, particularly in the domains of inanimate nature and nonbiological phenomena. Such critiques underscore ongoing debates regarding the scope and coherence of Aristotle's teleological system and its capacity to explain the each and every aspect of the natural world.

[3] The variety of the explanations of the final cause found in Aristotle's physical treatise is often taken as one homogeneous category. The constant phrase usually employed by Aristotle for the notion of final cause is '(that) for the sake of which (οὗ ἕνεκα)'. For Aristotle's definition of the final cause, see chapter 2.1.1.

[4] In addition to the texts quoted in note 2 above, see also *Phys* II.8, 198b32–199a8; *DA*, III.12, 434a31; III.9, 432b21; III.12, 434a31; *PA* I.1, 639b12–640a20.

reflects the Unmoved Mover's unique role as the final cause, which holds primacy over all other causes and remains independent of them. It also makes clear that, within the natural world, the efficient, formal, and material causes collectively play indispensable roles in the realization of a continuous, and living cosmos. These causes function within a hierarchy that serves the overarching teleological purpose established by the final cause. The material cause provides the substratum for change, the formal cause constitutes the structure and identity of things: in Aristotle's framework, the efficient cause is often integral to the actualization of the formal cause, particularly in processes involving change or motion. For instance, in natural generation, the efficient cause initiates the process through which the formal cause is realized in the material substrate. The efficient cause explains the spatial and temporal continuity. Together, they interact dynamically to fulfill the telos, or purpose, of the cosmos.

Although Aristotle attributes an overarching teleological order to the cosmos—a framework in which all natural phenomena are understood to exist 'for the sake of' some good'—there are significant instances where the inherent goodness or purposiveness of certain aspects of reality remains obscure. These moments reveal the boundary of Aristotle's teleology, as they expose gaps in the application of his final causal explanations. For example, natural occurrences such as the behavior of inanimate elements or unpredictable meteorological events often resist straightforward alignment with Aristotle's teleological framework, challenging the idea that all phenomena can be easily integrated into a purposive and goal-directed system.

These interpretive challenges arise because Aristotle's final causal explanation, while comprehensive, was not intended to apply uniformly across all domains of reality. Instead, it finds its most robust expression in biological contexts, where the purposeful structures and functions of living organisms vividly illustrate the operation of final causes. However, when applied to phenomena such as the motions of nonliving bodies or certain irregular natural processes, the explanatory power of teleology appears more constrained. These limitations invite critical reflection on whether Aristotle's teleological framework can provide a truly universal explanation of the cosmos or whether its application must be understood as context-dependent. In such cases, the alignment of these phenomena with Aristotle's broader teleological vision becomes obscured, requiring a more nuanced consideration of how—or even if—such aspects of reality can be

reconciled with the overarching teleological order.

It is important to note that, while Aristotle assigns a central role to the final cause in achieving a unified explanation of the universe, he seems to acknowledge that some causes do not operate universally across all domains; for example, the applicability of the final cause may be less evident in meteorological phenomena or the motion of inanimate elements. In addition, he seems to recognize that certain phenomena resist being fully explained in terms of teleology or intrinsic goodness, particularly when their connection to a broader purpose is not immediately apparent.

As early as Theophrastus[5], interpreters of Aristotle have expressed concerns regarding an apparent tension in his causal framework: while Aristotle asserts the primacy of the final cause, he often does not explicitly invoke it in explanations of certain natural phenomena, such as meteorological processes and the formation of water bubbles. Theophrastus' critique highlights a crucial challenge in Aristotle's teleology—how can the final cause be considered primary if it is absent from the explanation of various physical occurrences?

This study takes Theophrastus' critique seriously and examines *Meteorology* and other Aristotelian texts to uncover possible implicit responses Aristotle might have offered. Had Theophrastus directly posed this challenge, Aristotle's response, I suggest, would have emphasized a distinction between different levels of teleological explanation. While Aristotle maintains that the universe as a whole is directed toward the good, the explanatory focus shifts when investigating specific natural phenomena. In such cases, rather than analyzing how each discrete part contributes to the overarching good, Aristotle is concerned with the structural continuity and causal interdependence that unify disparate elements of the cosmos. This continuity, which ensures that the world is a coherent cosmos rather than a mere aggregation of independent entities, is often accounted for through references to the efficient cause.

Throughout this study, I will examine key Aristotelian passages where this explanatory shift occurs, demonstrating how Aristotle integrates efficient causation to account for natural continuity while still upholding the broader

[5] Theophrastus criticizes Aristotle's signature theories of the Unmoved Mover and teleology in his *Metaphysics*. However, it appears that he is unaware of the central and later books of Aristotle's *Meta*, focusing his comments instead on the earlier books, particularly Book *Lambda*. See Gutas (2010, 5–6) and Frede (2000, 47–49).

teleological orientation of the cosmos. By engaging with these textual nuances, this thesis seeks to offer a more refined understanding of the interplay between final and efficient causation in Aristotle's natural philosophy.

Given that some modern interpreters regard the boundary of Aristotle's final causation in providing a unified explanation as a question influenced by Theophrastean critique[6], it is essential to clarify Aristotle's own position. To this end, I will quote a significant passage from Theophrastus' *Metaphysics*, composed within the intellectual milieu of Aristotle's school, to provide further insight into Aristotle's concerns:

> But again, the actual assignment of a formal account to each entity by referring to something for the sake of which in all cases is difficult, in the case of animals and plants and in the very bubble[7];—unless it happens through the order and change of other things that all sorts of shapes and varieties of things in the air and on earth arise; the main example of which according to some are the facts of yearly return of the seasons, on which generations of animals, plants and fruits depend—the sun being, so to speak, the begetter. These questions too call for an inquiry into them somewhere here, requiring as they do a delimitation of how far the ordered extends, and why more of it is impossible or the change would be for the worse.
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> *Meta* 7a19–b8 (trans. M. van Raalte)

In this passage, Theophrastus critically examines the boundaries of final causal explanation in providing a unified account of the universe. He raises concerns about the applicability of final causes, especially in cases where assigning a teleological purpose to entities appears problematic. Specifically, Theophrastus questions whether every entity—down to the smallest organic forms such as animals, plants, or even ephemeral phenomena like bubbles—can meaningfully

[6] See e.g., Lennox (1985, 259–279; 2001a, 226–227); Repici (1990, 182–213); Johnson (2005, 35–37). Lennox (1985, 259–279) treats Theophrastus' text as a critic of Aristotle's teleology. Repici (1990, 182–213) criticizes Lennox's position by documenting much agreement between Aristotle and Theophrastus. But Lennox (2001a, 226–227) then responds to Repici's critique, and clearly treats Theophrastus' arguments as a concern shared by Aristotle. Johnson (2005, 35–37) summaries these interpreters' comments and follows Lennox's view.

[7] For 'in the very bubble', Theophrastus, in his short treatise *Metaphysics*, explicitly raises the problem of the appropriate role of purposive and normative terminology in scientific explanation, with respect to everything from the heavenly bodies to the structure of the bubble. For the structure of 'bubble', see also Aristotle, Prob 913a19–33, 936b1–9; 939a25–7.

be explained "for the sake of" some overarching purpose. He further observes that many phenomena, particularly those found in cosmology, meteorology, and biology, resist straightforward teleological explanation. For instance, Theophrastus suggests that certain features of the natural world, such as the annual recurrence of the seasons, might be better understood as arising from the interactions and transformations of other phenomena, such as the movements of the sun. In this view, the sun acts as a kind of generative principle, indirectly bringing about the cycles that sustain life, including the reproduction of animals, plants, and fruits. This leads Theophrastus to propose an important philosophical question: to what extent does the order in the universe extend, and where does it encounter its boundaries? He suggests that there is a need to delimit the scope of teleological explanations, asking why the universe is not more ordered than it is and whether any further ordering would result in adverse changes. These reflections invite further inquiry into the nature and limits of the teleological framework within Aristotle's philosophical system, challenging the universality of final causation as a principle for explaining all aspects of reality.

Building on the problem raised by Theophrastus, we are led to ask: what solution does Aristotle offer regarding the limitations of final causal explanation? In key passages of Aristotle's corpus, the continuity and coherence of the cosmos—understood as its spatial and temporal continuity—is attributed not solely to final causes but also to the operation of chains of efficient causes. These efficient causes play a crucial role in linking distinct phenomena and ensuring the interconnectedness of the cosmos across its various domains.

While final causes are essential for understanding the teleological order of the universe, certain phenomena resist explanation solely in terms of "the sake of which". In such cases[8], efficient causes provide a mode of explanation that offers a more comprehensive understanding of things happening in the cosmos. This perspective suggests that efficient causation plays a pivotal role in ensuring the coherence of reality, particularly in contexts where the teleological orientation or inherent goodness of specific phenomena is less immediately evident. Chains of efficient causes establish the dynamic linkages necessary to sustain spatial and temporal continuity throughout the cosmos.

This tension highlights a significant and contentious issue in Aristotle's

[8] For detailed discussion of these critical passages, see chapter 3.

philosophy: the achievability of a unified account of the universe, one that adequately explains its spatial and temporal continuity. The possibility of such an account depends on reconciling the teleological primacy of the final cause with the operational significance of efficient causation. This thesis investigates this question by highlighting the critical role of efficient causation in Aristotle's natural philosophy, focusing particularly on the function of efficient causal chains. Efficient causes, in Aristotle's framework, directly account for the chains of interaction between otherwise disconnected domains of the universe. For example, they help bridge the explanatory gap between the heavenly realm and the sublunary world, which are characterized by fundamentally different natures and modes of operation. The heavenly bodies, governed by eternal and unchanging circular motion, do not interact directly with the mutable, perishable entities in the sublunary realm. Yet, through efficient causation—such as the influence of celestial movements on terrestrial phenomena like the changing seasons—Aristotle establishes a causal link that integrates these distinct regions of the cosmos. This approach allows Aristotle to maintain the coherence of his natural philosophy while acknowledging the complexity and diversity of causal relationships that underlie the functioning of the universe. This investigation seeks to demonstrate that Aristotle's use of efficient causes serves as a complement to his teleological framework, thereby ensuring that the cosmos is intelligible as a unified and interconnected whole.

While this study acknowledges the foundational importance of all four causes in Aristotle's system, it deliberately focuses on efficient causation, recognizing its distinctive contribution to maintaining the cosmos as a unified and ordered whole. Aristotle's fourfold schema of causation—material, formal, efficient, and final—offers a comprehensive framework for understanding natural phenomena, with each cause playing a unique and indispensable role. Material causes constitute the substratum or matter from which entities are formed, while formal causes define their essential structure and identity. These causes are vital for explaining the composition and essence of natural substances and their capacity for change. However, this study is specifically concerned with the problem of unity in Aristotle's cosmos, particularly the spatial and temporal continuity that binds disparate phenomena into a coherent and intelligible whole. While material and formal causes constitute the essence and composition of individual entities, they do not directly account for the dynamic processes that sustain the

interconnectedness and continuity of the cosmos as a unified system. In this context, efficient causation emerges as a critical explanatory principle, addressing the mechanisms through which distinct phenomena are linked and the integrity of the cosmos is preserved.

In this dissertation, I have deliberately chosen not to focus on material and formal causes, as my primary objective is to examine the relationship between final and efficient causes in Aristotle's philosophy, particularly their role in grounding the unity and continuity of the cosmos. This decision is motivated by the specific nature of my research question and the central argument of this thesis: to examine how efficient causation operates in relation to, or even in contrast with, the teleological framework established by the final cause. A detailed analysis of material and formal causes risks diverting attention from this focus on the complementary relationship between final and efficient causation, thereby exceeding the scope of this study and detracting from its contribution to understanding cosmic unity through these two causes. This decision is a methodological choice aimed at ensuring clarity and precision in addressing the research question. While this thesis acknowledges the basic significance of material and formal causes within Aristotle's framework, their treatment is confined to a secondary role, emphasizing instead the critical relationship between final and efficient causation as the primary factors in explaining the unity and continuity of the cosmos. By narrowing the focus in this way, the thesis seeks to provide a deeper understanding of how these two causes interact to sustain Aristotle's vision of the universe as a coherent and purposive whole.

Moreover, it is crucial to emphasize that the concept of unity in the context of this dissertation, as informed by Aristotle's philosophy, can be understood as the coherent interconnection of diverse phenomena within the cosmos, achieved through the interplay of causative principles, particularly the final and efficient causes. This unity encompasses several dimensions, each shedding light on the intricate relationships that sustain the cosmos as a unified whole.

The final cause, epitomized by the Unmoved Mover, provides the teleological grounding of the cosmos by functioning as its ultimate end or purpose. This framework establishes a teleological coherence, in the sense that that all natural phenomena are goal-directed and oriented toward the realization of the good. In this sense, unity is both operational and explanatory, reflecting the cosmos's alignment with an overarching purpose, even if this alignment is not always

immediately apparent in every phenomenon.

Another aspect of unity concerns the spatial and temporal continuity of the cosmos. Aristotle's universe is conceived as a coherent whole, wherein all parts and processes are dynamically interconnected. Efficient causal chains play a pivotal role in sustaining this continuity, providing the necessary linkages through which motion and change are transmitted. Even in contexts where the teleological orientation of the final cause is less evident, efficient causes ensure the interconnectedness of phenomena by enabling the processes that maintain the cosmos's coherence.

Additionally, unity arises from the interconnection of causes. While the final cause offers the ultimate rationale for the order of the cosmos, efficient causation operationalizes this order, connecting disparate processes into a cohesive system. This unity is not the result of any single cause operating in isolation but emerges from the interplay of all four causes. Efficient causes, in particular, shape and sustain the material and formal causes while complementing the teleological primacy of the final cause, ensuring the cosmos's dynamic and enduring coherence.

The relationship between teleology and continuity also underscores the nature of unity in Aristotle's philosophy. The final cause ensures the goodness and purpose of the cosmos, while efficient causation guarantees its continuity and coherence, particularly in instances where teleological connections are less directly observable. Unity, therefore, is both static, rooted in an ultimate purpose, and dynamic, manifested through ongoing causal processes. Teleological explanations, grounded in the final cause, and mechanistic explanations, provided by efficient causation, are not mutually exclusive but are reconciled to offer a comprehensive understanding – and thus: a unified explanation – of the cosmos.

Aristotle's universe is not only physically unified but also comprehensible as a coherent system. Efficient causal explanations articulate this dynamic coherence, ensuring that the cosmos can be understood as a continuous and integrated whole, even in cases where teleological frameworks alone might appear insufficient.

In summary, unity in Aristotle's philosophy, as explored in this dissertation, is multi-dimensional. It encompasses (1) the teleological coherence grounded in the final cause, (2) the continuity of the cosmos sustained by efficient causation, (3) the interplay of causes that integrates disparate phenomena, and (on a different level) the intelligibility of the cosmos as a coherent whole.

This study will focus on Aristotle's treatises on natural philosophy to explore how the problem of unity in his universe is addressed. Central to this investigation is the question of whether final causal explanation is confined to living beings or extends to the cosmos as a whole. If there are limits to the explanatory scope of the final cause, to what extent can it serve as a comprehensive principle for the universe as a whole? Furthermore, how can a full explanation of Aristotle's cosmos be ensured, given that final causation alone appears insufficient to account for its entirety? This inquiry also seeks to clarify the specific role of efficient causation in Aristotle's account of cosmic unity. How does Aristotle incorporate efficient causes as complementary explanatory principles, particularly in the light of his recognition of the constraints of final causal explanation? Finally, this study will explore the concept of unity at the foundation of Aristotle's philosophy of nature, focusing on the role of efficient causation in sustaining the continuity and coherence of the cosmos within a teleological framework. By complementing and extending the teleological function of the final cause, efficient causation contributes to a comprehensive understanding of the cosmos as a unified and ordered system.

In this dissertation, I propose a new approach to addressing the problem of a unified explanation of Aristotle's universe by emphasizing the role of efficient causation in ensuring the continuity and coherence of the cosmos within the framework of final causal explanation, as outlined in Aristotle's physical treatises. To achieve this aim, the dissertation is divided into three main parts. In the first part (Chapter 1), I use *Meta Lambda* as a starting point to examine the central role of the final cause in Aristotle's unified explanation of the cosmos. This chapter also explores the precise limits of the final cause's explanatory scope across different domains of the universe. In the second part (Chapter 2), I turn to *Phys* VIII to investigate the specific contribution of efficient causation to the unified explanation of Aristotle's universe. This chapter examines the role of efficient causes in various fields of the cosmos, assessing whether and how they complement final causation in providing a cohesive explanatory framework. Finally, in the third part (Chapter 3), I analyze how Aristotle integrates final and efficient causes to construct a unified explanation of the universe. This chapter explores the relation between these two types of causation, evaluating their combined role in Aristotle's broader philosophical project of explaining the unity of the cosmos.

The sequence of my investigation into the contributions of the final and efficient causes to the unified explanation of Aristotle's universe aligns with Aristotle's own framework for the study of nature, as outlined in the prologue to the *Meteorology:*

> We have previously discussed the (1) the primary causes of nature, and natural change in general; (2) also the stars ordered according to their motion; (3) and the corporeal elements, how many there are and what they are like, and how they change into others; (4) and generation and corruption in general. (5) It remains still to theorize about a part of this inquiry, which all our predecessors called meteorology… (6) Once we have dealt with these things, we will consider whether we are somehow able to give, in accordance with the method indicated, an account of animals and plants, both in general and separately. Once this is discussed, perhaps the whole of what we established at the outset will be complete.[9]
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> *Meteor* I.1, 338a20–339a10 (trans. M. R. Johnson)

In this passage, Aristotle outlines a comprehensive program for the systematic inquiry into the natural world, presenting a sequence of investigations that are distinct yet deeply interconnected. The order of these inquiries reflects Aristotle's structured approach to the study of nature, progressing from the general to the specific and from the universal to the particular. He begins with an examination of the primary causes of nature and natural change in general, establishing the foundational principles of his natural philosophy. This foundational inquiry is followed by the study of the celestial realm, encompassing the stars and their ordered motions, which provides a framework for understanding the larger, immutable structures of the cosmos. Aristotle then shifts to the examination of the corporeal elements—their nature, properties, and the processes by which they transform into one another. This study bridges the immutable celestial sphere and the mutable terrestrial domain, serving as a basis for understanding change and motion within the sublunary world. He continues with an inquiry into meteorological phenomena, focusing on the intermediate region between the Moon and the Earth, where the elements interact dynamically to produce a variety

[9] I discuss the role of final cause and efficient cause following Aristotle's outline of his study of nature, since (1) (2) is the field of cosmology; (3) (4) is the field of the motions of elements; (5) is the field of meteorology; while (6) is the field of biology.

of natural occurrences, such as winds, precipitation, and other atmospheric phenomena. The program culminates in an investigation of the sublunary world, particularly the growth, motion, and behavior of plants and animals. This final stage reflects Aristotle's interest in understanding living beings both in general and in their particular forms, extending his study of natural processes to encompass the principles of life itself. By following this structured progression, Aristotle's natural philosophy moves from abstract, universal principles to the specific, concrete realities of living organisms, illustrating a unified and hierarchical view of the cosmos.

This passage not only provides a recommended order for investigating the natural world but also reveals the interrelations between Aristotle's various natural treatises. His works on cosmology, the motion of the elements, meteorology, and biology are interconnected, forming a coherent framework for understanding the unity of nature. Each domain contributes to the overall picture, with the earlier inquiries providing the foundation for the later ones. For example, the study of celestial motions informs the understanding of the elemental motions, which in turn underpin the phenomena of meteorology and the dynamics of life in the sublunary sphere.

Following this Aristotelian order of inquiry, my analysis reflects the natural progression outlined by Aristotle himself, beginning with the foundational principles of causation and culminating in their application to the study of living beings. By adhering to this sequence, my work not only remains faithful to the Aristotelian method but also emphasizes the interconnectedness of his natural writings, offering a holistic perspective on the unity of nature as understood in Aristotle's philosophy.

Chapter 1 serves as the definition of Aristotle's final causation and efficient causation. I prefer first to examine Aristotle's causal framework and the hierarchical model of explanation in *Physics* II.7. The second step aims to provide a clear definition of Aristotle's concept of the final cause. This investigation begins with a careful examination of his explicit discussions on final causation. Generally speaking, Aristotle is considered terminologically consistent throughout his corpus of natural philosophy when referring to the final cause. [10]

[10] On Aristotle's terminologically consistent use of final causes, see Johnson (2005, 64) and Leunissen (2010a, 4).

The recurring phrase we encounter, which Aristotle employs to denote the final cause, is "that for the sake of which".[11] However, as we will see, Aristotle also uses other formulations of the final cause in his theoretical works.[12] This raises an important question: how are the various notions of the final cause, which Aristotle appears to employ, systematically interrelated in his natural philosophy? Exploring these different formulations of the final cause across Aristotle's treatises can help refine some of the key terms used in this study to discuss his concept of the final cause more precisely.

As for the efficient cause, I aim to provide a definition as derived from Aristotle's treatises on natural philosophy. Aristotle's most characteristic formulation of the efficient cause is found in *Meta* I.3, where he defines it as "where the origin of the motion [comes] from" (984a27–28).[13] Similarly, in *Phys* II.3, the efficient cause is described as "that from which the origin of the change or the staying unchanged comes" (194b29–30). These definitions highlight two key features of Aristotle's notion of the efficient cause: (a) it is identified in directional terms as the source from which motion originates; and (b) it is also the point of origin for change or the persistence of a state.

Chapter 2 seeks to examine whether and how the final cause can serve as an explanation for the entirety of the universe as presented in Aristotle's natural philosophical treatises. This inquiry is framed in light of the critiques by many modern interpreters, who have highlighted the limitations of the final cause's role in certain aspects of the universe. For the sake of clarity, I structure the investigation of final causal explanation into four distinct steps.

From the first step to the fourth step, I focus on examining whether and how Aristotle's concept of the final cause can serve as an explanation across different domains of his universe—specifically in cosmology, the motion of elements, meteorology, and biology.[14] In the first step, I explore the role of the final cause in providing an explanation of Aristotle's universe within the domain of cosmology. My investigation begins with Aristotle's *Meta Lambda*, where the final cause is conceived as a teleological principle applicable to everything in the

[11] E.g., *Phys* II.3; *Meta* I.3; *GA* I.1; *NE* I.1; *Post* II.11.

[12] E.g., 'to the benefit of which'; 'aim of something'. (See detailed discussion in chapter 2.1)

[13] Tuozzo (2014, 23)

[14] In Chapters 2 and 3, the order of the investigation follows the order of Aristotle's investigation of nature: see above.

universe. This perspective suggests that the entire cosmos is effectively unified through the operation of the final cause. Following Aristotle's line of reasoning, I focus on the discussion at the end of *Lambda* 5, which is directly relevant to the exploration of the final cause. Here, I analyze Aristotle's treatment of the relationship between causes and argue why certain causes can be applied universally, while others cannot. Subsequently, I extend my investigation to *Lambda* 6–10, as well as other related treatises, to examine whether and how Aristotle's conception of the final cause—epitomized by the Unmoved Mover[15]—can serve as an explanation for the entire universe. The second step shifts to an analysis of the final cause's contribution to the explanation of Aristotle's universe within the field of the motion of elements. This involves addressing three key points: (a) why some commentators interpret the orientation of each element toward its proper place as an instance of Aristotle's final causal explanation, (b) the limitations of the final cause's role in explaining the motion of sublunary elements, and (c) the constraints on the final cause in accounting for the motion of celestial elements.

In the third step, I examine the role of the final cause in providing an explanation of Aristotle's universe within the field of meteorology, addressing the question of whether final causal explanation can be meaningfully applied to meteorological phenomena. A key component of my argument involves analyzing the well-known example of rainfall, which has been extensively discussed by many interpreters in relation to final causal explanation.

The fourth step investigates the contribution of the final cause to the unified explanation of Aristotle's universe within the realm of biology. This analysis focuses on the extensive use of direct final causal explanation found in Aristotle's biological treatises. It is widely acknowledged that final causal explanation is most effectively and successfully applied in Aristotle's biological works.[16] Given that Aristotle's biological works are grounded in the foundational principles laid out in *DA*, it is necessary to begin by examining the presupposition in *DA* that the soul functions as the final cause of living beings. Following this, I turn to Aristotle's biological treatises to investigate his use of final causal explanations in relation to living organisms, their parts, and their movements. First, I will explore

[15] 'Unmoved Mover' also can be called as 'first mover' or 'primary mover' in Aristotle.

[16] See Nussbaum (1978, 101–106).

whether the final cause, epitomized by the soul of a living being, can serve as a unified explanation in the field of biology. Next, I will examine Aristotle's attempt to establish a unified explanation in his biological works, with the soul as the organizing final cause. Finally, although the application of final causal explanation in biology is widely regarded as the most successful expression of Aristotle's concept of the final cause, certain exceptional cases within this domain resist explanation through final causation alone. I will analyze these special cases and critically assess the limitations of the final cause in Aristotle's biological framework.

In Chapter 3, I examine the role of Aristotle's efficient cause across different domains of the universe to assess whether and how efficient causes contribute to the unified explanation of Aristotle's cosmos. My interpretation suggests that Aristotle implicitly recognized the limitations of final causes in accounting for universal unity. In addition, efficient causal principles are necessary to ensure the continuity and coherence of the cosmos within a teleological framework. In this chapter, I aim to examine whether and how Aristotle's efficient cause can provide a unified explanation of the whole universe across various domains of his natural philosophy—namely, cosmology, the motion of elements, meteorology, and biology.

First, I explore the role of the efficient cause in the unified explanation of Aristotle's universe within the field of cosmology, using *Phys* VIII as the starting point. In this treatise, Aristotle describes the Unmoved Mover operating as an efficient cause that unifies all changes and motions in the universe. To analyze the role of efficient causation in this context, I focus on the continuous chains of efficient causation extending from the Unmoved Mover to the heavenly bodies. Given that the Unmoved Mover is also presented as a final cause in *Meta Lambda*[17], I will compare and contrast the causal explanations in *Phys* VIII and *Meta Lambda* to clarify their differences and interconnections.

Second, I investigate the contribution of efficient causation to the unified explanation of Aristotle's universe in the field of the motion of elements. This investigation is divided into two parts: (1) the efficient causal chains that govern the motion of the four sublunary elements and (2) the efficient causal chains linking the motion of the sublunary elements with the motion of aether.

[17] See Chapter 2.2.1 (or: 2.1.1?)

Third, I analyze the role of efficient causation in the unified explanation of the universe within the field of meteorology. Many modern scholars have criticized Aristotle for a perceived disconnection between the celestial and sublunary regions in his cosmology. However, I argue that, in Aristotle's framework, these two regions are directly and closely connected by efficient causal chains. The unified explanation of the universe in meteorology is supported by the continuous operation of efficient causes, which I analyze in two ways: (1) the heat produced by the Sun as an efficient cause of generation and corruption in the sublunary world and (2) the continuous efficient causal chains linking the celestial and sublunary realms within the domain of meteorology.

Fourth, I examine the role of efficient causation in the unified explanation of Aristotle's universe in the field of biology. According to Aristotle, the vital heat produced by the Sun serves as an efficient cause for the reproduction of living beings in the sublunary world, distinct from the ordinary heat generated by the Sun. [18] I will investigate the contribution of this vital heat in detail, focusing first on the role of heavenly bodies as efficient causes in the generation of living things. Subsequently, I will evaluate whether continuous efficient causal chains exist to support a unified explanation of the universe within the biological realm.

Armed with a detailed analysis of the roles of the final and efficient causes in providing a unified explanation of Aristotle's universe across these different domains, I will then turn to address the relation of the final and efficient causes within Aristotle's broader philosophical project.

Chapter 4 examines how the relationship between final and efficient causation establishes Aristotle's unified explanation of the universe. For the sake of clarity, the discussion is divided into four steps. The first step is to explore the relation between final and efficient causation in Aristotle's *Meteor* and *PA*. Here I focus on discussing *Meteor* I.9, IV.11, and IV.12, along with *PA* I.1 and II.9, to explore the relationship between Aristotle's efficient and final causes because these texts provide a comprehensive framework for understanding how these two causal principles interact across different domains of nature. By engaging with these texts,

[18] Aristotle clearly puts forward the concept of 'vital heat', deriving the 'vital heat' from the heat of the Sun for the research in biology and ascribing to it the function of generating living beings. Although Aristotle himself did not explicitly bring forward the concept of 'ordinary heat', his theory of the vital heat produced by the Sun actually implies the distinction between the 'ordinary' heat produced by the Sun and 'vital heat' Compare Longrigg (1975, 213).

I aim to show how efficient and final causes are employed in different yet interconnected ways to account for both the mechanisms and purposes of natural phenomena, highlighting their complementary roles and the scope of teleology in Aristotle's philosophy.

The second step is to analyze the fundamental role of final causation in Aristotle's unified explanation of the cosmos. I will first examine the fundamental role of Aristotle's final cause with respect to the fact that the final cause is always taken as primary within Aristotle's unified explanation of the universe. And then investigate the fundamental role of Aristotle's final cause with respect to the fact that the continuous efficient causal chains are directed toward the final cause.

The third step is to investigate how efficient causation complements the teleological framework provided by the final cause. I will explore the complementary role of efficient causation in Aristotle's philosophy by ensuring the continuity and coherence of the universe within a teleological framework. In order to show that, by integrating efficient causation into the teleological framework of final causation, Aristotle achieves a comprehensive understanding of the natural world, balancing purpose and process in a harmonious whole.

The fourth step is to explore the commensurability and non-competition between final and efficient causation. The commensurability and non-competition between Aristotle's final and efficient causation are fundamental to understanding how efficient causation ensures the continuity and coherence of the universe within his teleological framework. Efficient causation explains the how of phenomena, offering an account of the processes or mechanisms that bring change into being, while final causation explains the why, providing the ultimate purpose or goal (telos) toward which these processes are directed. Here I will focus on examining how the relation between final and efficient causation ensures Aristotle's unified explanation of the universe.

Chapter 1: Aristotle's Definition of Final Cause and Efficient Cause

In Aristotle's philosophy, final causation and efficient causation are not isolated concepts but are deeply related within his broader teleological framework. A thorough understanding of the role of efficient causation in ensuring the continuity and coherence of the universe requires a careful examination of both efficient and final causation. This dual focus is necessary because Aristotle's causal system operates holistically, with each type of cause contributing to an integrated explanation of natural phenomena.

The clarification of Aristotle's definition of final causation is essential for several reasons. First, final causation represents the ultimate purpose or end (telos) toward which all efficient causal processes are directed. In Aristotle's teleological framework, efficient causes are not random or purposeless; they act for the sake of a specific end. For example, the efficient cause of a house—the activity of the builder—makes sense only in relation to the final cause, which is the purpose of the house as a place of shelter. Clarifying the definition of final causation will help to articulate the teleological orientation that underpins Aristotle's understanding of natural processes and the universe as a whole. This clarification is indispensable to avoid a fragmented interpretation of efficient causation, ensuring that its role is fully contextualized within Aristotle's system.

Equally important is the need to clarify Aristotle's definition of efficient causation. While efficient causation is often understood as the source or agent of change, Aristotle's treatment of this concept is nuanced and extends beyond mere mechanical causality. For Aristotle, efficient causation operates not only in the realm of artifacts but also in nature, where it interacts dynamically with material, formal, and final causes. For example, in the case of a tree, the efficient cause is the source of motion or generation that brings about its growth and existence, which is inextricably linked to its material constitution (the seed), its formal cause (its inherent structure), and its final cause (its full maturity as an organism). By elucidating the precise nature of efficient causation, this thesis aims to demonstrate how Aristotle's conception of causality avoids reductionism and provides a coherent account of change and motion in the natural world.

The relation of efficient and final causation is particularly evident in Aristotle's cosmology. For instance, in the case of the Unmoved Mover, the distinction between these two types of causation is seemingly blurred: the Unmoved Mover functions both as the efficient cause of the cosmos, initiating motion, and as the final cause, being the ultimate aim of all motion.[19] Clarifying these definitions is crucial for understanding how Aristotle integrates the continuity of motion with the teleological orientation of the universe, which is the central concern of this thesis.

Therefore, the clarification of both final and efficient causation is indispensable for a comprehensive account of Aristotle's philosophy. Final causation provides the teleological framework that explains why efficient causes operate as they do, while efficient causation accounts for how change and motion occur. By examining these definitions in detail, this thesis seeks to illuminate the relation between these two causes and their joint contribution to a unified account of Aristotle's universe.

1.1 Aristotle's Causal Framework and the Hierarchical Model of Explanation in *Physics* II.7–8

Aristotle's theory of the four causes—material, formal, efficient, and final—establishes a comprehensive explanatory system for natural and artificial processes (*Phys* II.3, 194b23–195a3). These causes function together to provide a full account of why a particular entity or event occurs. The material cause explains what something is made of, the formal cause specifies its defining essence or structure, the efficient cause identifies the agent or mechanism that brings it into being, and the final cause explains its purpose or end (*Phys* II.8, 198b10–198b35). Aristotle's teleological approach is built on the principle that natural entities exhibit intrinsic purposes that guide their development and functions.

However, in *Physics* II.7, Aristotle introduces an apparent problem: how do we reconcile the primacy of the final cause with the existence of events that do

[19] For detailed discussion on this point, see chapter 4.2.

not seem to exhibit purposeful direction, such as chance occurrences (*Phys* II.7, 198a5–198a30)? If final causation is the ultimate principle of explanation in nature, why do some events appear to occur without reference to a goal or purpose? Aristotle resolves this issue by distinguishing between essential causes (which provide necessary explanations) and accidental causes (which arise incidentally and do not have the same explanatory priority (*Phys* II.8, 199b15–199b32). Aristotle argues that both chance and spontaneity are accidental causes rather than fundamental explanatory principles (*Phys* II.7, 197a36–197b15). Unlike the four essential causes, which provide intrinsic explanations for why things occur, chance and spontaneity operate within preexisting causal structures as incidental byproducts of multiple causal interactions. To clarify this point, Aristotle differentiates between spontaneity and chance. Spontaneity refers to natural events that occur without deliberation but still follow an inherent tendency. For example, a stone falling to the ground does so in accordance with its natural motion, but if it happens to hit something upon landing, that result is spontaneous rather than intentional. Chance, on the other hand, is a subcategory of spontaneity that applies specifically to human actions, occurring when a rational agent acts with intention but produces an unintended outcome due to the convergence of independent causal chains (*Phys* II.7, 198a5–198a18).

Crucially, Aristotle maintains that chance events are still causally intelligible. Even though they lack an explicit final cause, they are not uncaused or purely random. Instead, they result from a convergence of efficient causes (*Phys* II.8, 198b10–198b35), meaning that while they lack purposiveness at the level of the specific event, they still fall within the broader structure of causal necessity.

Aristotle's treatment of accidental causation in *Physics* II.7–8 has important implications for his teleology. While he insists that the final cause is the highest explanatory principle in nature, he recognizes that not every event can be directly accounted for in teleological terms (*Phys* II.8, 199a3–199a20). In cases of chance and spontaneity, continuity the interplay of different causal processes takes precedence over the immediate fulfillment of a teleological goal. In other words, while the universe as a whole is directed toward the good, Aristotle acknowledges that when certain processes are impeded or interfered with (ἂν μή τι ἐμποδίζῃ, *Phys* II.8, 199a10–11), their outcomes are best explained by efficient causation rather than final causation. Aristotle's discussion of cause here serves to refine his overall causal model by clarifying that not all events are best explained through

the final cause alone (*Phys* II.8, 199a30–199b10). While the cosmos as a whole exhibits teleological order, Aristotle maintains that the explanation of specific natural phenomena often depends on the interplay between efficient causes and material causes — the latter introducing a dimension of natural necessity (ἐν γὰρ τῇ ὕλῃ τὸ ἀναγκαῖον, *Phys* II.9, 200a14). In certain cases, matter may interfere with the realization of form and purpose, as in the generation of malformed animals (τέρατα), where the formal cause is correct but the material conditions fail to support its proper actualization (GA IV.4, 769b4–12). I will return to this problem in section 1.2.2, "Nature Does Nothing in Vain" and the Limits of Final Cause. This is also particularly evident in his discussion of meteorological phenomena and biological processes, where efficient causes often provide the most immediate and relevant explanation (*Phys* II.9, 200a1–200a20).

However, Aristotle does not treat this as a rejection of teleology. Rather, he introduces a hierarchical model of explanation. Firstly, at the highest level, the cosmos as a whole is teleologically oriented toward the good, as Aristotle suggests in his discussion of nature and motion (*Phys* III.1, 200b10–20). Secondly, at the level of individual natural processes, some phenomena are best explained through a combination of efficient, material, and formal causes, rather than through explicit reference to a final cause (*Phys* II.8, 199b15–199b32). Thirdly, at the level of incidental occurrences, chance and spontaneity arise as byproducts of multiple intersecting causal sequences, yet they remain intelligible within Aristotle's causal system (*Phys* II.6–7, 198a5–198a18).

By integrating chance and spontaneity within his broader framework, Aristotle preserves the intelligibility of nature while allowing for contingency. His treatment of causation thus ensures that his teleological account remains robust without requiring every single occurrence to exhibit explicit purposiveness.

In sum, Aristotle's discussion in *Physics* II.7–8 refines his causal framework by demonstrating that final causation, while primary, does not provide the sole explanatory principle for all natural occurrences. By distinguishing between essential and accidental causes, he accounts for events that appear contingent while preserving the intelligibility of nature within a structured causal hierarchy. His hierarchical model of explanation accommodates different levels of causal explanation: teleological order governs the cosmos as a whole, while efficient and material causes play a dominant role in explaining individual natural processes, and chance and spontaneity emerge as incidental yet intelligible occurrences

within this broader structure. This approach allows Aristotle to reconcile teleology with the presence of seemingly purposeless events, reinforcing the coherence of his explanatory system while acknowledging the complexity of causal interactions in the natural world.

1.2 Aristotle's Definition of the Final Cause

According to the discussion above, in Aristotle's philosophy, the concept of "cause" is multifaceted, and within the notion of the final cause lies a crucial distinction between its role as a motivating principle, object of desire and its explanatory function. The final cause, as exemplified by the Unmoved Mover, does not act in the sense of direct intervention or physical causation. Instead, it is characterized by " actuality," existing as an ultimate object of desire that inspires motion and change without itself undergoing any change or engaging in any specific action. This conception emphasizes the Unmoved Mover's role as a teleological principle that underpins the cosmos' order and unity.

At the explanatory level, appeals to the final cause serve to illuminate the inherent purposefulness and goodness within the cosmos. Such explanations aim to uncover how natural phenomena strive toward what is best, revealing the teleological orientation of nature. For example, the orderly circular movements of the heavenly bodies can be understood as directed toward their highest fulfillment, guided by their wish to be as similar as possible to the final cause. However, not all phenomena lend themselves easily to such teleological explanations. Certain domains, such as meteorology or the irregular behavior of elemental substances, pose interpretative challenges. These phenomena, while still encompassed by Aristotle's framework, resist straightforward accounts of their purpose or alignment with an ultimate good.

Thus, Aristotle's concept of the final cause functions on two complementary levels: as the ultimate motivating principle that provides the cosmos with its order and coherence, and as an explanatory framework that seeks to reveal the purposefulness inherent in natural processes.

This section aims to provide a clarification of Aristotle's notions of the final cause. Scholars have adopted various approaches to elucidate Aristotle's concept

of the final cause, reflecting its complexity and centrality within his philosophy. Leunissen[20] identifies three distinct types of final causation based on Aristotle's *Phys*. First, a final cause can refer to the completed natural substances or artifacts that represent the end results of generative processes. Second, it encompasses the functions performed by parts of substances. Third, it includes the objects of desire that serve as the aims of deliberative actions. Kullmann[21] offers a similar division of final causation, focusing on the relationship between the cause and its end. He explains that when something exists for the sake of another, its orientation toward the end may be inherent in itself, serve the interest of another, or depend on an interaction between the two. Charles[22] emphasizes the goal-oriented nature of Aristotle's final cause, which he defines as the good to be achieved. He further interprets the logical structure of the final cause in terms of hypothetical necessity, highlighting its alignment with the goals inherent in natural processes. Gotthelf[23] argues that the final cause—particularly as it pertains to the development, structure, and functioning of living organisms—is a central tenet of Aristotle's philosophy. He underscores that this concept is empirical in nature, emerging from observations of the natural world rather than being imposed as a presupposition. Furley (2002), taking a broader perspective, examines Aristotle's final cause within the context of the four causes. He explores the interconnections between the final cause and the material, efficient, and formal causes, illuminating the distinctions and relationships among them in Aristotle's framework. These scholarly interpretations collectively highlight the multifaceted nature of Aristotle's final cause and its fundamental role in his explanation of natural phenomena.

In this section, I concentrate on clarifying and refining some of the key terms and concepts I use in discussing Aristotle's final cause. By engaging with these perspectives, I seek to establish a nuanced framework that underscores the role of the final cause within Aristotle's teleological system while situating it in relation to the efficient cause, which forms the central focus of this study.

[20] Leunissen (2010a, 12–13).

[21] Kullmann (1985, 172).

[22] Charles (2012, 2–9).

[23] Gotthelf (1987a, 222–229).

1.2.1 Aristotle's Notions of Final Cause

The various explanations of the 'final cause' (τὸ τέλος, 'end') found in Aristotle's physical treatise are often taken as one homogeneous category. Generally speaking, when referring to Aristotle's final cause, Aristotle is considered to be terminologically consistent throughout his corpus of natural philosophy.[24] The phrase employed by Aristotle for the notion of the final cause, is 'that for the sake of which' (τὸ οὗ ἕνεκα)[25].

I will start with a careful examination of his direct discussion of the final cause in *Phys* II.3, where Aristotle puts forward the doctrine of four causes, which is also one of the essential points of his *Phys*. While Aristotle discusses final causal explanation in a wide range of natural philosophy, this passage contains his key definition:

> And lastly, there is the *end* or purpose, for the sake of which the process is initiated, as when a man takes exercise for the sake of his health. 'Why does he take exercise?' we ask. And the answer 'Because he thinks it good for his health' satisfies us.
>
> *Phys* II.3, 194b32–35 (trans. P. H. Wicksteed and F.M. Cornford)

In this passage, Aristotle introduces the concept of the final cause by emphasizing that there is always something "for the sake of which" a thing exists or an action occurs. This notion, central to Aristotle's teleological framework, identifies the purpose or end that explains why phenomena occur or why entities possess specific features (*Phys* II.3, 195a1–15). Aristotle's discussion in this chapter extends beyond merely introducing the final cause to include a methodological exploration of how to identify and articulate it within causal explanations. By emphasizing causal relevance, Aristotle demonstrates how statements about final causes uncover the true nature of purposeful activity, whether in natural or artificial contexts.

To illustrate the explanatory power of the final cause, Aristotle provides

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[24] On Aristotle's terminologically consistent use of final causes, see Johnson (2005, 64) and Leunissen (2010a, 4).

[25] *to hou heneka*: e.g., *Phys* II.3; *Meta* I.3; *GA* I.1; *NE* I.1; *Post* II.11.

several examples that emphasize its role in clarifying the connection between purpose and action. In the example of someone walking (above, *Phys* II.3, 194b33–35), health functions as the final cause of walking, as it provides the rationale for the action. The final cause does not compel an individual to walk indiscriminately; rather, it directs them to walk only under conditions conducive to health. For instance, the final cause governs the manner and timing of walking to ensure it promotes well-being, reflecting its role as a guiding principle that aligns action with its ultimate purpose.

Aristotle further elucidates the nature of final causation with the example of a saw's sharp teeth (*Phys* II.9, 200b5–10). The sharp teeth are explained by their purpose: cutting. The final cause of the teeth is sawing, and their existence and configuration are determined by their utility in achieving this end. Explicitly, the teeth exist "for the sake of" cutting, with their shape and structure adapted to fulfill this purpose. This example illustrates Aristotle's teleological framework, where the functional characteristics of an object are intrinsically linked to its intended goal, offering a clear rationale for its design and features.

In both examples, Aristotle underscores the explanatory primacy of the final cause in accounting for actions, structures, and phenomena. The final cause does not function in isolation but interacts dynamically with other causes, such as the efficient cause, to bring about the realization of an end. For instance, in the case of walking, the efficient cause—the physiological mechanisms enabling motion—operates in service of the final cause, health. Likewise, the efficient cause in crafting a saw's sharp teeth is guided by the final cause, which dictates their purpose and functionality.

These examples illuminate the broader implications of final causation within Aristotle's philosophical system. The final cause not only explains individual phenomena and artifacts but also reveals the teleological organization of the natural world. By identifying the "for the sake of which" in each instance, Aristotle demonstrates how final causation integrates purpose, structure, and activity into a unified explanatory framework. This framework applies across both natural and artificial domains, highlighting the centrality of teleology in Aristotle's philosophy, where the final cause serves as the ultimate principle of explanation.

This reflects his concern with the relationship between structures and functions. The finished house is both the fully realized structure and the final cause

of the craft of house building, while the activity's ultimate purpose—providing shelter—serves as the function and final cause of the finished house. Thus, providing shelter emerges as a function that follows from the presence of the house.[26] This interconnection of structure and function also characterizes Aristotle's treatment of the final cause in his biological works. In *PA* II–IV, Aristotle examines the substances constituting specific organs and their role in performing fundamental life functions. He explains biological examples of final causation in terms of structure and function. For instance, bones exist for the sake of flesh (*PA* II.8, 653b33–37; II.9, 654b28–655a4), serving to support and protect it (structure). Similarly, the liver exists for the sake of concoction (*PA* III.7, 670a28–b17), aiding digestion (function). Aristotle presents a hierarchy of final causation in living organisms. Bones exist for the sake of supporting and protecting flesh, but flesh itself serves a higher purpose. The notion that "bones are for the sake of flesh" suggests two things: bones are necessary prerequisites for the flesh's existence, and the flesh provides a sufficient reason for the existence of bones. In this way, final causes explain the indispensable prerequisites of a thing's function or structure. By linking the concepts of function, structure, and purpose, Aristotle establishes a teleological framework that applies across crafts and biological processes. This demonstrates how final causation integrates disparate elements into a coherent explanatory model, underscoring its centrality in his philosophy.

In *PA*, Aristotle uses the term "for the sake of which" to describe the end of a developmental process in relation to its preceding stages (*PA* I.1, 639b25–30). In this context, the final cause explains the development of an animal: certain types of matter must be present as prerequisites for the animal to exist as the ultimate end. This matter undergoes successive changes, moving step by step toward the end goal—becoming a fully realized animal. The development occurs "for the sake of" this end, which provides both the purpose and explanation for the process. Aristotle employs a similar perspective in *DA*, where he describes the soul as both the cause of motion and change and the "for the sake of which" in the developmental processes of living things. Here, the soul functions as the final cause that organizes and directs the unfolding of life, integrating matter and form

[26] Leunissen (2010a, 12) describes the function performed by artifacts as the second kind of final cause in the second book of the *Phys*.

into a unified living being.[27] In the second book of the *Phys*, Aristotle further elaborates on the final cause as a mode of causation expressed in terms of an "end" [28]. This is exemplified in the process of house building, where the finished house represents the final end of the activity.[29]The end provides a sufficient reason for the preceding stages of construction, while those earlier stages are indispensable prerequisites for achieving the finished structure. Across these discussions, Aristotle underscores that the final cause serves as both the purpose and the organizing principle of a process. It not only explains why a process unfolds as it does but also ties together its stages into a coherent whole. Whether in the development of animals, the activity of living beings, or the crafting of artifacts, the final cause reveals the teleological orientation inherent in Aristotle's explanatory framework, where every stage is directed toward and justified by its ultimate purpose.

Aristotle complicates our understanding of final causation by attributing two distinct meanings to the phrase "for the sake of which" in at least five different passages (*DA* II.4, 415b1–7; 415b19–22; *Phys* II.2, 194a33–36; *Meta* XII.7, 1072b1–5; *EE* VII.15, 1249b14–16). Despite its significance, this distinction has received relatively little attention in the scholarly literature on Aristotle.[30] I argue that clarifying this twofold meaning is essential for a more comprehensive understanding of his concept of final causal explanation. In both *Phys* (*Phys* II.2, 194a33–36) and *Eudemian Ethics* (*EE* VII.15, 1249b14–16), Aristotle briefly mentions that "for the sake of which" has a twofold meaning without elaborating further. However, in *DA* (*DA* II.4, 415b2–3) and *Meta* (*Meta* XII.7, 1072b1–5), he explicitly defines the twofold distinction. According to Aristotle, "that for the sake of which" (τὸ οὗ ἕνεκα) can refer either to "that towards which" (τινος)—the end to be achieved—or to "that for which" (τινι)—the being in whose interest the action or process occurs. This distinction reveals that "for the sake of which" in

[27] See *DA* II.4, 415a23–27; 415b15–21.

[28] 'Again, there is a mode of cause (final cause) in the sense of the end'. (*Phys* II.3, 194b32)

[29] See *Phys* II.9.

[30] See Kullmann (1985, 170–172) and Johnson (2005, 65). Other interpreters tend to disregard this distinction, for example, Gotthelf (1987a, 210) holds that 'the passages which identify or refer to two ways in which 'for the sake of which' is "said", are intended to isolate the sense of "that for the sake of which" which plays a technical role in Aristotle's philosophy from an ordinary use, approximating "beneficiary", and as such are neither intended to nor do shed light on that technical sense'. Hicks (1907, 340) remarked on 415b2 that 'this is of the nature of a footnote' and 'Probably either here or there it is out of place'.

Aristotle's framework encompasses two key ideas: purpose and beneficiary. Purpose refers to the goal or end of an action or process, while beneficiary denotes the entity for whose benefit the action is undertaken. By distinguishing between these meanings, we gain a deeper understanding of Aristotle's teleological explanations, as they integrate both ends and interests into his broader causal framework.

1.2.2 "Nature Does Nothing in Vain" and the Limits of Final Cause

By this point, we have examined the various expressions and notions that explicitly invoke the final cause— "that for the sake of which". However, Aristotle's physical treatises also present a broader final causal explanation encapsulated in the principle that "nature does nothing in vain" (τὸ μάτην)[31]. This principle occupies a pivotal role in Aristotle's causal framework, shedding light on the intricate relationship between final and efficient causes and raising important questions about the limitations of final causation in providing a comprehensive explanation of natural phenomena.

The term "in vain" (μάτην) is explicated in *Phys* II.6 (197b22–29), where Aristotle connects it directly to the concept of "that for the sake of which." According to Aristotle, an action or process is considered "in vain" when it occurs without being directed toward any proper telos (goal), rather than merely failing to achieve its intended outcome. While artificial activities, such as an aimless walk, may lack a determinate purpose, natural processes do not occur arbitrarily. Even when they fail to fully realize their end—such as an acorn failing to develop into an oak tree—this does not undermine the teleological structure of nature. Instead, such failures are exceptions within an ordered system where natural entities are intrinsically oriented toward their characteristic ends. For instance, walking aimlessly, with no purpose—neither to aid digestion, nor to reach a destination, nor for any other end—can be described as"in vain". However, if one walks with the goal of aiding digestion but this effect does not follow, the action is not strictly "in vain" in the Aristotelian sense, since it remains oriented toward an intelligible

[31] See *DA* III.12, 434a31–32; *Cael* II.11, 291b12–13; *PA* V.8, 788b20–22.

purpose, even if unsuccessful. Aristotle's assertion that nature "does nothing in vain" does not imply that every natural process invariably attains its intended outcome; rather, it affirms that natural processes are never arbitrary. Even when they fail to fully realize their ends—such as in the case of malformed animals—this does not undermine the teleological structure of nature, but instead reflects the inherent limitations and contingencies within natural development. Aristotle elaborates that the term expresses a teleological relationship between activities, presupposing an inherent expectation that one action will ordinarily lead to another within a purposeful framework. Importantly, Aristotle emphasizes that the notion of "in vain" cannot be applied to unrelated phenomena. For example, it would be absurd to claim that "washing is in vain because the sun is not eclipsed" (*Phys* II.6, 197b27). This clarification underscores that "in vain" presupposes a meaningful teleological connection and reinforces its close association with the concept of "that for the sake of which."

Building on this foundation, Aristotle derives the broader principle that "nature does nothing in vain," meaning that "everything in nature is for the sake of something" (*DA* III.12, 434a31–32). This principle encapsulates Aristotle's teleological outlook, asserting that natural processes are inherently purposeful. However, as Lennox points out, Aristotle does not apply this principle in a vague or universal manner. Rather, he employs it in a specific and methodological way — to explain particular phenomena that require teleological clarification, such as the structure of animal organs or the arrangement of natural processes.[32] In Aristotle's scientific practice, this principle guides the formation of hypotheses based on empirical observation: since nature does nothing in vain, we should expect that any regular feature or structure we observe must exist for some purpose. For example, in Generation of Animals (*GA* V.8, 788b20–22), Aristotle argues that nature never fails nor produces anything without purpose, so far as it is possible given the conditions of each case. This methodological use of final causation also implies that final causes operate in coordination with other causes, particularly material and efficient causes.

The interconnection of final and efficient causes is evident in Aristotle's framework. While final causes provide the rationale behind why something exists or occurs— "that for the sake of which"—efficient causes explain the mechanisms

[32] Lennox (2001a, 210–220).

that bring about these ends. For example, the celestial movements are themselves directed by a final cause, namely, the stars' desire to imitate the unmoved mover through eternal circular motion (*Phys* II.8, 198b10–13). These celestial motions, in turn, produce regular physical effects on the sublunary world — such as the orderly progression of the seasons — which serve the teleological purpose of sustaining life on Earth. In this way, while celestial motion originates from final causation, the resulting natural processes on Earth unfold through efficient causation, ensuring the coherence of the cosmos. In this way, efficient causes serve as the dynamic processes that actualize the purposes outlined by final causation.

Aristotle's principle "nature does nothing in vain" also raises critical questions about the limits of final causation. While teleological explanations are fundamental to his philosophy, Aristotle acknowledges that their applicability may not be universal. In domains such as meteorology or inanimate motion, final causes may be less apparent or entirely absent. Instead, material and efficient causes may take precedence in explaining phenomena. This flexibility in Aristotle's causal framework reflects his recognition of the diversity of natural phenomena and the necessity of adapting explanations to their specific contexts.

Frede argues that the concept of μάτην (in vain) is closely tied to Aristotle's teleological framework, as it helps illuminate the conditions under which final causation is properly invoked.[33] According to Frede, Aristotle's notion of μάτην is not limited to the failure of achieving an intended goal; rather, it designates cases where actions or processes occur without any proper reference to a telos at all. This reading highlights that, for Aristotle, acting μάτην is not merely about failing to reach a purpose, but about lacking purposive direction altogether. Nevertheless, Frede does not suggest that such cases are typical within nature. On the contrary, the very point of Aristotle's teleological framework is to show that natural processes — by their essential nature — tend to be directed towards ends. Apparent cases of μάτην are exceptional and typically signal some defect, disorder, or external interference. They do not undermine the general teleological structure of the natural world, but rather presuppose it. Moreover, Frede also highlights the importance of efficient and material causes in cases where teleological connections are tenuous, suggesting that Aristotle's system is both hierarchical and context-sensitive. Hankinson similarly notes that while teleological

[33] Frede (1987c, 125–150).

explanations dominate Aristotle's account of natural processes, the reliance on efficient causation ensures the explanatory system remains grounded in observable mechanisms.[34]

Aristotle's emphasis on the interconnectedness of causes is most apparent in his assertion that "there are many causes of the same thing" (*Phys* II.7, 198a24–26). This statement illustrates that the four causes—material, formal, efficient, and final—are not isolated explanatory categories but are interwoven within a unified framework. The final cause provides the overarching purpose, the formal cause defines the essence, the material cause offers the substrate, and the efficient cause brings the phenomenon into being or sustains its existence. Together, these causes create a comprehensive explanatory system that balances teleological principles with the practical realities of natural processes.

The principle "nature does nothing in vain" emerges not merely as a statement of teleological optimism but as a cornerstone of Aristotle's causal philosophy. It encapsulates the relation between final and efficient causes, illustrating how these types of causation collectively sustain the unity, continuity, and coherence of the cosmos. Moreover, this principle serves as a lens through which to evaluate the limits of teleology and the extent to which final causation functions as a unifying principle across diverse fields, including cosmology, meteorology, and biology.

1.3 Aristotle's Definition of Efficient Cause

This section aims to provide a clarification of Aristotle's definition of the efficient cause.[35] A variety of Aristotle's explanations of the 'efficient cause' (τὸ ποιητικόν) can be found throughout his treatises of natural philosophy. Generally speaking, when referring to Aristotle's efficient cause, the most characteristic formulation is from *Meta*:

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[34] Hankinson (1998, 132–153).

[35] The definition of Aristotle's efficient cause is generally considered to be 'whence there is a first beginning of change or rest', based on Aristotle's definitions in *Meta* and *Phys* (see Suárez (1994, 17.1.1–2), Huismann (2022, 663–664) and Tuozzo (2014, 25–26)). In this part, I shall carefully examine the definitions of Aristotle's efficient cause in these two treatises, as well as in his other natural philosophical treatises.

> And to seek this is to seek the second cause, as we should say, —that from which comes the beginning of movement.
>
> *Meta* I.1, 984a27–28 (trans. W. D. Ross)

The definition 'that from which comes the origin of the motion (or change)' highlights two features of Aristotle's notion of the efficient cause[36]. On the one hand, the efficient cause is defined in directional terms: it is '*where*' the change or motion originates. This shows its feature of direction and means that the efficient cause directly explains the source of the change or motion and shows the chains of interaction where the change or motion happens. On the other hand, the efficient cause is also where the '*beginning*' of the change comes from. This shows its feature of origin and means that the efficient cause directly explains the origins of the change or motion and shows the causal chains of the change or motion. Thus, Aristotle's definition of the efficient cause in *Meta* clearly manifests the features of direction and origin. Similarly, in *Phys*, Aristotle defines the efficient cause as:

> Again, the primary source of the change or rest.
>
> *Phys* II.3, 194b29–30 (trans. R. P. Hardie and R. K. Gaye)

This definition shows these two features of efficient cause in *Meta*, and shows that efficient causes can directly explain where the source of motion or rest originates. Aristotle also provides some cases to explain the efficient cause, for instance, the father is the efficient cause of a child. Similarly, in *Phys*, Aristotle elsewhere defines the efficient cause as the cause where the motion comes from (*Phys* II.3, 195a8–9), which also shows the role of efficient cause as the source of motion or change, and he illustrates hard work as the efficient cause of fitness. Moreover, the efficient cause is described as 'the primary moving cause' (*Phys* II.7, 198a33–35), since the efficient cause is the primary moving cause to explain change and motion, and in terms of coming to be, the efficient cause is the main cause to investigate, for instance, 'what comes to be after what?' and 'what was the primary agent or patient?' And so, in this way, each step of the efficient causal series can be studied. In addition, Aristotle also has some similar definitions of the efficient cause in his other natural philosophical treatises. In *DA*, Aristotle defines the efficient cause as 'the first thing from which the local movement arises' (*DA* II.4,

[36] See Tuozzo (2014, 25) on the two features of Aristotle's efficient cause in *Meta* I.1, 984a27–28.

415b21–22), when he considers the soul to be the efficient cause[37] of living things as the original source of locomotion[38].

Furthermore, with respect to such definitions, the efficient cause directly explains the causal chains of the motion, and it seems that the definition of efficient cause is closely related to Aristotle's concept of motion. The term 'relative' (τὸ πρός τι) is applied sometimes with reference to excess and defect, sometimes to agent and patient, and generally to what can move and what can be moved (for what can cause movement is relative to what can be moved, and vice versa, *Phys* III.1, 200b31–32). The motion comes from the mover and occurs in the moved, and whatever is in motion is moved by something[39]. Such things will act and be acted on by another thing in many ways: each of them will be capable at the same time of acting and of being acted upon, and thus, what causes motion as an agent can also be moved: when such a thing causes motion, it is itself also moved. The result that everything moved is moved by something enables Aristotle to argue the chains of moved movers concerning their source, and to conceive of 'links' in such chains acting upon the next simultaneously[40].

And Aristotle then argues that all chains of movers that cause another motion must originate from a first cause[41], either something which moves itself, and thereby something else, or something unmoved that moves something else, and that either way, since what moves itself contains an intrinsically moved and an intrinsically unmoved part, all causal chains originate from an intrinsically Unmoved Mover. By supposing the existence of an Unmoved Mover, Aristotle also deals with the complication of infinite regress of the chains of moved movers.

Consequently, it can be seen that Aristotle views the efficient cause as the source or the origin of chains of interaction that operate as efficient causal chains

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[37] For detailed discussion on the soul as efficient cause of living things, see chapter 3.4.

[38] However, the power of locomotion (ἡ κατὰ τόπον κίνησις) is not found in all living things, but change of quality and change of quantity are also due to the soul (*DA* II.4, 415b24–25).

[39] See *Phys* VIII.4. But Aristotle criticizes some people who suppose that every mover can be moved, since he claims that it is possible for a thing to cause motion, though it is itself incapable of being moved (*Phys* III.1, 201a22–27). It can be seen that although Aristotle says that whatever is in motion is moved by something, he posits the existence of a first mover, which causes motion without itself being moved. For detailed discussion, see chapter 3.1.1.

[40] On 'links' of moved movers in Aristotle, see Blyth (2015, 103–105).

[41] Aristotle deals with the complication of infinite regress of moved movers by supposing that all chains of movers that cause another motion must originate from a first cause, which is an Unmoved Mover.

in the universe.

In order to investigate the role of final causation and efficient causation in Aristotle's unified explanation of the universe, it is then necessary to survey the role of the final cause and efficient cause to a unified explanation in different fields of the universe, namely, in cosmology, in the motion of elements, in meteorology and in biology.

Chapter 2: The Limitations of Final Causation in Aristotle's Explanation of the Universe

In this chapter, I aim to investigate whether and how final causes can provide a unified explanation of the entire universe across Aristotle's corpus of natural philosophical treatises. This investigation engages with critical interpretations that challenge the explanatory scope of final causality in Aristotle's natural philosophy, particularly regarding its applicability to specific domains of the universe. Gutas[42] draws attention to Theophrastus' reservations regarding the sufficiency of final causes in accounting for first principles, arguing that Aristotle's teleological framework encounters fundamental difficulties when extended to the most basic strata of reality. As Gutas observes, Theophrastus raises the question of whether final causality operates at the level of primary substances or whether its proper domain is restricted to composite entities, whose functions and ends are more readily intelligible within a teleological schema. This critique underscores a broader philosophical concern: whether Aristotle's teleology constitutes a universally applicable mode of explanation or whether its validity is circumscribed by specific conditions. A similar challenge is presented by Frede[43], who, in his analysis of *Meta Lambda*, interrogate the extent to which teleological explanations can be coherently extended beyond the sublunary realm, particularly with respect to the Prime Mover and the celestial spheres, where causal relations appear to diverge from those operative in the domain of natural substances. By engaging with these critiques, this study will evaluate the extent to which final causality can serve as a unifying explanatory principle within Aristotle's philosophy of nature and whether its limitations necessitate a reassessment of its role within his broader metaphysical framework.

Aristotle assigns the final cause a central role as the ultimate explanatory principle within his teleological framework. He attributes an overarching teleological order to the cosmos, a theme explored extensively throughout his corpus of natural philosophical treatises. In *Meta Lambda*[44], which serves as the

[42] See Gutas (2010, 5–6).

[43] See Frede (2000, 47–49).

[44] See *Meta*, *Lambda*. 6–10.

starting point for our investigation, Aristotle presents the universe as unified by the final cause, conceiving it—exemplified by the Unmoved Mover—as a teleological principle that applies to all things in the cosmos. This unity, as Aristotle suggests, can be understood either in the sense that nature as a whole is directed towards a final cause, or by analogy, as in the way an army is unified under a general or a household is ordered towards the good of the household. One might expect consensus on so fundamental an issue. Nonetheless, there remains significant debate over whether and how the final cause functions as a unified explanatory principle across different domains of Aristotle's universe—namely, cosmology, the motion of elements, meteorology, and biology. A central point of contention concerns the apparent tension between Aristotle's assertion that the cosmos as a whole possesses a telos and the fact that certain parts of it seem to lack an intrinsic final cause. If teleology is to serve as a universal explanatory principle, should it not apply uniformly to all aspects of the natural world? Or does Aristotle's framework permit a hierarchical or differentiated teleology, wherein certain entities—such as living beings—are more explicitly directed toward ends, while others—such as inanimate elements—are only teleological in a derivative or subordinate sense? This ambiguity raises broader questions about the coherence of Aristotle's teleological system, particularly regarding the causal role of the Prime Mover and the extent to which natural substances participate in teleology by analogy rather than through direct purposiveness.

On the one hand, scholars such as Rist and Owens argue—either explicitly or implicitly—that the final cause extends to the entire universe, maintaining that teleology operates at a cosmic level rather than being confined to particular domains.[45] Kahn argues that final causal explanation is universal and can be applied to both the animate and inanimate worlds. Balme, while agreeing that final causal explanation can be applied to certain domains of the universe, such as the motion of elements, rejects the notion of an overarching, universal final causal explanation in Aristotle's philosophy.[46] On the other hand, Ayala argues that Aristotle's final causal explanation is applicable only to the animate world and

[45] Rist (1965, 343) assumes that final causal explanation applies to nature as a whole. Owens (1968, 159) holds that there is an overall final causal explanation in Aristotle's natural world.

[46] It seems that Balme holds the view that the motion of elements is explicable by final causal explanation: 'Finality, in Aristotle's view, goes through and through nature from the elements upwards' (Balme 1987b, 277). But Balme rejects a unified overall final causal explanation in nature (Balme 1972, 94), for example, in biology (Balme 1999, 34 (note at 696b27)).

cannot be used to explain non-living things.[47] Similarly, Nussbaum contends that Aristotle's final causal explanation does not apply to the motion of elements or meteorological events but is confined to the domain of biology. [48] Furthermore, other scholars[49] also maintain that final causes do not operate in the fields of meteorology or the motion of elements. It is evident, then, that the role of final causal explanation in providing a unified account of Aristotle's universe across its various domains requires further investigation.

Addressing these tensions will allow for a more precise assessment of whether Aristotle's conception of final causality can indeed function as a unified explanatory principle across the various domains of his natural philosophy. For clarity's sake, the chapter is divided into four sections. Section 2.1 explores the role of final causes in within the field of cosmology. This analysis begins with *Meta Lambda*, where Aristotle conceives of the final cause as a teleological principle applicable to everything in the universe. Section 2.2 addresses the limited role of final causal explanation in the motion of elements, considering both terrestrial and celestial motions. Section 2.3 investigates the contribution of final causes to Aristotle's explanation of the universe in the field of meteorology, seeking to answer whether final causal explanation can be applied to meteorological phenomena. Finally, Section 2.4 examines the role of final causes in the unified explanation of Aristotle's universe within the field of biology. This section focuses on the extensive use of direct final causal explanation in Aristotle's biological treatises, while also discussing specific biological cases that cannot be fully explained through final causes alone.

[47] See Ayala (1970, 48).

[48] Nussbaum (1978, 92–93) argues that final causal explanation cannot be utilized in the elemental motions nor the meteorological phenomena: 'the idea that I think natural phenomena—eclipses, rainstorms, the downward motion of earth, the upward motion of fire—are best explained teleologically, is a misconception that I frequently try to avoid'. Therefore, she rejects a universal final causal explanation in Aristotle's project.

[49] Including Wieland (1975, 150), Gotthelf (1987a, 209–210) and Byrne (2002, 18–19), etc.

2.1 The Limitation of Final Causation in Aristotle's Explanation of Cosmology

We can now investigate the contribution of Aristotle's final cause to a unified explanation across the various fields of his universe. To begin, I will examine the role of the final cause in achieving an explanatory framework within the field of cosmology. Most scholars who have studied the role of final causation in this field have assumed or defended the role of final causes in cosmology[50]; other scholars argued that in the field of cosmology final causes play a limited role[51]. For instance, Cooper contends that Aristotle's explanation of final causes is sufficient to account for all natural processes without requiring an additional external teleological principle that lies beyond these processes.[52] In this view, final causality is not something imposed from outside but is intrinsic to nature itself, structuring its processes without necessitating further ends or purposes beyond what is already present within the workings of natural phenomena. Furley rejects the view that Aristotle's final cause has a limited role to explain natural phenomena, instead, he posits an overall final causal explanation for the natural world, including the field of cosmology.[53] Kahn holds that the cosmic final cause reaching down from the outer heavens is thought to include both inanimate nature and the biological works. Matthen argues that the final cause is sufficient to explain the cosmos: 'The cosmos is so organized as to achieve an end proprietary to its own essence'.[54] On the other hand, Leunissen, rejecting such conceptions, believes that, in comparison with other physical treatises, Aristotle's general reliance on the final cause to explain the different motions and features of the heavenly bodies seems to be limited.[55] Charles even argues that the instances in the cosmology do not

[50] The effective role of final cause in the field of cosmology is assumed or defended by Cooper (1982); Furley (1985, 115–116); (2002, 75); Kahn (1985); Matthen (2001) and (2009); and Wardy (1993, 19).

[51] The limits of the role of Aristotle's final cause in the field of cosmology are emphasized by Leunissen (2010b) and Charles (2012, 23–26).

[52] Cooper (1982).

[53] See Furley (1985, 115–116) and Furley (2002, 75).

[54] See Matthen (2001, 192).

[55] Leunissen (2010b, 216–217).

meet Aristotle's own conditions for a final cause.[56] Clearly, then, the status of the explanation of Aristotle's final cause in the field of cosmology needs sorting out.

In this section, I undertake to investigate how Aristotle's final cause contributes to a unified explanation of the universe. I begin my analysis with *Meta Lambda*, where Aristotle presents the final cause as a teleological account applicable to everything in the universe. Following Aristotle's line of reasoning, I start my investigation at the end of *Lambda* 5, which directly addresses Aristotle's exploration of the final cause. Here, I analyze Aristotle's treatment of the relationship between different causes and argue why some causes can be applied universally while others cannot. I then turn to *Lambda* 6–10 and other related treatises to examine whether and how Aristotle's final cause, epitomized by the Unmoved Mover, functions as an explanatory principle for the entire universe.

2.1.1 Final Causation in *Metaphysics Lambda:* The Unmoved Mover Governs the Universe as a Final Cause

The *Meta Lambda* lays the foundation for the role of the final cause in Aristotle's cosmological framework.[57] In this treatise, Aristotle presents the primary Unmoved Mover as a final cause, at the same time providing an explanation through which everything in the universe is interconnected. Thus, *Meta Lambda* serves as the starting point for my investigation into the role of the final cause in achieving a teleological explanation of the universe as a whole.[58]

To clarify the role of the final cause in Aristotle's cosmology, it is essential to

[56] Charles (2012, 23–26).

[57] Scholars who have studied the role of Aristotle's final cause in the field of cosmology have focused mainly on the role of the Unmoved Mover as final cause in Aristotle's *Meta*. See Kahn (1985); Horn (2016); Matthen (2001, 190–192); Charles (2012, 23–24); Ross, A (2016), Johnson (2005, 253–258) and Bodnar (2016).

[58] To be sure, the Unmoved Mover (first mover) is also discussed in *Phys* VIII. Aristotle's discussion on the Unmoved Mover in *Meta* XII is closely related to *Phys* VIII. (Many scholars have been aware of the correspondence between these two books, e.g., Berti (2000, 185–189); Johnson (2005, 254–255); Ross (1997, 342–349). In my mind, Aristotle in *Meta* XII discusses the primary Unmoved Mover in terms of final cause; while in *Phys* VIII he investigates the primary Unmoved Mover in the sense of efficient cause. For the role of the first mover as efficient cause in *Phys* VIII, see chapter 3.1.

examine how Aristotle develops this claim. Before delving into his arguments in detail, I will first outline key lines of discussion. Aristotle begins *Meta Lambda* with an exploration of certain established principles regarding the nature of substances and their changes (*Meta* XII.1–5). He then proceeds to identify the ultimate causes of all motion in the natural world (*Meta* XII.6), culminating in the introduction of a primary Unmoved Mover on which depend all moving causes. Subsequently, Aristotle investigates how an Unmoved Mover causes motion (*Meta* XII.7), the actual number of Unmoved Movers (*Meta* XII.8), and the specific mode of causation attributed to the Unmoved Mover (*Meta* XII.9). Ultimately, Aristotle concludes that the primary Unmoved Mover must function as a final cause. Finally, in *Meta* XII.10, he integrates these findings by positing a final cause that governs the cosmos.

The discussions directly relevant to examining the role of the final cause in achieving a unified explanation begin in *Meta* XII.4 and XII.5[59], where Aristotle claims that the causes and principles of different things, although differing with respect to the specific substance, are by analogy one and the same (*Meta* XII.4, 1070a32–33)[60]. Although Aristotle acknowledges that causes differ for different things, as they are understood relative to distinct kinds of perception, he maintains that all things share the same causes by analogy (*Meta* XII.4, 1070b9–20). He illustrates this principle using the example of elements to demonstrate how the same causes can apply universally across diverse phenomena[61] (*Meta* XII.4, 1070b21–30). Aristotle explains that while things in the universe share the same elements and principles, specifically different things possess specifically different elements. However, we cannot assert that all things have identical elements in a literal sense, but rather only by analogy. For example, principles such as form, privation, and matter differ across various classes of things. In the case of color, the principles are white, black, and surface; similarly, for phenomena like day and night, the principles are light, darkness, and air. Furthermore, Aristotle clarifies that causes are not limited to inherent properties within an object but also include external factors, such as the moving cause. Thus, the terms “principle” and

[59] *Meta* XII.4 and XII.5 are closely linked together: they form a distinct whole, in which Aristotle argues that the causes of different things are by analogy one and the same. See Crubellier (2000, 137).

[60] Sedley (2000, 327) considers this thought as one of the key points to the research of *Metaphysics*.

[61] For a discussion of the example of elements, see Crubeller (2000, 156–160).

"element", while closely related, are not synonymous, though both function as causes. Aristotle concludes by noting that the causes, which are analogous across different cases, can also be expressed in a universal formula (*Meta* XII.5, 1071a20–30). The causes of things belonging to different classes—such as colors, sounds, substances, and quantities—differ except in an analogical sense. Even within the same species, causes differ; for instance, the matter, form, and moving cause of one individual are distinct from those of another. However, Aristotle argues that these causes are identical in their universal formula. He integrates the causes of form, matter, mover, and end, asserting that in the sense of analogy, these causes are one and the same.

For example, while different things have distinct final causes, all final causes are, by analogy, one and the same. Aristotle extends this principle to substances, contending that the causes of substances can be regarded as causes of all things, insofar as removing these causes results in the cessation of everything (*Meta* XII.5, 1071b6–9). By treating the universe as a whole, Aristotle elevates the extent to which all things can be said to share the same cause to the highest level of generality. The analogical identification of causes in the universe arises from the fact that universal causes are, in essence, one and the same. According to Aristotle, the universe itself possesses its own matter, form, mover, and end. The matter of the universe is the elements; its form is the spherical structure, divided according to the natural place of the elements; and its mover is the primary Unmoved Mover.[62]

In XII.6, Aristotle demonstrates the eternity of motion and examines the relationship between potentiality and actuality in motion. Based on this analysis, he posits the existence of an unmoved substance[63] (*Meta* XII.6, 1071b11–22). If there is eternal motion, such as the movement of the heavenly bodies, and if its potentiality admits the possibility of not acting, the cause of this motion must be pure actuality. The reason is that if the cause were potential, even partially or under certain aspects, it would entail the possibility of not acting—such as not moving. In this case, the eternal motion of the heavenly bodies would not exist, since that which is potential may also fail to be. Consequently, there must exist a principle whose very substance is pure actuality. Furthermore, the actuality of this unmoved

[62] For the matter, form and the mover of the universe, see Matthen (2001, 189–197).

[63] For the reason why this substance is unmoved, see *Phys* VIII.4–5, which I will discuss in Chapter 3.2.1. For the discussion of the connection of Aristotle's *Phys* and *Meta*, see chapter 3.2.3.

substance is not merely the actuality of immobility but also the actuality of a moving cause. Aristotle critiques his predecessors, including Plato and Leucippus, for their limited discussions on this topic (*Meta* XII.6, 1072a4–6). For instance, while Plato and Leucippus assert the eternal existence of motion, they fail to explain why motion exists or what causes it. They do not identify the principle responsible for the universe's motion, whether in one way or another. Thus, in *Meta* XII.6, Aristotle establishes the existence of an unmoved substance, which is pure actuality, grounded in the concept of eternity of motion and his theory of potentiality and actuality. These ideas are further developed in XII.7[64], where Aristotle investigates the characteristics of the Unmoved Mover and its relationship to that which it moves. [65] Indeed, the most explicit evidence supporting the Unmoved Mover as a final cause appears in the renowned passage of XII.7. Specifically, after positing the existence of a mover that moves the universe without itself being moved, Aristotle states:

> And the object of desire and the object of thought move in this way; they move without being moved.
>
> *Meta* XII.7, 1072a25–27 (trans. W. D. Ross)

In this argument, Aristotle addresses how an Unmoved Mover can cause motion, proposing that it moves in the same manner as the object of desire or the object of thought, which cause motion without themselves being moved. This ability to cause motion without being moved is the defining characteristic of the Unmoved Mover. To illustrate this principle, Aristotle introduces the examples of desire and thought: both cause motion without undergoing change themselves. These ideas are closely linked to Aristotle's doctrines of desire and thought as causes of motion, discussed in *DA* and *Motu*[66]. In these treatises, Aristotle frequently emphasizes cases of motion initiated without reciprocal movement. For instance, the object of

[64] XII. 7 does not constitute a self-contained unit, but is the continuation of a discussion begun in XII.6.

[65] Some interpreters comment on the object of desire and the object of thought in 1072a26–b1 as the primary Unmoved Mover; see, for instance, Laks (2000, 221–223) and Jaeger (1962, 112). But I prefer a less far-reaching interpretation of these sentences: the primary Unmoved Mover moves in the same way in which the object of desire and thought move without being moved, since Aristotle does not explicitly say here that the object of desire or the object of thought is the primary Unmoved Mover.

[66] See e.g., *DA* III.10, 433b10–14; *Motu* VI, 700b15–701a5.

desire moves without being moved by being imagined or thought of (*DA* III.10, 433b13). Expanding on this, in *Meta* XII.7, Aristotle explicitly cited above that the Unmoved Mover "produces motion without being moved" (1072a25). He further clarifies this mode of causation by describing the Unmoved Mover as moving "as if it were beloved", analogous to how loved things inspire motion without themselves being moved. This mode of causation provides a universal explanation for the continuity of motion throughout the cosmos. Aristotle then identifies a specific aspect of the final cause: "That a final cause (that for the sake of which) exists among unmovable entities is shown by the distinction of its meanings; for the final cause is some being for whose good the action is done, and something at which the action aims; and of these the latter exists among unmovable entities though the former does not"[67] (*Meta* XII.7, 1072b1–3). Here, Aristotle explicitly presents the Unmoved Mover as a final cause, describing its existence as 'for the sake of which', thereby indicating its role as the ultimate aim or purpose (telos) of all motion rather than as a beneficiary. This distinction is crucial, as the Unmoved Mover does not receive or gain from the motion it actualizes, but rather functions as the end toward which all motion is directed.

More importantly, Aristotle then devotes his attention to the necessity of the primary Unmoved Mover (*Meta* XII.7, 1072b4–13). The motion of the first heaven is posited here by way of contrast with the primary Unmoved Mover. Its actuality consists in being the primary motion; and insofar as it is in motion, it is capable of being otherwise with respect to place, even if not with respect to substance (*Meta* IX.8, 1050b6–1051a3; *Phys* V.1, 224a19–224b7). While the primary Unmoved Mover is something which imparts movement while itself being unmoved being in a state of actuality, it can in no way be otherwise than it is. The motion inspired by the primary Unmoved Mover produces the motion of the first heaven as well as other heavenly bodies. Further, Aristotle identifies locomotion[68] as the primary and most fundamental kind of change, and the circular motion of the heavenly bodies as the first and most perfect form of locomotion (*Phys* VIII.7, 260a26–b7; *DC* II.6, 288a28–b5). The primary Unmoved Mover (first mover) then exists of necessity, and insofar as it is

[67] For the detailed discussion of the two senses of 'for the sake of which' in Aristotle, see chapter 1.2.1.

[68] According to Aristotle, 'motion' (κίνησις) is a broader term than 'locomotion' (ἡ κατὰ τόπον κίνησις).

necessary, it is good, and in this sense the first mover is the 'first principle'. For what is necessary has all these senses—that which is necessary perforce because it is contrary to impulse, that without which the good is impossible, and that which cannot be otherwise but is absolutely necessary (*Meta* XII.7, 1072b12–14). Accordingly, Aristotle says that heaven and the world of nature depend on the Unmoved Mover (first principle) (*Meta* XII.7, 1072b15f). As a result, there is no doubt that heaven and the world of nature depend on the first mover, which is conceived as a final cause. In this sense, the final cause, epitomized by the first mover, can ensure a unified explanation, not only in the cosmos, but in the whole world of nature.

Meta XII.8[69] provides some additional evidence in favor of the Unmoved Mover as the final cause of the universe[70]. Here Aristotle attempts to specify the number of unmoved substances (Unmoved Movers), and discusses the number of Unmoved Movers that are necessary to move not only the first heaven, but also the other celestial bodies.[71] Aristotle proposes two different numbers for the celestial spheres—and consequently for the Unmoved Movers—namely, 47 and 55 (*Meta* XII.8, 1074a12–30). He then argues against the possibility of additional Unmoved Movers, reasoning that if a movement exists for the sake of another movement, then the latter must also exist for something else. Since an infinite regress of such movements is impossible, every movement must ultimately be directed toward one of the divine bodies that move through the heavens. Consequently, Aristotle concludes that there is but one primary Unmoved Mover.

Next, we turn to the doctrine that the Unmoved Mover, which unifies the universe as a final cause, is conceived of as divine thought (*Meta* XII.8, 1074a7–10). This characteristic of the Unmoved Mover follows from the discussion of *Meta* XII.6 and XII.7. In XII.6, Aristotle shows an Unmoved Mover whose substance is actuality (*Meta* XII.6, 1071b20–21) and by which all things are moved in the same way as 'thought is moved by the object of thought' (*Meta* XII.7,

[69] Some commentators have followed W. D. Ross (1997, 348) in believing that *Meta* XII.8 is a misplaced fragment which is much later than the rest of the treatise, and should be placed at the end of this book (*Meta* XII). E.g., Jaeger (1965, 342) and Devereux (1987, 168).

[70] Berti (2000, 204) comments that the evidence in *Meta* XII.8 is very weak to support the Unmoved Mover as the final cause of the universe. But I prefer to argue that XII.8 provides some evidence additional to the other passages in *Meta* XII.

[71] For a discussion of the relation between *Meta* XII.8 and Aristotle's other treatises on astronomy, see Lloyd (2000, 245–252).

1072a30). This Unmoved Mover is therefore the principle ‘on which depend the heaven the world of nature’ (*Meta* XII.7, 1072b13). Thus, the Unmoved Mover unifies the universe as a final cause. Aristotle then sets out to give us an idea of the mode of existence of the Unmoved Mover: ‘its life is such as the best which we enjoy, and enjoy for but a short time, for it is ever in this state (which we cannot be), since its actuality is also pleasure’ (*Meta* XII.7, 1072b14–17). This characterization of the Unmoved Mover as a final cause unifying the cosmos is not merely a metaphysical postulate. Rather, Aristotle further elucidates its causal efficacy in the natural world by showing how the Unmoved Mover produces motion in the first heaven. While itself remaining in pure actuality and immobility, the Unmoved Mover inspires the eternal circular motion of the heavenly bodies, beginning with the first heaven. This connection between the supreme actuality of the Unmoved Mover and the first and most perfect type of change — locomotion — is central to Aristotle's cosmology. After presenting these significant points, Aristotle continues to argue the characteristics of the first mover and indicates that the actuality of the first mover is also pleasure, and that since it is pleasure, it is also thinking, and since it is thinking it is also life, the highest good and eternal life, namely, god (*Meta* XII.7, 1072b17–30). And it seems that both the whole universe and also the nature of the world depend on the first mover, whose life is always such as the best which we enjoy, since its actuality is also pleasure. Thus, waking, perception and thinking are the most pleasant, and hope and memory are the most pleasant since they relate to them.

Aristotle employs the pleasure of the actuality to explain the pleasure we take in cognitive awareness: therefore waking, perception and thinking are most pleasant, and hopes and memories are so as a result of their reference to these. But it is thinking itself which is clearly the primary mode of such awareness, and which both possessing and being determined by its object. Thinking thinks itself since it shares the nature of the object of thought, and it becomes the object of thought in the process of coming into contact with and thinking its objects, thus thought and the object of thought are the same (*Meta* XII.7, 1072b19–23). For that which is capable of receiving the object of thought—namely, substance—is the faculty of thought. This faculty becomes active when it possesses its object. Therefore, it is the possession of the object, rather than the faculty of thought itself, that constitutes the divine element which thought appears to contain. Moreover, active thinking is both the most pleasant and the highest form of thought. After

the identification of thought as the divine thing which can think itself, in *Meta* XII.[72], Aristotle officially devotes himself to the discussion of 'some difficulties'[73] concerning the questions about divine thought.[74] Accordingly, the famous doctrine of XII.9 with respect to which the Unmoved Mover thinks itself, provides the necessary condition to admit that it also loves itself and moves for the pleasure of moving, having as its end as only itself[75].

Once Aristotle has ascertained that the Unmoved Mover unifies the universe as a final cause, which is pure actuality, being the best and the intellect (divine thought), he connects these arguments by focusing, no longer directly on the Unmoved Mover unifying the universe as a final cause, but on an overall final causal explanation of the universe in *Meta* XII.10[76]. The key question that emerges is how this order operates: is it a hierarchical structure in which all beings are oriented toward the Prime Mover by degrees of participation, or is it an intrinsic teleological organization where each entity realizes its own actuality in relation to the whole? By exploring this transition, Aristotle provides an overarching final causal explanation of the universe. Although no direct discussion of the Unmoved Mover is to be found in this text, the whole argument still concerns a unifying final cause for the whole universe[77]. In the key texts on the unifying final cause of the whole, at the opening of *Meta* XII.10, as Aristotle describes, the universe is

[72] *Meta* XII.9 seems to be a sort of appendix to XII.7, separated from it by the appendix on astronomy in XII.8. For the comparison between *Meta* XII.7 and XII.9, see Brunschwig (2000, 301–306).

[73] For the discussion of these difficulties, see Kosman (2000, 312–325).

[74] Ross (1997, 349) notes that because of the number of these difficulties, the structure of the chapter is often described as fairly disorderly.

[75] The 'difficulties' which Aristotle has discussed in *Meta* XII.9 cannot threaten the orderly arrangement of the universe which is guaranteed by the Unmoved Mover, so I will not discuss these difficulties in detail.

[76] According to the interpretations of Matthen (2001, 195–196) and Sedley (2000, 327–328), Metaphysics XII.10 remains primarily concerned with the characterization of the Unmoved Mover. Matthen argues that the passages in Metaphysics XII.10, where the Prime Mover is described as the source of the good in the universe, present an analogy to a general who imposes order within his army. Sedley, in contrast, maintains that the Unmoved Mover functions as the ultimate cause, directly or indirectly inspiring all beings to actualize their highest potential. Notably, although Aristotle does not explicitly employ the term 'final cause' throughout this passage, references to 'the good' and 'the best' are pervasive, suggesting an implicit teleological dimension.

[77] It should be noted that this passage is not straightforwardly the explanation of final cause at all, but in view of Aristotle's discussion in this passage and its relation to other passages of *Meta* XII, I prefer to follow the interpretation that this passage is about the unifying final cause. For the interpretations of the explanation of the universe based on final causal explanation in *Meta* XII.10, see Horn (2016, 280–286); Charles (2012, 23–26); Johnson (2005, 271–274); Mattern (2001, 192–196); Sedley (2000, 327–336) and Furley (2002, 74–76).

well unified and organized in terms of the good. Aristotle refers to 'the nature of the whole' and continues by presenting a hierarchical 'joint arrangement'[78] of the whole universe. Aristotle employs the analogy of an army to illustrate how the universe is unified (*Meta* XII.10, 1075a11–16). Just as an army derives its order and purpose from the leadership of a general, so too is the universe structured in a way that its unity depends on a primary governing principle. In this analogy, the good of the army is realized both in the general and the soldiers, yet it ultimately depends on the general, whose leadership imparts direction and purpose to the whole. Aristotle goes on to analyze how everything in the universe is jointly arranged in relation to one thing. A good example brought forward by Aristotle concerns the analogy with a 'household'. According to Aristotle's argument, the universe as a whole is similar to a 'household' with respect to the fact that, although different things are arranged in different ways, all things in a 'household' are arranged to one end. For instance, the freemen in a 'household' are arranged with the least freedom to do what they wish, while slaves and beasts in a 'household' are arranged with no freedom and little common responsibility and act for the most part at random, but all of them are ordered together to one end (*Meta* XII.10, 1075a18–25).

Aristotle's discussion here shows an 'overall' explanation of the final cause of the universe, as offering a reasonable account in the sense of final causal explanation which makes the relevant instances in the universe intelligible, not to establish that final causes actually do their work in reality. The analogies of the army and the household express his view that although all things in the universe are not ordered in the same way, they are connected with each other and ordered together into one thing. He uses these two examples to help to explain how all things in the universe are jointly arranged in relation to 'one thing', which seems to be the unifying final cause. His discussion in *Meta* XII.4–5 resembles that in *Meta* XII.10 in several ways. Aristotle claims that the causes and principles of different things, although differing with respect to the specific substance, are by analogy one and with respect to the same for all (*Meta* XII.4, 1070a32–33). It can be seen that the principles for different things are 'one' in the sense of analogy. I

[78] For the passages of *Meta* XII.10, I have followed Sedley's translation (2000, 328–329), with several modifications. Notably, Sedley translates ἀμφοτέρως as 'joint arrangement,' a rendering that captures the reciprocal or dual nature implied in the original Greek. However, I have adjusted certain terms to better align with my interpretation of Aristotle's argument.

think this helps us to understand his arguments in XII.10. Considering that the causes and principles of different things are by analogy one and the same and that this implies the existence of a universal final cause in the universe[79], it seems that the argument of 'all things in the universe are ordered together to one thing' applies also in relation the final cause.

According to the discussion based on Aristotle's *Meta Lambda*, it seems fair to conclude that (1) there exists an overall influence of the final cause in the universe, and (2) the Unmoved Mover, which is pure actuality and is conceived as divine thought, imparts movement without being moved and unifies the universe as a final cause. Thus, the final cause, epitomized by the Unmoved Mover, can ensure a unified explanation of the whole universe.

2.1.2 The Limitation of Final Causation in *De Caelo*

Scholars who have studied the role of Aristotle's final cause in the field of cosmology have concentrated almost entirely on the role of the Unmoved Mover as a final cause in Aristotle's *Metaphysics*.[80] However, the role of the final cause in *De Caelo*, the treatise on cosmology in which Aristotle focuses on investigating the motions and characteristics of heavenly bodies, has received relatively little attention in the scholarly literature on Aristotle.[81] Aristotle, however, emphatically

[79] See the discussion of *Meta* XII.4–5 in chapter 2.2.1.

[80] See Kahn (1985); Horn (2016); Matthen (2001, 190–192); Charles (2012, 23–24); Ross, A (2016), Johnson (2005, 253–258) and Bodnar (2016).

[81] See, in particular, Leunissen (2010b). Leunissen has specifically explored final causal explanations that stand on their own and account for the absence of heavenly features—such as eternal circular motion or imperishability—in cosmological phenomena of the sublunary world discussed in *De Caelo (DC)*, concluding that explanations based on final causality appear more limited in comparison to those found in Aristotle's other physical treatises. Furthermore, she objects to Leggatt's view that Aristotle deliberately sought to exclude final causal explanations at certain levels of his cosmological framework. Leggatt, in his commentary on *DC*, argues that Aristotle downplays the role of the final cause in this treatise because of his dissatisfaction with Plato's teleological explanations in the *Timaeus* (see Leggatt 1995, 36–37). Consequently, Leggatt devotes little analysis to Aristotle's use of final causality in *DC*. Bolton (2010, 68) has examined certain cosmological phenomena through the lens of final causality, particularly in his discussion of the two standards for inquiry in *DC*. Charles (2012, 23–26) likewise investigates Aristotle's use of final causal explanations in *DC*, arguing that such explanations render the heavens and their movements more intelligible—appearing 'non-paradoxical' or 'reasonable' to us—precisely because they do not rely on secure teleological causes of which we have direct knowledge.

posits his study of the heavenly bodies as part of his study of nature[82]. Since he shows how the study of nature involves the theory of the four causes[83], final causal explanation should apply also in the field of cosmology. Thus, in this part, I will examine specific cases of cosmological phenomena, and discuss in how far the final cause plays a role in this field.

In *DC*, Aristotle provides several examples[84] of final causal explanations of cosmological phenomena, which are articulated through the notion of the final cause—expressed in terms such as 'for the sake of which,' 'nature does nothing in vain,' and 'end.' The first type of final causal explanation, understood in the sense of 'for the sake of which' as referring to purpose rather than beneficiary, can be identified in three cosmological phenomena: why there is more than one motion (*DC* II.3, 286a7–10); why the heavens move in the direction they do (*DC* II.5, 288a1–12); and why the heavenly bodies move with different complexities (*DC* II.12, 292a15–25). In these cases, Aristotle's teleological framework explains cosmic motions not in terms of an external beneficiary but in terms of the intrinsic purposiveness of natural processes themselves. The second kind of final causal explanation, which is in the sense of 'nature does nothing in vain', can be found in four different examples in *DC*; that is, to explain why there is no motion contrary to motion in a circle (*DC* I.4, 271a20–35); why heavenly bodies have no organs for moving (*DC* II.8, 290a29–35); why the heavenly bodies do not move on their own (*DC* II.9, 291a23–25); why the absence of the harmony of the spheres shows that the heavenly bodies do not move on their own (*DC* II.11, 291b10–15). These examples indicate that celestial bodies move according to an intrinsic purpose rather than arbitrarily. Besides these examples, there are also final causal explanations of cosmological cases in the sense of 'end'. For instance, Aristotle argues that it is best for the heavenly bodies to attain their real end, identifying this real end as a final cause governing their motion and order (*DC* II.12, 292b21–23)[85]. In this context, Aristotle maintains that celestial motions are not purely

[82] See e.g., *DC* I.1, 268a1–3; III.1, 298b1–4; *Meteor* I.1, 338a20–25.

[83] For instance, *Phys* II.2, 194a 9–18; II.3, 194b15–25; *Post* II.11, 940a20–28; Falcon (2005, 14–16).

[84] For the examples of precise causal explanation of cosmological phenomena in *DC*, I follow Leunissen's study. For detailed discussions of these seven instances of final causal explanation, see Leunissen (2010a, 152–174). As Leunissen has discussed these cases very explicitly, I will not focus on investigating these instances in detail. In the following I shall add one instance of final causal explanations of cosmological phenomena in *DC* in the sense of 'end', i.e., *DC* II.12, 292b21–23.

[85] Here Aristotle shows that, while it is obviously best for any being to attain its real end; if it cannot

mechanistic but are instead oriented toward the best possible state.

Although Aristotle does employ final causes to explain certain cosmological phenomena, these explanations constitute only a small proportion of the broader discussion in *DC*. As Leunissen has argued, while teleological explanations play a role in Aristotle's cosmology, his account of celestial movements relies predominantly on necessity and the eternal nature of the heavens. The following discussion will further examine the extent to which final causation is integrated into Aristotle's cosmological framework, particularly in relation to Leunissen's analysis. Moreover, Aristotle's investigations of cosmological phenomena are primarily based on mathematical principles and numerological doctrines, focusing on the number, shape, and possible motions of heavenly bodies (*DC* III.7). In fact, Aristotle explicitly objects to approaches that attempt to force perceptual phenomena into alignment with preconceived theories and opinions (*DC* II.13, 293a10–25); rather, he insists that additional theories should accommodate the evidence provided by perceptual phenomena. For instance, for the question of whether the Earth moves or is at rest, Aristotle responds in detail to the perceptual data of the natural notion of earth and motions of the fixed stars in relation to the Earth, and then he comes to the conclusion that the relevant perceptual phenomena testify to the fact that the Earth is the center of the whole universe (*DC* II.14, 296a24–b25). With regard to the shape of the Earth Aristotle argues on the basis of perceptual phenomena and infers that the Earth must be spherical (*DC* II.14, 297b20–25)[86]. Furthermore, Aristotle invariably uses mathematical principles to help to explain cosmological phenomena. For example, Aristotle uses calculations of the mathematicians[87] to prove the small size of the Earth, as well as the relative motions and positions of heavenly bodies.[88] It is clear by now that Aristotle aims to establish his investigations of the cosmological phenomena on perceptual data and mathematical principles, which are not explained by the final cause.

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be, then the nearer it is to the best the better will be its state. Because they do not reach the final end, they get as close to it as their share in the divine principle allows.

[86]Besides the examples I have already discussed, there are also many arguments in *DC* to explain the cosmological phenomena based on perceptual phenomena and mathematical principles (e.g., the relatively small size of the Earth as compared to other fixed stars (*DC* II.14, 297b30–35), that Mars is further away from the Earth than the Moon (*DC* II.12, 292a21–30)) Since these are not central to the present discussion, I shall not further go into these examples here.

[87] 'Also, those mathematicians who try to calculate the size of the earth's circumference arrive at the figure 400,000 stades (about 10,000 miles). (*DC* II.14, 298a21–22)

[88] See *DC* II.14, 297a1–298a22.

Therefore, it might be asked why there are still cosmological phenomena, for which Aristotle seeks teleological explanations. Aristotle suggests that because of the long distance[89] it is difficult to offer explanations of the celestial world that are based on the perceptual phenomena:

> Since circular motion is not the contrary of the reverse circular motion, we must consider why there is more than one motion, though 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.
>
> *DC* II.3, 286a5–7 (trans. J. L. Stocks)

This significant passage tells us that investigations of cosmological phenomena, which are based on the perceptual data, may encounter many difficulties because of the long distance between us and the celestial world. This long-distance perception is considered to be the main source of the difficulties. According to Aristotle, as a result of the long distance, we seem to be incapable of receiving enough empirical evidence from observation to come to an explanation. In other words, no matter how careful and hardworking we are in gathering empirical data from the celestial world, we can only ever have limited perception of its features. Regarding the difficulty of long distance in the investigation of the celestial world, Aristotle posits his solution that we can employ final causal explanation[90], since we can use final causal explanation to make the heavens and their motions seem 'reasonable'[91] to us. For instance, Aristotle believed that if one assumed that nature always followed the best course, then the associated difficulties would be resolved, and we will be given something that can be used as a reason for seeking, even if we do not prove that it is true (*DC* II.5, 288a1ff). Similarly, the most plausible view, Aristotle argued, is that stars are spherical, provided that 'nothing is in vain in nature.' (*DC* II.11, 291b12ff) In both cases, adopting a teleological perspective allows us to propose plausible explanations for phenomena for which

[89] For the difficulty of long distance in Aristotle's investigation of the celestial world, see Falcon (2005, 86–87); Leunissen (2010b, 222).

[90] 'But let not that deter us. The reason must be sought in the following facts. Everything which has a function exists for its function'. (*DC* II.3, 286a7–8)

[91] For the qualification 'reasonable' in *De caelo*, see e.g., II.5, 288a1ff; II.6 288a28ff; II.11, 291b12ff. See also Charles (2012, 23); Burnyeat (2004, 14).

we cannot prove relevant explanations (*DC* II.6, 288a28ff). As I have discussed before, Aristotle sometimes utilizes final causal explanation to explain cosmological phenomena in the sense of 'for the sake of which', 'nature does nothing in vain' and 'end'. As a scientist, Aristotle aims at establishing his investigations of the celestial world on the perceptual data and mathematical principles, thus providing a scientific explanation which is based on empirical evidence. For those cosmological phenomena on which we have insufficient perceptual data, Aristotle refers to for an explanation to the final cause.

Accordingly, my contention is that the role of Aristotle's final cause in the scientifically challenging field of cosmology is limited. In this field, Aristotle's ambition is to employ explanations based on perceptual evidence; for phenomena with limited empirical evidence, however, Aristotle relies on final causal explanation.

2.2 The Limitation of Final Causation in Aristotle's Explanation of Elements

Having examined the comparatively limited role of the final cause in Aristotle's explanations in the field of cosmology, I will now turn to investigate its role in the domain of the motion of elements.

For Aristotle, the motion of elements is part of the science of nature (*DC* I.2, 268b14–269a2) and Aristotle's science of nature involves the knowledge of all four causes[92], so the final causal explanation is likely to apply to the motion of elements as well. Considering, however, that where the motion of elements is concerned Aristotle has never referred directly to final causes, modern commentators have debated whether final causes actually play a role in this field.[93]

[92] See e.g., *Phys* II.2, 194a 9–18; II.3, 194b15–25; *Post* II.11, 940a20–28; Falcon (2005, 14–16).

[93] Commentators' viewpoints are divided on this issue. On the one hand, Rist (1965, 339) and Owens (1968, 165) believe that the motion of elements is the key point in Aristotle's final causal explanations. Balme (1965, 8) holds that Aristotle has applied the explanation of final cause in the field of the motion of elements. Johnson (2005, 131–145) has subsumed it under the normal use of Aristotle's final cause. Lang (1998, 276) considers the role of final cause in the motion of elements to be the essence of his final causal explanations. On the other hand, Nussbaum (1978, 60) comments

If final causes are not operative in the motion of elements, their overall function seems to be at stake. Therefore, the status of final causal explanation in the motion of elements needs sorting out.

Considering that the commentators who agree that Aristotle's final cause can be applied to the motion of elements conceive of the orientation of each element toward its determinate place as an explanation in terms of final cause, it is necessary to examine in what sense this interpretation is justified[94]. The purpose of this section is to clarify the role of the final cause in Aristotle's motion of the elements. The investigation of this section will be divided into two parts: the limits of the role of the final cause in the motion of sublunary elements and the limits of the role of final cause in the motion of celestial element.

2.2.1 The Limitation of Final Causation in Aristotle's Explanation of Sublunary Elements

For Aristotle, the study of the motion of elements is part of the investigation of nature. He posits that the science of nature is concerned with bodies and their magnitudes, affections and motions. As regards bodies, there exist both simple bodies and compound ones, and simple bodies are elements. Aristotle announces five elements in the universe: the celestial element (aether) which naturally has circular motion; and the sublunary elements (earth, water, air and fire) which naturally have rectilinear motion (*DC* I.2, 268b14–269a9).

Considering that the sphere and the motion of the four sublunary elements is different from the motion of the celestial element, we need to discuss them separately. In this part, I will concentrate on examining the role of the final cause in the motion of the four sublunary elements and investigating whether and how

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that Aristotle neither [? never?] applies final cause to the nonliving natural bodies. Wieland (1975, 150), Gotthelf (1987a, 210–212), Byrne (2002, 19–20) and Charles (2012, 20–23) reject that Aristotle's final cause can be applied to the motion of elements since elements do not have ends.

[94] See e.g., Lang (1998, 271–275); Bodnár and Pellegrin (2006, 280–282); Leunissen (2010b, 215); Scharle (2005, 122); Gill (2010, 157); Matthen (2001, 181–184; 2010, 133–136). Leunissen and Gill mention this point without discussion. Matthen examines the explanation of final cause in the motion of element earth in the sense of a natural place as the end. Bodnár and Pellegrin have discussed the final causal explanation in the four sublunary elements, which would naturally move to their natural place. Although I do not accept Lang's conception of Aristotelian place, I agree with her that the determinate places of the elements are final causes.

it fits in with the idea of a teleological orientation of the universe as a whole.

Unfortunately, Aristotle's general reliance on final causes to explain the different motions and features of the sublunary elements seems to be limited. For Aristotle's theory of the four sublunary elements contain only limited utilization of final causal explanation. Moreover, Aristotle does not explicitly invoke final causes in his explanations of the motion of the four sublunary elements. However, certain explanations imply a teleological framework by presupposing a relevant notion of final causation. This is particularly evident in Aristotle's account of how each element moves toward its determinate place[95]. In this sense, the motion of the elements can be understood as goal-directed: fire, for instance, moves upward not arbitrarily, but because its proper place is at the outermost boundary of the sublunary sphere. The final cause, as Aristotle conceives it, is not merely an external goal but the actualization of the element's nature—its inherent tendency to realize its proper state. Thus, the movement of each element can be seen as occurring for the sake of[96] reaching its determinate place, where it attains its full actuality. Considering that *Phys* VIII.4 and *DC* IV.3 provide Aristotle's main account of elemental natural tendency, it is necessary to investigate these two texts.

Before discussing the elemental natural tendency in these two texts, we should first examine the different kinds of heaviness and lightness of the four sublunary elements which are closely related with their natural tendencies. In *DC*, Aristotle identifies the 'heavy' and 'light' in terms of something's natural tendency. If a body is heavy, it means that it has the natural tendency to move to the center of the universe, while saying that a body is light means that it has a natural tendency to move away from the center of the universe. In Aristotle's thought, the universe has a center and an extremity, so it must have an up and down: the extremity of the universe is up; the center of the universe is down. If a body is absolutely light, it means that this body moves upward or to the extremity of the universe. And if a body is absolutely heavy, it means that this body moves downward or to the center of the universe (*DC* IV.1, 308a22–38). According to Aristotle, the 'heaviness' and 'lightness' of elements determines their natural tendency. Earth is

[95] In my view, the determinate places of the sublunary elements are considered to be the final end or purpose of their elemental natural tendency. Scholars often refer to the 'natural places' of the elements. But Morison (2002, 33) has indicated that Aristotle nowhere speaks of 'natural' places of elements. Therefore, I prefer to express the places of elements to be their determinate places.

[96] For the relevant notions of final cause, see chapter 1.2.1.

absolutely heavy, and it cannot have any lightness, so it sinks to the bottom of all things and moves towards the center of the universe, which is a fixed point (*DC* IV.4, 311b22), so once earth reaches the center of the universe, it comes to rest since earth cannot move downward anymore.[97] While fire is absolutely light and it cannot have any weight, so it naturally moves upward, toward the extremity of the universe.[98] Just as earth fails to move upward, so fire fails to move downward; for fire has no weight even in its own place, as earth has no lightness. Considering that earth is absolutely heavy and fire is absolutely light, for the intermediate elements, Aristotle argues that water and air are relatively heavy and relatively light[99], which means that water and air are lighter than earth but heavier than fire.

By this point, we have discussed the different kinds of heaviness and lightness of the four sublunary elements. In order to have further evidence for the determinate places of the four elements, we need to turn to *Phys* VIII.4, where Aristotle connects his account of lightness and heaviness, in terms of elemental natural tendency, with his thought of potentiality and actuality. For instance, fire and earth are moved naturally when they are moved towards the actuality which they potentially can attain (*Phys* VIII.4, 255a30). If the elements move naturally, it means that it is possible for them to change their potentiality into actuality, and when sublunary elements get to their determinate places, they finally realize their actuality.[100] Aristotle demonstrates that the light things explain his thought, saying that 'To be in a certain place, i.e., up, is the actuality of the light' (*Phys* VIII.4, 255b10–11). The actuality of the light is to be somewhere, namely up. But when the light is in the opposite place, its actuality is being prevented (*Phys* VIII.4, 255b12). It can be inferred that the four sublunary elements realize their actuality by being at their determinate places. The actuality of light things is to be up, and this upward place is the realization of the actuality of light things. Light things are moving to their determinate place because of their lightness, and by being there, light things achieve their absolute actuality. And considering the four elements move to their determinate places by their natural motion, their natural motion can

[97] See *DC* I.8, 277a12–23; IV.2, 308b13–14; IV.4, 311a20–21; IV.4, 311b20–25.

[98] Ibid.

[99] See *DC* IV.4–5.

[100] It seems to me that Aristotle's view of elemental motion here is closely related to his definition of motion in *Phys* III.1–3, where he defines the motion as the incomplete actuality of the mover and moved, which will end with the complete actuality. In this respect, this explanation shows the realization of a final end.

be regarded as a realization of their potentiality. Aristotle then tries to answer the question why light things and heavy things move into their own place:

> The reason for it is that they have a natural tendency towards a certain position; and this is what it is to be light or heavy, the former being determined by an upward, the latter by a downward, tendency.
>
> *Phys* VIII.4, 255b15–17 (trans. R. P. Hardie and R. K. Gaye)

According to this passage, the reason why elements move towards their determinate place is that they move following their natural tendency. As we have examined above, earth is absolutely heavy while fire is absolutely light; and water and air are both endowed with relatively heavy and relatively light qualities. Earth moves to its own place since it is absolutely heavy and naturally somewhere. Fire moves to its own place since it is absolutely light and naturally somewhere. For the intermediate elements, water and air, they move to their own places (air goes to its own place above water, while water goes downward below air) since they are both relatively heavy and relatively light. The determinate places of the four elements show their different natural tendencies and define the range of their movements in the universe. Moreover, the determinate places of the elements define what the elements are and how they naturally move, as Aristotle puts it: 'the one defined by the up and the other by the down'.

Now, we return to *DC* IV.3, where Aristotle again poses the question why some bodies move always and naturally upward and others downward, while others again move both upward and downward. Aristotle then answers that which produces upward and downward movement is that which produces weight and lightness and that that which is moved is that which is potentially heavy and light, and the movement of each body to its determinate place is motion towards its own form[101] (*DC* IV.3, 310a16–b2). His argument here is similar to his discussion in *Phys* VIII.4. We have seen that it is the fire which always and naturally moves upward since fire is absolutely light, while it is earth which always moves

[101] Although Aristotle here treats each body's natural tendency to its determinate place as a formal cause, according to my understanding of Aristotle's argument in *DC*, I believe that it is also a final cause. Scholars are divided on this point. For the rejection of the opinion that a determinate place is any sort of cause, see Machamer (1978, 385); Charles (2012, 20); Algra (1995, 192–221). For the agreement on the view that the natural tendency of elements to their determinate places is the explanation of final cause, see Lang (1998, 271–275); Bodnár and Pellegrin (2006, 280–282); Leunissen (2010b, 215); Gill (2010, 157).

downward since it is absolutely heavy. The two intermediate elements, water and air, again move both upward and downward since they are both potentially heavy and potentially light. These four sublunary elements are naturally moving towards their determinate places. But where are their determinate places? This question is closely linked to Aristotle's definition of the boundary of the universe. As said above, Aristotle posits that the universe has two boundaries: its center and its outermost extremity (*DC* IV.3, 310b7–8). The boundary of the universe is the boundary of the containing body at which it is in contact with the contained body (*Phys* IV.4, 212a5–6). Hence the place of a thing is the innermost motionless boundary of what contains it (*Phys* IV.4, 212a20–21). It can be seen that the motion of the elements can only move within the boundary of the universe. As regards the determinate place of earth, since earth is absolutely heavy and it cannot have any lightness, it sinks to the bottom of all things and moves towards the center of the universe, which is a fixed point (*DC* IV.4, 311b22). Once earth reaches the center of the universe, it comes to a rest since earth cannot move downward anymore.[102] Thus the center of the universe is the determinate place of earth.

However, Aristotle does not say explicitly what the determinate place of fire is. Following his discussions on the natural tendency of fire, Aristotle first indicates that fire is always light and moves upwards (*DC* IV.2, 308b13–14) and stresses that fire, so long as there is no external obstacle, moves upward (*DC* IV.4, 311a20–21). Then he claims that fire cannot have any weight and is capable of rising to the surface of all things, and people can observe fire to move upward even in air itself while the air remains at rest, thus fire is moving towards the extremity of the universe (*DC* IV.4, 311b20–25). As we have seen, in Aristotle, the celestial sphere is made up of aether, which performs circular motion, and the celestial sphere is eternal and has no corruption or generation (*DC* I.3, 270b1–12). This means that fire cannot exist in the celestial sphere since fire is destructible (*DC* I.3, 270b12–16); if the element fire could move beyond the sublunary sphere and reach to the celestial sphere, this would mean that the celestial sphere was not merely made up of aether, thus the celestial sphere would also be generable and destructible. This case is impossible since Aristotle clearly posits that the celestial sphere is eternal. Therefore, it is impossible that fire can move beyond the

[102] See note 100.

sublunary sphere, thus we can infer that the determinate place of fire is the extremity of the sublunary sphere.[103] The determinate places of the intermediate elements water and air are between the determinate places of earth and fire[104], and the determinate place of air is always above water[105].

Accordingly, regarding the determinate places of the four sublunary elements, it seems that the sublunary sphere presents a hierarchical order of the four elements: the extremity of the sublunary sphere is the determinate place of fire;

[103] Many interpreters hold that the final goal of fire is the extremity of the sublunary sphere. See Guthrie (1971, 243–244); Cohen (1994, 154–155; 1996, 40–41); Bodnár (1997, 97–98); Matthen (2001, 180–181; 2010, 123). I follow their discussions and consider the extremity of the sublunary sphere to be the determinate place of fire. Apart from the evidence from their arguments, I would like to add another evidence for my claim: the celestial sphere is eternal while the sublunary world is changeable, but fire is perishable, so fire cannot exist in the celestial world (see my detailed discussion above). However, there are also some scholars who hold that fire stops moving up when it reaches the sphere of the Moon, not because that is the natural goal, but because it can move upward no further. The most representative scholar is Gill (1989, 235–240; 1994, 31; 2010, 143–144). Gill welcomes Bodnár's label for Aristotle's cosmos: it is pressurized—at least the sublunary region is, but she claims that fire stops moving up when it reaches the sphere of the Moon, not because that it its natural goal, but because it can move upward no further. As for this claim, she refers to *DC*, I.8, 276a22–30, which, however, can be taken as counter-evidence to her position. Here Aristotle distinguishes natural motion and rest from enforced motion and rest, and the mention of natural rest could suggest that the elements have a principle of rest, as well as a principle of motion, Gill thinks that both natural and enforced elemental motions are limited by something external to the element. Rest at the center is natural for earth, because earth has arrived at its 'like' (Gill believes *DC* IV.3 treats the place of earth as its form and designates that place as its 'like'). Rest away from earth's own place is enforced, because earth's downward motion is impeded by something other than its 'like'. For the passage of Gill's evidence, in my mind, I am sceptical to her view that this passage suggests elements have a principle of rest as well as a principle of motion, but I prefer to think that Aristotle's purpose is merely to compare the natural motion and enforced motion as well as the enforced rest and natural rest since Aristotle then further emphasized that if a given movement is due to enforcement, its contrary is natural (*DC*, I.8, 276a27–28). Sisko (2002) holds a similar view as Gill's, but as evidence he is citing *DC* IV.5, 312b2–19, where Aristotle discusses the intermediate elements, air and water. Sisko thinks this passage suggests the intermediate elements are not programmed to stop in the intermediate places either: they stop where they do because their motion downward is impeded by the element below. In my view, for this passage, I think Aristotle does not mean that the motion of intermediate elements is 'impeded' by the element below, but means that the ordering of the intermediate elements can be reversed, since air is like fire, but also like water; and water is like air, but also like earth (see *DC*, IV.3, 310b11–15). Moreover, it seems that, in Aristotle, the four sublunary elements are defined in relation to their natural tendencies and determinate places. These four elements naturally move towards their determinate places, and they come to a rest when they naturally reach their determinate places. For fire, it does not stop as a result of the impediment of the sublunary boundary, but it stops at the extremity of the sublunary sphere because it reaches its determinate place and naturally rests.

[104] The reason is that water and air are lighter than earth but heavier than fire and thus are both endowed with relative heaviness and relative lightness (see *DC* IV.4–5).

[105] The reason is that only considering the water and air, air goes upward to its determinate place above water, while water goes downward to its determinate place below air (see *DC* IV.5, 313a6–13).

the center of the sublunary sphere (also the center of the universe) is the determinate place of earth; the determinate place of air and water is between the determinate place of fire and earth, while the determinate place of water is always below the determinate place of air.

Now we have investigated the orientation of the four sublunary elements towards their determinate places. The determinate place of an element's motion determines its direction. Fire goes upward and not downward since its final goal (end) is the extremity of the sublunary world, while earth goes downward and not upward since its final goal (end) is the center of the sublunary world (also the center of the universe). When an element naturally reaches its determinate place, it realizes its actuality and comes to a rest. In this respect, it seems to me that the orientation of each sublunary element towards its determinate place can be considered as the explanation in terms of the final cause.

Although the final cause plays an important role in the field of the four sublunary elements, as far as ensuring a unified explanation is concerned, my contention is that the final cause alone cannot guarantee a unified explanation in this field. This is based on the following reasons. Firstly, it is through the explanatory framework of final causation that the four sublunary elements are naturally moved toward their determinate places, thereby generating four distinct, concentrically ordered spheres. In this process, each element actualizes its potentiality, fulfills its natural end (telos), and attains a state of rest. In this way, it seems that final cause is not unifying since the actual condition of the world is not in agreement with the application of the final cause, but changing the sublunary world into a state of rest and there would be no generation and corruption. Thus, in this situation for the generation of any complex substances, for instance, living things, would be impossible. Secondly, only considering the explanation of the final cause, the four sublunary elements have their own determinate places which are different from each other. It can be observed that each sublunary element naturally moves toward its own determinate place, doing so separately and independently, without direct interaction with the other elements. Consequently, it appears that the role of the final cause alone cannot account for a unified explanation of the motion of the four sublunary elements. In fact, Aristotle seems to implicitly acknowledge the limitations of final causality in this domain, as he does not discuss its unifying function in relation to the sublunary elements. Rather, he emphasizes a form of unity that does not rely on an appeal to final causality,

instead describing a hierarchical order in which each higher element is related to the one below it, thereby interlinking the elements (*DC* IV.3, 310b13–15). This hierarchical structure suggests that the natural motion of the sublunary elements, rather than demonstrating the unifying function of final causality, instead highlights the indispensable role of the efficient cause in the generation and ordering of the natural world. In this sense, the causal framework of the sublunary realm may be seen as a compelling instance of unified causation, where the interaction between elements is primarily governed by their efficient causes rather than by a single, overarching final cause.

Having examined the limitations of the final cause in the field of the four sublunary elements, now we turn to the role of the final cause where the celestial element —aether— is concerned.

2.2.2 The Limitation of Final Causation in Aristotle's Explanation of the Heavenly Element

In Aristotle's universe, the sublunary realm is filled up with the four sublunary elements—earth, water, air and fire, whose natural motion is rectilinear. These four sublunary elements have their own determinate places which are different from each other. In contrast, Aristotle supposes the existence of the fifth element, aether, to be the element of celestial sphere, and he posits that the celestial realm is filled with aether[106], which naturally and eternally performs circular motion[107]

[106] For Aristotle's evidence of the existence of the element aether, see *DC* I.3, 270b1–25. Firstly, Aristotle believes that the element of heavenly bodies must be different from the material in sublunary world since the heavenly sphere is divine sphere (*DC* I.3, 270b1–12). Secondly, Aristotle posits that the heavenly realm is eternal and without generation and corruption, thus the element of heavenly bodies must be eternal and different from the earth, water, air and air in sublunary world. (*DC* I.3, 270b13–16). Thirdly, in Aristotle's thought, the heavenly bodies are eternal since in all of the past time with respect to the records handed down from one generation to another, neither the whole of the outermost heaven nor any proper part of it has ever apparently changed (*DC* I.3, 270b17–22). Fourthly, Aristotle believes the word 'aether' originates form the meaning of 'always running' (ἀπὸ τοῦ θεῖν ἀεί) for an eternity of time, since in Greek traditions people believe that the element of heavenly realm is better and higher than the four elements in sublunary world (*DC* I.3, 270b23–25).

[107] Many commentators believe that the introduction of aether is Aristotle's great innovation within the elemental theory. For instance, Solmsen (1960, 289) points out that Aristotle's aether endows the heavenly bodies with physical bodies, and therefore non-physical agents being again eliminated from the cosmos; Longrigg (1975, 213) comments that Aristotle's innovation of aether has certain

(*DC* I.2, 269a1–9).

In the previous part, we have examined how the orientation of each sublunary element towards its determinate place can be understood as the role of the final cause, but what is the role of the final cause in the motion of the celestial element—aether?[108] Can the final cause guarantee a unified explanation in the motion of aether?

According to the discussion of the role of the final cause in the motion of the four sublunary elements, it can be seen that the role of the final cause is related to their natural tendency towards their determinate places. Moreover, in *Phys*, Aristotle defines natural motions in terms of their endpoints. And for something to have the property to move in a certain direction is for it to be able to arrive at its goal or final end[109]. Considering that aether naturally and eternally performs circular motion, we should first discuss its natural motion to examine whether this is the work of the final cause. Considering that Aristotle clearly says that the natural motion of aether is circular motion, we need to examine the circular motion of aether.

However, Aristotle's general reliance on the final cause to explain the motion of aether seems to be limited. Moreover, it is difficult to find the role of the final cause in the natural motion of aether since it is unclear what the motion of aether is for the sake of, or its purpose or end. In *Phys*, Aristotle demonstrates that only circular motion can be continuous, such in contrast to rectilinear motion, so it can be seen that there is no beginning or end in the case of circular motion (*Phys* VIII.8, 261b27-265a2). Considering that the natural motion of the four sublunary elements is rectilinear motion which cannot continue without limit[110], there are final ends or determinate places in the natural motion of these four sublunary

advantages: 1) it enables Aristotle to abolish the psychophysical dualism of Plato and brings the heavens within the sphere of physical explanation; 2) Aristotle's theory that the heavenly bodies are made of an eternal element, never subject to change but undergoing incessant circular motion, is in complete harmony with Aristotle's firm conviction of the eternity of the cosmos; 3) it is also fully in accordance with the phenomena, since records gathered for generations revealed no change in the heavens. Besides, it is a traditional belief in ancient Greece that the celestial sphere is more divine than the sublunary world.

[108] Although some scholars hold the view that final cause also applies to the motion of aether, they do not explain what is the end or purpose in the motion of aether in Aristotle's project. For instance, see Rist (1965, 339); Owens (1968, 165); Balme (1965, 8); Johnson (2005, 131–145); Lang (1998, 276) and Lloyd (1996, 161).

[109] See *Phys* VIII.9.

[110] For the natural motions of the four sublunary elements, see chapter 2.2.1.

elements. When the four sublunary elements naturally reach their determinate places, they realize their actuality and come to a rest. But the circular motion of aether is endowed with unlimited continuity, meaning that the circular motion has no end and rest, so it is impossible for circular motion to have its determinate place or to come to a rest. Considering that the orientation of each sublunary element towards its determinate place apparently depends on the role of the final cause, it seems that there is no final causal explanation of this type in the circular motion of aether. Moreover, as discussed above[111], it is through the final cause that the four sublunary elements actualize their potentiality and reach their natural ends upon arriving at their determinate places. However, the case of circular motion presents a unique challenge to this framework. Aristotle characterizes circular motion as complete and everlasting (*Phys* VIII.9, 265a16-b8), which raises the question of whether it has a distinct final end. One might argue that, since final causality entails the realization of actuality, the celestial spheres, by continuously engaging in circular motion, are perpetually at their final end. However, this interpretation is complicated by Aristotle's definition of motion as the actualization of potentiality, which suggests that motion itself cannot be a continuous state of pure actuality. Thus, there is no need for the final cause in the circular motion of aether in the sense of final end. In the *DC*, Aristotle further provides arguments for the fact that there is no contrary to circular motion:

> the motion (circular motion) goes from the same point towards the same point, and contrary motion was distinguished as motion from a contrary to its contrary.
>
> *DC* I.4, 271a20–22 (trans. J. L. Stocks)

Aristotle argues that circular motion cannot be integrated into a system of contrary motion. Contrary motion can occur between contrary places. But for circular motion, there is no motion contrary to it[112]. Circular motion occurs not from one

[111] Ibid.

[112] The absence of a contrary to circular motion is central to Aristotle's argument that celestial bodies, which naturally exhibit circular motion, are not subject to generation and corruption. He states: 'It is equally reasonable to assume that this, i.e., the fifth body, will be ungenerated and indestructible and exempt from increase and alteration, since everything that comes to be comes into being from a contrary and some substrate, and passes away likewise in a substrate by the action of a contrary into a contrary' (*DC* I.3, 270a13–16). By this reasoning, celestial substances, composed of the fifth element, or aether, differ fundamentally from sublunary entities, which undergo change due to the presence of contraries. Since no contrary motion exists to oppose the natural circular motion of

contrary to the other, but is from the same place to the same place since the motions which take place in opposite directions along the same circle are not contrary to one another. So, it seems that circular motion is in a state of complete actuality and is always in the same place, which is different from the rectilinear motion of the four sublunary elements. Aristotle also offers a battery of arguments to explain the differences between the circular motion of aether and the rectilinear motion of the four sublunary elements[113]. According to Aristotle's argument, for each thing there is at most one contrary, and the natural motion is the contrary of unnatural motion, while upward motion and downward motion are the contraries of one another (*DC* I.2, 269a9–13). Hence, the motion upward is the contrary of motion downward. If one thing moves upward naturally, its only contrary motion will be motion downward, and if one thing moves downward naturally, its only contrary motion will be motion upward. So, if something moves in a circular manner unnaturally, then its natural motion will be contrary to the circular. But for one thing there is one contrary; and upward and downward are contraries of one another. If there is some other body which moves in a circular manner unnaturally, there will be some other motion natural to it. But this is impossible, since if it moves upward naturally, it must be fire or air, and if it moves downward naturally, it must be earth or water (*DC* I.2, 269a15–20). Thus, since Aristotle is committed to the principle that for one thing there can be one contrary at most, it is excluded that a rectilinear motion is contrary to circular motion. Moreover, no circular motion can be contrary to circular motion. So, it can be seen that there is no motion contrary to circular motion, which occurs from the same place to the same place. Therefore, although the natural tendencies to the determinate places of the four sublunary elements can be explained by final causal explanation, the natural tendency of aether to perform circular motion cannot be explained by the final cause within Aristotle's theory in the same way as the four sublunary elements.

According to some interpreters[114], the circular motion of the heavenly bodies is best understood as an imitation of the immobility of the Unmoved Mover, which serves as the ultimate final cause. In this reading, celestial motion is not final in

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celestial bodies, Aristotle concludes that they must be imperishable and exempt from the processes of coming-to-be and passing-away that characterize the terrestrial realm.

[113] See *Cael* I.2.

[114] E.g., Kahn (1985, 198); Wisnovsky (2003, 133–134); Richardson (2004, 82) and Johnson (2005, 257).

itself but is directed toward an extrinsic final cause—the Unmoved Mover—whose unchanging actuality provides the explanatory principle for its continuous motion. This interpretation aligns with Aristotle's broader teleological framework, wherein natural entities move not arbitrarily but in pursuit of an end. Thus, rather than seeing the final cause and the Unmoved Mover as distinct explanatory principles, their joint involvement in celestial motion may reinforce the coherence of Aristotle's causal system, integrating both the internal orientation of the heavens toward perpetual motion and their ultimate reference to a transcendent actuality. Although Aristotle explicitly says that the motions of the four sublunary elements imitate (μιμεῖσθαι) the circular motion of aether (*GC* ii.10, 336b25–337a7), he did not say in so many words that the circular motion of aether imitate the Unmoved Mover. However, he left some hints that the motion of heavenly bodies is for the sake of the Unmoved Mover in *Meta*[115] (*Meta* XII.7, 1072b13–31). Moreover, even if the circular motion of aether can be understood as an imitation of or a kind of love for the Unmoved Mover, this form of final causality differs fundamentally from that which governs the motion of the four sublunary elements. While the movement of aether is directed toward the Unmoved Mover as an ultimate object of aspiration, in the sublunary realm, the final cause operates in terms of end-place, determining the natural tendencies of elements to move toward their proper locations. This distinction raises a problem of continuity: if final causality functions differently in the celestial and sublunary spheres, can it still serve as a unifying explanatory principle for the motions of all elements in Aristotle's cosmos?

This issue is further complicated by a fundamental problem of discontinuity within Aristotle's theory of the five elements. The celestial sphere, composed of aether, naturally and eternally engages in circular motion, whereas the four sublunary elements exhibit rectilinear motion. Crucially, there appears to be no direct interaction or causal connection between the motion of aether and that of the sublunary elements, raising the question of how Aristotle accounts for the coherence of the physical cosmos as a whole. I will argue that this apparent discontinuity is resolved through Aristotle's concept of the efficient cause, which provides the necessary explanatory link between these two domains and ensures

[115] In chapter 2.2.1, I am dealing with the role of final cause only in the field of the motions of Aristotle's five elements. For the role of Unmoved Mover as a final cause of the heavenly bodies' motion, see chapter 2.1.1.

the overall continuity of his cosmological framework. Thus, we may conclude that Aristotle's final cause cannot ensure a coherent explanation covering the motion of the sum-total of elements.

2.3 The Limitation of Final Causation in Aristotle's Explanation of Meteorology

Having explored the role of the final cause in the domain of the motion of elements, I now turn to examine its role in Aristotle's explanations in the field of meteorology. This investigation seeks to address whether final causal explanation can be meaningfully applied to meteorological phenomena. For Aristotle, meteorology is a part of the science of nature (*Meteor* I.1, 338a20–b4) and Aristotle's science of nature involves the knowledge of all four causes[116], so the final causal explanation can be presumed to apply to the field of meteorology. However, in *Meteorology*, Aristotle investigates various meteorological phenomena between the upper and lower realms of the universe with reference to matter and sources of motion[117] and it seems that there is no role to be found for the final cause. For Aristotle, meteorological phenomena occur as a result of the four sublunary elements—earth, water, air and fire—as 'the material cause of the events of this kind (meaning by 'material' what is subject and is affected)' (*Meteor* I.2, 339a28–29), and the eternally moving bodies as 'the cause whence the motion originates' (*Meteor* I.2, 339a30–31). Thus, there does not seem to be room for the role of final cause in the field of meteorology.

However, although it is difficult to find the application of the final cause in Aristotle's field of meteorology, in *Phys* II.8 there is debatably a case in Aristotle's explanation of the final cause which uses a meteorological phenomenon, rainfall, as an example. What is up for debate in *Phys* II.8 is whether Aristotle is supporting the position that rainfall can be explained through final causal explanation—that

[116] See e.g., *Phys* II.2, 194a 9–18; II.3, 194b15–25; *Post* II.11, 940a20–28; Falcon (2005, 14–16).

[117] The source of motions can be considered as the explanation of efficient cause in Aristotle ('efficient cause' is Aristotle's technical term for 'source of motion'). For the definition of Aristotle's efficient cause, see chapter 1.3.

rainfall exists for the sake of the growth of crops. There are two kinds of view on this point, both based on the same arguments from *Phys* II.8: one takes the statement about rainfall to be Aristotle's own example of for the sake of which—that is to say, an example of a process that according to Aristotle can be explained by final cause;[118] the other takes it to be merely the meteorological process without the role of final cause[119]. Since these interpreters come up with opposite conclusions from the same passages of Aristotle[120], it is necessary to investigate the rainfall example in *Phys* II. 8 and to examine exactly what Aristotle says in these passages.

Here, Aristotle first raises a difficulty (ἀπορία): what prevents the meteorological phenomena to be neither for the sake of something, nor for the sake of the better (*Phys* II.8, 198b16–17)? Take for example, the event of rainfall. What if the sky does not produce rain in order to make the crop grow, but out of necessity (for what rises up must be cooled and what is cool becomes water and must fall down)? In that case, the crop's growth just happens as a result of this event. Similarly, if a man's crop is spoiled on the threshing-floor: the rain did not fall for the sake of this—in order that the crop might be spoiled—but this result just followed (*Phys* II.8, 198b20–22). This example suggests that rainfall does not occur for the sake of something: the growth of crops seems to be the incidental beneficial outcome of the rainfall—testify the fact that rainfall sometimes can also spoil the crop. Along these aporetic lines, rainfall is due to necessity and to have incidental results, in contrast to an explanation in terms of final cause. Rainfall is explained as a meteorological process: what is drawn up must cool, and what has been cooled must become water and descend, thus the rainfall occurs. Aristotle then brings forward the example of teeth: if teeth do not exist for an end, it is merely a coincident that the front teeth are sharp, which makes them fit for tearing, while the molars are broad and useful for grinding food. What prevents teeth to be thus, not for the sake of something, but of necessity[121]? And similarly, regarding

[118] For recent interpreters who hold that meteorological events like rainfall can be explained by final cause in Aristotle, based on the passages in *Physics* II. 8, see Owens (1976, 159–173); Balme (1987a, 275–286); Cooper (1982, 217–218); Furley (1985, 177–182; 2002, 76); Scharle (2008a, 150–154), Leunissen (2010a, 69–72) and Horn (2016, 283).

[119] For recent interpreters who reject the role of final cause in the example of rainfall, based on the same passages in Aristotle, see Nussbaum (1978, 60–62); Johnson (2005, 150–152) and Charles (2012, 18–19).

[120] See Charles (1991, 12–13) and Code (1997, 128–129).

[121] Aristotle here employs Democritus's viewpoint that teeth do not exist for a final end, but out of

other parts of a body (*Phys* II.8, 198b26–30). Moreover, for the example of an eye's color, Aristotle posits that it is necessary that an eye has a certain color, but having grey or blue eyes is not for the sake of anything (*GA* V.1, 778a29–b19). It is evident that Aristotle introduces these examples to illustrate that certain things arise out of necessity or as a consequence of hypothetical necessity, but not for the sake of an end.

By means of this aporetic reasoning, then, Aristotle argues that in the case of rainfall necessity applies , since it is difficult to find the rainfall occurs for the sake of anything, which is merely a coincidental result, thus there does not seem to be a role of final cause in the example of rainfall.

Still, there is a scholarly debate on whether rainfall can be considered as a case of final causal explanation or not at all? It seems that the interpreters' arguments, no matter whether they agree or disagree with the role of final cause in Aristotle's rainfall example, are all based on the following passage:

> But it is impossible for things to be that way. For these and all <other> natural things come about in a given way (οὕτω198b5) either always or for the most part, but that which is by luck and by spontaneity does not. For it does not seem to be by luck or spontaneity that it rains a lot in the winter, but only if it does in the summer. Nor does a heat wave in summer, but only in winter. So, if it seems to be either by spontaneity or for the sake of something, and if they cannot be by coincidence or spontaneity, then they are for the sake of something. But that all these things are by nature, even those saying such things would agree. Therefore, action for an end is present in things which come to be and are by nature.
>
> *Phys* II.8, 198b34–199a8 (trans. R. P. Hardie and R. K. Gaye)

Aristotle in this passage returns to discuss winter's rainfall. The debate is more general: rainfall serves as an example of whether rainfall can be considered as a case of final causal explanation. Aristotle here notes that rainfall happens a lot in winter, and implies that the winter rainfall comes about always or for the most part and happens by nature. Aristotle posits that natural things either come to be for

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necessity. However, Aristotle later stresses that Democritus's viewpoint is right in so far as it is applied to certain individual cases, but he is wrong in making it of universal application (*Phys* VIII.1, 252b3–4).

the sake of something, or they do so spontaneously. Based on this aporetic passage, some recent scholars argue that Aristotle's account of the necessity of rainfall parallels his final causal explanation of certain biological features, such as teeth, which exist for the sake of tearing and grinding food. While Aristotle distinguishes between events that occur either spontaneously or for the sake of something, these scholars suggest that he may nevertheless allow for a teleological explanation of rainfall—namely, that it occurs in accordance with a final cause.[122]. Some other scholars even posit that the end purpose of rainfall is for the sake of human beings since the rainfall can make the crop grow.[123] However, for the meteorological

[122] This line of argument was specifically clarified by Furley (1985, 177–182) and Cooper (1982, 216–218). For a helpful overview of the subsequent debate on Furley's comments, see Scharle (2008a, 149–151). Furley is the most representative scholar who has clarified the passages of rainfall example in *Phys* II.8 and believes that rainfall can be explained by the final cause. Furley further comments that there are two kinds of interpretation of Aristotle's final causal explanation: the first interpretation would tend to the view that final causal explanation in Aristotle only applies to the field of biology; the second interpretation would imply a much wider application of final cause—perhaps embracing all the works of the whole natural world (1985, 177).

[123] Some scholars have argued that rainfall, within Aristotle's framework, has a teleological explanation and ultimately serves human purposes, as it enables the growth of crops. Sedley (1991, 179–182), for instance, advocates for an anthropocentric interpretation of Aristotle's final causal explanations. He contends that winter rainfall occurs for the sake of human agriculture and that human beings constitute the that for the sake of which in the sense of beneficiaries of a goal-directed process (Sedley 1991, 179). According to this view, rainfall is not merely an incidental occurrence but is directed toward the sustenance of human life. However, I argue that rainfall cannot be adequately explained through Aristotle's notion of final causality. While Aristotle applies teleological explanations to many natural processes, meteorological phenomena like rainfall do not fit within his framework of purposiveness. My objections to Sedley's interpretation are as follows. Firstly, Aristotle's teleology is not anthropocentric, nor does it extend to all natural phenomena. While Aristotle describes biological processes teleologically—explaining, for instance, that an acorn grows into an oak tree for the sake of achieving its mature form—he does not extend this principle to inanimate processes such as rainfall. The universe is not systematically arranged for human benefit, and Sedley's claim that Aristotle views rainfall as serving human agriculture overextends Aristotelian teleology. Secondly, rainfall does not exhibit the characteristics of final causality. Aristotle's final causes explain processes that are goal-directed, meaning they exhibit intrinsic tendencies toward a specific end-state. However, rainfall results from material and efficient causes alone—it occurs due to the condensation of water vapor and atmospheric conditions, not from an inherent tendency toward a particular purpose. While rain may incidentally benefit human agriculture, this does not imply that it occurs for the sake of human survival. Thirdly, Sedley himself acknowledges a tension in his argument. He notes a contradiction between interpreting final causes in terms of specific species' needs (e.g., rain benefiting humans or animals) and understanding them as part of a larger teleological system. If rainfall were to be explained teleologically, it would need to have a single, determinate telos; yet, it serves multiple functions across different species and ecosystems. This suggests that rainfall does not have a final cause but instead operates within the broader framework of material and efficient causation. Thus, rainfall should not be understood in teleological terms within Aristotle's philosophy. Meteorological phenomena such as rainfall lack an intrinsic goal-directed nature and can be sufficiently explained by material and efficient causes alone. Consequently, Sedley's attempt to attribute a final cause to rainfall misinterprets Aristotle's

phenomenon of rainfall, Aristotle does not suggest that it happens either by chance or for the sake of something since he argues that many of these phenomena occur by necessity without the involvement of either chance or a final cause (*Phys* II.4, 196a25–b9). The rainfall occurs because of necessary conditions of the movement of elemental bodies in the atmosphere which also depend on the climates and seasons and other meteorological causes.[124]

Therefore, my contention is that according to Aristotle the example of rainfall cannot be explained by its operating as a final cause. Although rainfall can make the crops grow, it is not for the sake of the growing of crops. Moreover, rainfall does not always make the crops grow since the rainstorm could also destroy the crops. For a clearer understanding of Aristotle's view on whether natural processes, such as rainfall, occur for the sake of human ends, we may turn to his discussion in the *Protr* (79.25–80.20). There, Aristotle asserts that art imitates nature, suggesting that human craft operates with purposeful design, whereas natural processes do not necessarily exhibit the same kind of intentionality. He maintains that every process in the arts comes about for the sake of something, reflecting the teleological structure of human action. However, this does not entail that all natural phenomena likewise occur for the sake of human purposes. In this light, while rainfall enables humans to grow crops, its occurrence is not itself directed toward fulfilling human needs. Instead, Aristotle would interpret the phenomenon of rainfall as the result of elemental movements in the atmosphere, governed by physical necessity rather than teleological intention. Nevertheless, within Aristotle's broader framework, the human capacity to harness natural processes—such as using rainfall for agriculture—exemplifies the way in which skill and technology introduce teleology into natural phenomena that, in themselves, lack intrinsic purpose with respect to human ends.

Moreover, Aristotle explicitly expresses the causes of rainfall in *Meteor* and *GC* without mentioning any causes about the crops' need or human needs, for rainfall happening as a result of a concomitant transmutation of the air into water, which Aristotle considers as part of the cycle of evaporation[125]. More precisely,

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explanatory framework by imposing teleology where Aristotle himself would not do so.

[124] Matthen (2009, 12–13) points out that Aristotle has identified the Sun and the obliquity of its orbit as the overarching cause responsible for the circularity of the seasons and the regularity of rainfall, so this circular process follows the course of the Sun, for according as the Sun moves to this side or that, the moisture in this process rise or falls.

[125] See *Meteor* I.9, 346b16–31and *GC* II.11, 338a14–b19.

Aristotle posits the meteorological phenomenon of rainfall is a result of the circulation of elements in the atmosphere, relating to the orbit of the Sun and the change of the seasons, and is thus a regular natural phenomenon.[126] Therefore, it should be noted that Aristotle does not mention here that rainfall exists for the sake of anything. Moreover, although Aristotle famously maintains that "nature does nothing in vain" (*PA* I.1, 641b12), it is noteworthy that in his explanation of rainfall in Meteorology and GC, he does not explicitly invoke any final cause or purpose. Instead, rainfall is presented as a result of the concomitant transmutation of air into water, which belongs to the regular cycle of evaporation and condensation within the atmosphere. More precisely, Aristotle attributes the meteorological phenomenon of rainfall to the circulation of the elements, governed by the orbit of the Sun and the change of the seasons, thus treating it primarily as a regular and necessary natural process. Therefore, while Aristotle's broader teleological framework assumes that natural processes serve purposes, in this particular explanation he refrains from specifying that rainfall occurs for the sake of crops, humans, or any other end.

According to the discussion above, it may be concluded that some meteorological phenomena, like rainfall,[127] cannot be explained by the final cause in Aristotle's thought. Aristotle investigated various meteorological phenomena between the upper and lower realms of the universe with reference to the matter and sources of motion, and it seems that there does not exist any role for the final cause. In fact, Aristotle examines meteorological phenomena with what can be described as an efficient causal approach and manages to find the efficient causal reasons and influences of the phenomena[128]. He tries to describe why meteorological phenomena happen and gives sufficient conditions for the occurrence of these phenomena, without concentrating on final causation. Considering that in the case of specific meteorological phenomena it is hard to find a role for final causation, it is clear that the final cause cannot guarantee a full explanation in the field of meteorology.

[126] See *Meteor* I.9, 346b14–32; *GC* II.10, 337a1-7 and Matthen (2009, 12–13).

[127] E.g., the rainfall, the droughts and humidity, the incursions and reflexes of the sea, the corruptions and generations of topographic features of the earth.

[128] For the role of Aristotle's efficient cause in the field of meteorology, see chapter 3.3.

2.4 The Limitation of Final Causation in Aristotle's Explanation of Biology

Having examined the limited role of Aristotle's final cause in his explanations in the field of meteorology, now we turn to the next section to investigate the role of the final cause in the field of biology, to make clear how the final cause contributes to a unified explanation in this field. According to Aristotle's biological treatises, living things differ from each other in their mode of living, actions, habits and their parts. Aristotle's approach to study living things is to discuss these differences from a broad and general perspective, and subsequently to speak of these with close reference to each particular genus (*HA* I.1, 487a11–13). Aristotle points out that this approach is the best way to present the results of natural science, which starts with what is general and moves on to the more specific, to avoid overgeneralization and redundancy (*PA* I.1, 639a14–b6; I.4, 644b1–8; I.5 645b9–14). Since the study of living things is also part of Aristotle's investigation of science of nature, and given the fact that Aristotle's science of nature involves the knowledge of all four causes[129], the final causal explanation can be assumed to apply to the field of biology. In fact, Aristotle's utilization of final causal explanation to the field of biology in order to explain living things and their parts and movements is thought to be the most successful and most influential of its uses.[130]

The investigation in this section will be divided into three parts. I start by investigating the role of the soul as a final cause in Aristotle's biology. Then I turn to explore Aristotle's use of explanation in biology based on the soul as a final cause. Finally, although Aristotle's application of final causal explanation is thought to be the most successful in the field of biology, there are some special biological cases that cannot be explained by the final cause and therefore need to be examined.

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[129] See e.g., *Phys* II.2, 194a 9–18; II.3, 194b15–25; *Post* II.11, 940a20–28; Falcon (2005, 14–16).

[130] Many scholars hold this view, which I also choose to follow, see e.g., Ayala (1970, 46–48); Wieland (1975); Nussbaum (1978); Sorabij (1980) and Johnson (2005, 131–187).

2.4.1 The Soul Operates as a Final Cause in Aristotle's Biology

Aristotle makes explicit that inquiry should be done into some parts of the soul before exploring the living things themselves (*PA* I.1, 641a17–32), and treats the soul as the principle of living things as well the cause of their being alive: 'as it were, a principle of living things' (*DA* I.1, 402a8). So, it seems to me that what is particularly important for our understanding of Aristotle's explanation of the final cause in his biology is the role of the soul in living things[131]. Naturally, we should first investigate the role of the soul in Aristotle's biology in order to discuss the role of the final cause in a unified explanation in Aristotle's biology.

According to Aristotle's discussion in *PA*, his explanation of the souls of living things is closely related to his final causal explanation. Aristotle shows that a living being cannot exist without a soul. If the soul departs from a living thing, what is left is no longer living, and none of the parts remain what they were before (*PA* I.1, 641a19–22). Aristotle therefore believes that it is the duty of natural scientists to study the soul, to study the whole of the soul or that part of the soul which constitutes the essential characteristics of a living thing. And it is also the duty of natural scientists to discuss the attributes that attach to these essential characters, especially the soul as natural substance in the sense of being a final cause or in the sense of being an efficient cause. Aristotle supposes that either the whole soul or some part of it constitutes the nature[132] of living things since it is the presence of the soul that enables matter to constitute the nature of living things, much more than it is the presence of matter which so enables the soul. Thus, it can be seen that the attributes and essential characteristics of the soul, both in terms of the soul as a whole and in terms of that specific part of the soul, should be taken into account since the living things are natural. Moreover, the connection between the efficient cause and final cause can be found in the works of the soul and the

[131] In Aristotle's biology, the stages of living things' developments, which are from embryo, infant, child, adult, and so on, aim at completing all the parts which are capable of performing the functions of the living thing's soul.

[132] Aristotle defines nature as an inner source of change and rest (in respect of place, or of growth and decline, or by way of alteration) in that to which it belongs primarily of itself, and not accidentally (*Phys* II.1, 192b13–14; 192b20–23).

priority of final cause over efficient cause can also be found within Aristotle's investigations.

Furthermore, in *DA*, the soul is supposed to be the principle of living things and the cause of their being alive[133]. More importantly, in *DA* Aristotle explicitly expresses his view that soul as final cause, which is identified as 'for the sake of which', operates in living things:

> And it is clear that the soul is cause also as that for the sake of which. For just as the intellect acts for the sake of something, in the same way also does nature, and this something is its end. Of this sort is the soul in animals in accordance with nature; for all natural bodies are instruments for soul, and just as it is with those of animals so it is with those of plants also, showing that they exist for the sake of soul. But that for the sake of which is so spoken of in two ways, the purpose for which and the beneficiary for whom.
>
> *DA* II.4, 415b15–21 (trans. D. W. Hamlyn)

According to this passage, the soul is supposed to be the final cause of living things. As Aristotle indicates in *PA*, if the soul departs from the living things, what is left is no longer living, and none of the parts remain what they were before (*PA* I.1, 641a19–22). Aristotle here restates the final causal relationship between living things and soul: the instruments of living things that create the potential for the soul are turning into the relation in which a living being exists for the sake of its soul, since the soul is its final cause. This means that the soul operates through its natural bodies, and the capacities of natural bodies are necessary prerequisites for the realization of the capacities for the performance of a living being's life functions that then constitutes its soul.[134] Aristotle here also mentions two kinds of meaning of 'for the sake of which': 'that of which' and 'that for which'. More precisely, 'that of which' means 'aim of something', and 'that for which' means 'to the benefit of which'[135]. In this way, 'for the sake of which' has two kinds of meaning in Aristotle: the aim and the beneficiary.[136] Therefore, this passage

[133] See e.g., *DA* I.1, 402a8; II.4, 415b8.

[134] See also Leunissen (2010, 55–58) on natural bodies as instruments and 'existing for the sake of the soul'.

[135] Kullmann (1985, 172). It seems that Johnson (2005, 66) has followed Kullmann's identification of 'that of which' and 'that for which'.

[136] Aristotle refers to two kinds of meanings of the 'for the sake of which' (*DA* II.4, 415b1–7;

explicitly shows the soul is the final cause of living things. On the one hand, Aristotle believes that living things possess biological ontological principles in their nature, in their intrinsic origin of motion and rest, and in their intrinsic orientation towards their completion according to the function of natural bodies. On the other hand, Aristotle considers the soul to be the epistemological principle of living things. The soul is considered to be the final cause and has priority of explanation, since the type of soul determines the function and development of the living being. Therefore, the conception of the soul as a final cause serves as the foundational starting point for Aristotle's teleological explanations in biology, given that the body and its parts in living beings are organized for the sake of the soul.[137]. Thus, it seems Aristotle establishes a unified explanation in the field of biology through identifying the soul as a final cause.

However, in *DA*, Aristotle also indicates that there are different kinds of souls in different levels of living things, with the higher living beings possessing more complex capacities and faculties of soul.[138] For plants, their capacities are merely nutrition and reproduction, therefore the end of plants is growth and reproduction, in terms of the capacities of the soul that they have. For animals, in addition to the capacities of nutrition and reproduction, they also have the higher capacities of appetite, perception and motion, so the end of their life is perception and movement based on the capacities of the soul that they have. For human beings, in addition to the capacities of animals and plants, they also have the capacity to deliberate, so the capacities of a human being's soul are nutrition, reproduction, perception, movement and deliberation, and the end of their life is deliberation. Accordingly, there are five capacities of soul, namely, nutritive-reproduction[139], appetite, perception, movement and deliberation[140] (*DA* II.3, 414a31–32). Plants are endowed with a nutritive-reproductive soul. Animals have the nutritive-reproductive soul, and also have the capacities of perception and appetite in addition to their nutritive soul. If an animal has the capacity of movement, it also has the capacities of nutrition, appetite and movement. If a creature has the

415b19–22; *Phys* II.2, 194a33–36; *Meta* XII.7, 1072b1–5; *EE* VII.15, 1249b14–16). For detailed discussion on the two kinds of 'for the sake of which' in Aristotle, see chapter 2.1.

[137] This is also one of the reasons why it is necessary to first examine the soul itself in this section.

[138] See *DA* II.3, 414a29–415a13.

[139] Aristotle here considers the capacity of nutrition and reproduction to be one and a single capacity.

[140] In *DA*, Aristotle uses 'deliberation' or 'intellect' or 'thinking' to express the capacity of human beings.

capacity of deliberation, then it possesses all the capacities of the soul.[141] Therefore, considering that Aristotle identifies different kinds of souls in the different levels of living things and assumes that the higher living beings possess more complex capacities[142], each living being has its own kinds of soul. Thus, it seems that there is a unified final causal explanation in the fields of Aristotle's biology with respect to the application of the soul as a final cause since all living beings have their soul as their final cause.

Accordingly, in Aristotle's thought, the soul is the principle of living things and the cause of their being alive. And it is clear that the soul is a final cause of living things, that the soul operates through its natural bodies, and the capacities of natural bodies are conditionally necessary prerequisites for the realization of the capacities for the performance of a living being's life functions that constitutes its soul.

2.4.2 The Unified Explanation in Aristotle's Biology Based on the Soul as a Final Cause

Having examined the soul as a final cause gives us the starting point of the explanation of the final cause in Aristotle's field of biology, since the body and parts of living things are organized for the soul, now we continue to investigate the final causal explanations in living things and their parts and movements within this field. According to the discussion above, there are five kinds of capacities of the soul, namely, nutritive-reproduction, appetite, perception, movement, and deliberation[143], and higher living beings possess more complex capacities[144]. So, our discussion will start from the capacity which is most general, namely, the nutritive-reproduction.

Aristotle identifies the nutritive soul as the most primitive and widely distributed power of soul, being indeed the one in virtue of which all are said to have life (*DA* II.4, 415a23–25). It manifests itself in the act of reproducing and

[141] Specifically, in Aristotle's discussion of nutritive and reproductive capacities of the soul, he indicates that the soul is also an efficient and final cause (*DA* II.4, 415b8–12).

[142] See *DA* II.3.

[143] According to *DA*, we can also understand there are five kinds of souls.

[144] See *DA* II.3.

using food, since for any living being that has reached normal development (dependent on its nature and its position in the hierarchy of living beings) unmutilated, and whose mode of reproduction is not spontaneous, the most natural act is the production of another like itself, an animal producing an animal, a plant a plant. And because the nutritive-reproductive capacity of the soul indicates the function of living and reproduction of living things, thus nutrition and reproduction are the most important part of the explanation of the final cause in living things. Moreover, Aristotle explicitly indicates that the first soul ought to be named the reproductive soul since it is right to call things after the ends they realize, and the end of this soul is to generate another being of the same kind (*DA* II.4, 416b23–25) in order that, as far as its nature allows, it may partake in the eternal and divine. So, living things participate in eternity and divinity as far as possible, but since it is impossible for them to share eternity and divinity because they are perishable, they can persist in the same form through reproducing themselves. This is the goal for which all things strive, for which all things do whatever their nature allows.[145] So the soul exists as the final cause of living beings, functioning both as the principle of life and as that for the sake of which the living being exists (the aim and the beneficiary). Whether this pertains to the individual organism or to the species as a whole will be clarified further, particularly in relation to the perpetual existence of living things.

Similarly, in *GA*, Aristotle claims that the business of animals is nothing else than to produce offspring, just as the business of plants is to produce seed and fruit (*GA* I.4, 717a21–22; I.23, 731a24–b8). For plants, their nature does not involve any other function or business than the production of seeds, since this is caused by the union of male and female and that nature has mixed these and set them together in plants, so that the sexes are not divided in them. But for animals, their function is not only to reproduce, which is common to all living things, but they all participate in some kind of knowledge, since they have perception and this is a kind of knowledge. What distinguishes animals from plants lies in perception, but since animals must also live, therefore, when they need to fulfill the function of that which has life, they will unite and copulate. Furthermore, when taking into

[145] On this point, Aristotle considers the phrase 'for the sake of which' can refer to both kinds of meaning: the aim and the beneficiary (*DA* I.4, 415b2–3). See also *DA* II.4, 415b19–22; *Phys* II.2, 194a33–36; *Meta* XII.7, 1072b1–5; *EE* VII.15, 1249b14–16. For detailed discussion, see chapter 2.1.

account not species but individual living things, Aristotle indicates that only individuals can generate other individuals and only individuals can benefit from reproduction and any other function of the soul (*Meta* XII.5, 1071a26–29), thus it should be noted that individual living things are not themselves concerned with the preservation of their species; rather it is the individual's striving for participation in the divine for its own individual benefit which is the true cause of reproduction[146]. Accordingly, Aristotle treats the soul's nutritive-reproductive capacity as the fundamental function of living things, both for plants and animals, and his explanation of this function of living things serves as the basic explanation of the final cause in his biology. This function is the same for all living things since all the living things need to reproduce to continue their existence since no living thing can exist for the sake of anything adverse to its own survival or reproduction[147]. The perpetual existence of living things is considered to be the fundamental level in Aristotle's explanation of the final cause.[148]

Moreover, given that all living things exist for the sake of their survival and reproduction, in addition to the final causal explanation of individual animal kinds, Aristotle also focuses on the distribution and configuration the parts of living things to demonstrate the explanatory role of the final cause[149]. Aristotle uses the

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[146] For this view, see Cooper (1995, 588); Balme (1965, 13–14; 1987a, 279–80); Code (1997, 137–142); Lennox (2001a, 133–137) and Johnson (2005, 177–178). Cooper (1995, 588) and Lennox (2001a, 133–137) suppose that the production of living things is for the sake of the life, activities and the good of the individual living things that are reproduced, and not just for the sake of eternity of the plant and animal species. The other three scholars further make a distinction between final causal explanation in species and in individual living things. In Balme's view (1987a, 279–80), the immortality existence in species is regarded by Aristotle as a fact, and the explanation of this requires two kinds of things: first is the clarification of the cause for the sake of which this happens, for example, why it is good; the second is the necessitating condition to make this possible. Code follows Balme's view and considers the first is provided for simply by positing the good for the individual living things, whose species persists through the process of their reproduction. Johnson even identifies the animal as a kind or species that is 'for the sake of', while the individual living things is 'for the benefit of'.

[147] See Sedley (1991, 191) who says that each being serves both for its own ends and those of the next link on the food chain. Wardy (1993, 26) further shows such a situation would always create a conflict of interest due to the species lower on the food chain, and thus becomes a problem of final causal explanation.

[148] See also Cooper (1995, 587) on the most fundamental level of the explanation of final cause in Aristotle.

[149] For the relationship between living beings and their parts, according to Aristotle's *PA*, the parts are truly parts only if they belong to a living thing and are able to function for their life. Parts and their differentiations are explained foremost in terms of the functional contribution they make to the animals as a whole. See also Leunissen (2010, 113–114).

example of a man and his parts to express why it is necessary to explore the parts of living beings (*PA* I.1, 640a33–b4). A man has such and such parts since the parts are necessary conditions of a man's existence. Thus, it is impossible to be otherwise, or, in any case it is good that they should be there, namely, the living things are better because of the presence of the parts. Aristotle also illustrates some examples of how a final causal explanation with respect to the parts of living things should be made. In general, the parts of living beings may be either instrumental (meaning they exist for the sake of supporting some other part, process or activity[150]), or sensitive (meaning they exist for the sake of the most basic function, e.g., the perception of animals) (*PA* I.1, 641a2–3). For instance, the lung[151] exists for the sake of respiration (*PA* III.6, 669a15), while respiration exists for the sake of refrigeration, namely, internal temperature maintenance of living beings (*Resp* 16, 478a25–30). The basic process is the respiration and expiration of air due to 'counteracting' temperatures. Nutrition increases the internal temperature, making the lungs expand; the expansion of the lungs causes cool air to flow in, which has a chilling effect; the cooled lungs thus contract, and this contraction forces air back out. The expired air is warm because of its contact with the heat resident in the organs. Cool air is drawn in, counteracted by the hot, and then expired, and so forth[152]. Hence the main procedure here is the balance of temperature between hot and cold, but Aristotle does not use this example to demonstrate the breathing process, instead he uses it to demonstrate the role of the final cause in explaining the action in terms of its purpose or goal. Another example is the flesh, flesh exists for the sake of the perception of touch, so flesh exists around the bones, and is attached to the bones through thin fibrous bands, and it is for the sake of this that the bones themselves exist (*PA* II.8, 653b19–29). Besides the bones, the sinews, the blood vessels, the hair, the various kinds of nails, the skin and so forth exist for the sake of the security of the sensitive parts (*PA* II.8, 653b31–34). Additionally, Aristotle's demonstrations of eyes, eyelids, eyebrows and eyelashes are all related to this point, since eyelids, eyebrows and eyelashes all exist for the sake of the security of the eyes (*PA* II.13, 658b13–15). But the mouth is a part of living things which is for the sake of some different functions (*PA* III.1, 662a20–27). The mouth primarily exists to chew food and thus

[150] As the brain does for the sake of cooling, or blood does for the sake of nutrition. (See *PA* II.6–7)

[151] Gills function similarly.

[152] For an explicit analysis of Aristotle's explanation of respiration, see King (2001, 113–122).

digest it, but some animals also use their mouth for some special purpose in respect to their needs, for instance, a mouth can be used as an aid to respiration, a defensive weapon, and a speaking organ. Therefore, by demonstrating that the parts of living things exist for the sake of supporting some other parts, processes or activity, or for the sake of most basic functions, Aristotle establishes his final causal explanations of the parts of living things.

Besides the nutritive-reproductive capacity of the soul, there is also a capacity that all animals possess, namely, the capacity to perceive[153]. Aristotle supposes that it is the possession of perception that leads us to speak of living things as animals and not merely living things (*DA* II.2, 413b2–3). An animal is an animal in virtue of its perceptive part since the definitive characteristic of an animal is the possession of perception[154] (*PA* III.5, 666a34), and the exercise of perception or of thinking[155] is the final goal for all beings to which either of these pertains since these are best, and the final goal is what is best (*Somn* II, 455b23–25). Aristotle defines the life of animals by the capacity of perception, and defines the life of human beings by the capacity of thinking (*NE* IX. 9, 1170a16–19). He refers to the capacity of perception or thought as the essential characteristic of living beings, and thus he says that life seems to be essentially perceiving or thinking. In this way, the perception turns out to be the highest capacity of the non-human animals, so this is their final goal, and the end is also the best, thus the perception of animals is taken to be their final cause since perception is the final end or goal of animals.[156] Furthermore, Aristotle notices that some kinds of animals have behaviors which are to some extent similar to those of humans. For instance, ants are considered industrious since their various behaviors are related to gathering food, providing shelter, and promoting reproduction (*HA* IX.37, 622b19–25). Another example is spiders, as spiders are most accurate and skilled at weaving

[153] See e.g., *GA* I.23, 731a 30–4; *DA* II.2, 413b2; III.1, 425a8–10; III.12, 434b17–24; *Sens* I, 436b11; *Juv* I, 467b24–5; *Meta* I. 1, 980a27–8.

[154] See also Code (1997, 139).

[155] For animals, the exercise of perception is the final goal; while for human beings, the exercise of thinking is the final goal.

[156] At the most basic level in Aristotle's biology, the capacity of perception improves the practices and abilities of animals, especially in feeding and rearing its pups, so, it is closely related to the primary function of animals' nutritive-reproductive animal soul. Indeed, the function of a higher capacity of the soul does not diminish the importance of the primary and basic one, moreover, higher capacities result in more complex, social and intelligent behaviors in support of the basic process (*HA* VIII.1, 588b21–589a5; VIII.5, 596b20–23; IX.10, 615a24–25; IX.34, 620b10–11).

webs to survive and obtain food (*HA* IX.39, 623a8–15). Bees are also an example, as they have excellent diversity in their approach to activity and lifestyle (*HA* IX.40, 623b26–28). However, although some animals behave comparably to humans, Aristotle specifically points out that these non-human animals do not actually possess intellect in the sense that humans do, since non-human animals live merely by appearances and memories and they have little relevant experience, while humans live by art and reasoning[157]. Non-human animals do not have the capacity of deliberation, and so of discourse, inquiry and technology[158]. But meanwhile, Aristotle realizes that non-human animals are capable of highly advanced and complex practices for the benefit of their survival and reproduction (*Phys* II.8, 199a8–30). Non-human animals and plants do not have the capacity of deliberation, but they do have end-oriented activities, for they act for the sake of a final end. Their ends are determined by the capacity of their souls, which is independent of human activities and different from the ends of humans. Hence, non-human animals are actually focused on their own survival and reproduction, and their various activities are understood in terms of their capacities, even if they cannot deliberate. Accordingly, the activities of animals exist for the sake of their own survival and reproduction, and the exercise of perception is the final goal for all non-human animals[159].

According to the discussion above, the soul is a final cause of living things in Aristotle's biology, since the soul is the cause of living things being alive, and the body and parts of living things are organized for the soul. In Aristotle's biology, there are different kinds of souls in different levels of living things, with the higher living beings possessing more complex capacities and faculties of soul. Therefore, by identifying the soul as a final cause, Aristotle establishes a unified explanation in the field of biology.

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[157] See e.g., *Meta* I.1, 980b27–28; *DA* II.10, 433a11–12; *Politics* VII.14, 1332b4–5.

[158] See e.g., *HA* IV.9, 536b1–3; Pol I.2, 1253a7–18 and I.5, 1254b23; *Phys* II.8, 199a20–22.

[159] According to Aristotle, a human being is for the sake of the good itself. Although it is impossible to define a universal good for the sake of which humans are, it is possible that the good, which all humans are for the sake of, exists (*NE* I.4, 1096b32–35; 1218b7–16). In fact, this issue belongs to Aristotle's ethical works; since my work is focusing on Aristotle's works of natural philosophy, I choose not to discuss so much on the final end of humans.

2.4.3 The Limitation of Final Causation in the Explanation of Some Parts of Biology

Having examined many explanations in Aristotle's biology based on the soul as a final cause, now we turn to investigate limitations with regard to the final cause in the explanation of some particular phenomena. Aristotle mentions three kinds of biological cases which are difficult to explain through the final cause, namely, incidental cases, some specific phenomena, and spontaneous generations.

The first kind of cases which are difficult to fit into final causal explanation are the incidental cases in living things. For instance, Aristotle observes the incidental functions of eyes[160] (*EE* VII.13, 1246a26–35). He shows that, due to the eye being an eye, one might use the eye both for seeing and for falsely seeing by squinting, but it is also possible to use the eye in an incidental way, for instance, if one sells or eats it. Moreover, there are also some other incidental cases in Aristotle's biological works, such as, the enormous horns of deer, the violent nature of the heron, beards and hair growth in general, the futile existence of the day fly, male nipples, the definite shape and nature of plants. All these examples are difficult to explain with the final cause, since we cannot find their end or purpose. It seems that the final ends or aims do not apply to these biological cases and we can merely say that these cases happen by incident. A large number of plants and animals' development and generation seems to be explained only by the appropriate season, climate, or environmental conditions.[161] For example, the change of seasons is related to the heat of the Sun, which then has different effects on the air and the earth, thus affecting the movement of plants and animals.[162]

Secondly, there are also some specific biological phenomena which cannot be explained by the final cause. For instance, Aristotle indicates that the location of the mouth in some big sea creatures is for the benefit of other animals' survival[163]

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[160] See also Johnson (2005, 201–202) on incidental functions of organisms in Aristotle.

[161] These can be considered as instances of Aristotle's efficient causes, which I shall discuss in detail in chapter 3.

[162] Aristotle does not mention the final cause in the Sun's effect on the sublunary world.

[163] Balme (1972, note at 696b27) observes this special phenomenon in Aristotle's biology is 'a sarcastic rejection' of an overall final causal explanation in Aristotle, and he thinks this is evidence against Aristotle's view of final cause that animals are for the sake of their own survival and not for

(*PA*, IV.13, 696b23–30), which is contrary to his final causal explanation that living things exist for the sake of their own survival.[164] In Aristotle's observation, fishes display diversity in their mouths. In some animals, it is at the front end of the body and at the very extremity of the body, while in others, such as dolphins and sharks, it is placed on the under surface, so that these fishes turn on the back in order to take their food. Aristotle comments that the location of the mouth in these fishes provides a means of salvation for other animals, giving them the opportunity of escape during the time lost in the act of turning, since all fish with such mouths prey on living animals. Thus, it can be seen that the location of the mouth in sharks and dolphins and their turning over while feeding themselves provide a benefit to other animals which can escape more easily. This phenomenon is contrary to Aristotle's final causal explanation since these big sea creatures do not exist merely for themselves, but also for the survival of other creatures. This specific phenomenon cannot fit Aristotle's final cause explanations, and thus poses a challenge to certain interpretations of his final cause.

The third kind of case is the spontaneous generation of some living things.[165] We have discussed the final causal explanations of living beings' generation, namely, that living beings are generated based on the capacity of reproduction. Plants are generated through their seeds, which has the mix of male and female principles[166], while animals are generated through sexual reproduction. According to Aristotle, there are also some living things which are generated by spontaneous generation[167], for instance, the testaceous animals. In Aristotle's observation, the generation of testaceous animals is partly like and partly unlike the living things in other classes since they resemble plants when compared with animals, and they resemble animals when compared with plants[168]: in one sense it seems that they appear to come into being from semen but in another sense not so, and in one

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the sake of other animals. See also Charles (2012, 17–18).

[164] For detailed discussion that living things are for the sake of their survival, see chapter 2.5.2.

[165] Some scholars are aware of the challenge of Aristotle's final causal explanation in biology that spontaneous generation cannot be explained by the final cause. See Gotthelf (1989, 185–188) and Lennox (1982, 219–238).

[166] For explicit statements about the reproduction of plants in Aristotle's biology, see the references in Sprague (1991, 221–229).

[167] On the notion of spontaneous generation in Aristotle, see Balme (1962, 92–98). On the biological methodology in Aristotle's theory of spontaneous generation, see Zwier (2018, 385–395).

[168] On the relation of the different spontaneously generated living things to Aristotle's hierarchical gradation of the natural world, see Lloyd (1998, 122–124).

sense they are generated spontaneously but in another sense they are generated from their own kind, or some of them in the latter way and others in the former (*GA* III.11, 761a15–31). Because testaceous animals resemble plants, there are few or no kinds of testaceous animals that come into being on land, such as snails and other kinds of animals, but in the ocean and similar waters, there are many testaceous animals in various forms. But such kinds of plants are hardly represented in the ocean and such places, all of these growing on the land. Since plants and testaceous animals are analogous, and in terms of liquid have more life-sustaining power than solids, and water having more life-sustaining powers than earth, the nature of testaceous animals is also very different from that of plants because the object of testaceous animals is to be in such a relation to water as plants are to earth, as if plants were shellfish on land and shellfish were aquatic plants. Therefore, testaceous animals in some ways function like plants, in other ways they function like animals, so they are similar to all other living things, and thus Aristotle considers this kind of generation as spontaneous generation, which is an exception to the normal reproduction process of living things. Aristotle concludes that all those living things which do not 'bud off' or sexually reproduce are spontaneously generated[169] (*GA*, III.11, 762a8–16). All living things which are generated spontaneously, whether in earth or water, manifestly come into being in connection with putrefaction and an admixture of rainwater, since when the sweetness is separated into the substance that is forming, the residue of the mixture takes the form of spontaneously generated living things, thus nothing is formed by putrefying, but by concocting, and putrefaction and the thing putrefied is merely a residue of that which is concocted.[170] It is clear that spontaneously generated living things come into being in relation to rottenness and the mixture of rain water. As a result, they come into being in a wide variety of environments, but cannot be made to come into being by any regular process, such as reproduction. It can be seen that these spontaneously generated living things do

[169] It should be noted that Aristotle recognizes the existence of spontaneous generation against the explanation of final cause. This view is explicitly examined by Gotthelf (1989, 185–190) who comments that the reason why Aristotle provides the explanation of final cause is that Aristotle does not believe the materials alone are capable of coming together to produce the form of living things, so the final cause must work, but the spontaneous generation of some living things conflicts with the explanation of final cause.

[170] This process of spontaneous generation is analogous to the process of art, since in the process of art, the artist removes the useless materials, while in the process of spontaneous generation, nature removes useless materials. (*GA*, III.11, 762a17–18)

not have the capacity of reproduction, hence they do not fit into the explanation of the final cause according to which living things exist for the sake of their reproduction.[171]

Therefore, concerning the fact that there are some cases that cannot be explained through the final cause, it is clear that Aristotle's final cause has a limited role in some parts of biology, thus the final cause cannot not ensure a unified explanation in the field of biology.

Accordingly, by identifying the soul as a final cause, Aristotle posits that there are different kinds of souls in different levels of living things, with the higher living beings possessing more complex capacities and faculties of soul, and therefore he establishes a unified explanation in the field of biology, However, although Aristotle supposes that there are different kinds of souls in different levels of living things, with the higher living beings possessing more complex capacities and faculties of soul, and he tries to establish a unified explanation in his biology based on the soul as a final cause, given the fact that there are three kinds of biological cases which cannot be explained by final causal explanation, it seems that final cause cannot not guarantee a unified explanation in the field of biology as a whole.

[171] And this is also the reason why this kind of generation is called spontaneous generation, in accordance with the notion of spontaneity developed in *Phys* II.4–8. For a defense of the consistency of the notion of spontaneity in *Phys* with *GA*, see Lennox (1982) and Balme (1962).

Chapter 3: The Role of Efficient Causation in Sustaining Continuity and Coherence in Aristotle's Universe

According to the discussions in Chapter 2, although Aristotle attempts to utilize the final cause to provide an explanation for everything in the universe, the final cause appears to have a limited role in different fields of the universe, namely, cosmology, the motions of elements, meteorology and biology.

My contention is that Aristotle implicitly acknowledged the boundaries of final causation in providing a full explanation of the cosmos – testify the role of efficient causation to guarantee a unified explanation of the universe in terms of continuity and coherence. In fact, there are many cases in the universe that cannot be explained through a final cause but can be explained by an efficient cause;[172] moreover, the efficient cause more directly explains the chains of interaction between otherwise disconnected regions in the universe[173]. For instance, the disconnection between heavenly region and sublunary region and the lack of interaction between heavenly bodies.[174] Therefore, it is necessary to investigate how Aristotle's efficient cause contributes to a unified explanation of the universe – that is, the way in which it complements final causation in sustaining a comprehensive explanatory structure – and discuss how Aristotle's efficient cause helps to explain the cases which cannot be explained by final cause. Since even though many scholars have realized the limits of the contribution of the final cause to the unified explanation of the universe in Aristotle's works[175], they rarely paid attention to the achievement of the efficient cause to a unified explanation in

[172] For instance, a specific phenomenon in Aristotle, which could not be explained by the final cause, is the spontaneous generation of living things. Significantly, Aristotle employs efficient causal explanations to account for this phenomenon. (See detailed discussion in Chapter 2.4.3)

[173]Some commentators have criticized the disconnection between heavenly region and sublunary region with respect to Aristotle's theory of elements. See Solmsen (1960, 290), Freudenthal (2009, 239), Hankinson (2009, 84) and Falcon (2005, 87–88; 101–102).

[174] See detailed discussion in Chapter 3.

[175] See chapter 2.

Aristotle's thought.[176] In Aristotle's works, however, efficient causes directly explain the chains of interaction between different regions in the universe and play an important role to the unified explanation of the universe.

Thus, what I undertake to do in this chapter is to survey the contribution of the efficient cause to provide a unified explanation of the universe throughout the Aristotelian corpus of natural philosophical treatises. I divide the investigation of this chapter into four sections. Section 3.1 discusses the contribution of the efficient cause to a unified explanation in the field of cosmology. The starting point of the investigation is *Phys* VIII, where the Unmoved Mover operates as an efficient cause to unify all the changes and motions in the universe. Section 3.2 explores the contribution of efficient causes to a unified explanation in the motion of elements, including the chains of interaction between the four sublunary elements, and the chains of interaction between aether and the four sublunary elements. Section 3.3 explores how the efficient cause contributes to a unified explanation in the field of meteorology. Many modern scholars have criticized the disconnection between the celestial region and sublunary region in Aristotle's universe.[177] But in my interpretation, these two regions are directly and closely connected by efficient cause. The coherence of Aristotle's universe in the field of meteorology is guaranteed by the continuous efficient causal chains. Section 3.4 investigates the role of the efficient cause providing a unified explanation in the field of biology. The vital heat produced by the Sun is the efficient cause of the reproduction of living things in the sublunary world, which is different from the ordinary heat produced by the Sun, so it is necessary to investigate the efficient causal chains from the celestial realm to the sublunary realm.

[176] Some of the scholars who have studied the efficient cause in Aristotle discuss efficient cause in relation to other causes, e.g., Henry (2019), Scharle (2008b); Jack (2000); Code (1997) and Lewis (1988); while some of them focus on the clarification of Aristotle's notion of efficient cause itself, e.g., Tuozzo (2014); Huismann (2022), Schmaltz (2014) and Annas (1982), most of them explore the role of efficient cause in some specific fields, namely in physics and the generation of living things, e.g., Martin (2017b); Connell (2016), Code (1999) and Berti (2000).

[177] E.g., Freudenthal (2010, 239), Falcon (2005, 87–89) and Solmsen (1960, 290).

3.1 The Role of Efficient Causation in Achieving a Unified Explanation in Aristotle's Cosmology

Having examined the definition of Aristotle's efficient cause based on his *Metaphysics* and *Physics*, now I am in the position to investigate the role of efficient causation complementary to final causation in sustaining a comprehensive explanatory structure in the different fields of Aristotle's universe [178]. The first step is to examine the contribution of the efficient cause to a unified explanation in the field of cosmology. Following Aristotle's discussion, I treat *Phys* VIII as the starting point of my investigation, where Aristotle conceives of the first mover as the primary efficient cause of all the motions in the universe. As we have seen that the first mover is the starting point of all efficient causal chains in the universe, obviously in the field of cosmology the efficient cause derives its impulse of unity through causal chains from this starting point as well. Then turn to examine *Phys* VIII. 2, 5–6 and 10, and explore why the first mover must exist, as being the primary efficient cause of all the motions in the universe. Secondly, I shall discuss the efficient causal chains from the first mover to the heavenly bodies in the celestial realm, to survey whether the efficient causal chains are indeed continuous in this field.

3.1.1 The Role of Efficient Causation in *Physics*: The First Mover Unifies the Universe as an Efficient Cause

The eighth book of *Physics* sets the stage for the role of Aristotle's efficient cause in the field of cosmology. In this treatise, Aristotle attempts to prove the existence of the first mover, which is the primary efficient cause of all the motions in the universe, and thus to provide a starting point of all the efficient causal chains in the universe. So, I treat *Phys* VIII as the point of departure of my investigation as

[178] It has been argued in chapter 2.1.1 that the first mover unifies the universe as a final cause in Aristotle's *Meta*. The comparison between the role of the first mover in these two treatises will be discussed at the end of 2.1.1.

to how the efficient cause contributes to a unified explanation.

In order to investigate the role of the efficient cause in the field of cosmology, it is necessary to discuss how Aristotle comes out with the claim that the first mover is the primary efficient cause of all the motions in the universe. Before discussing Aristotle's arguments in detail, I prefer to show in brief the progression of his arguments. In the eighth book of *Phys*, Aristotle starts his investigation of the existence of the first mover which plays the role of the primary efficient cause by assuming that there always has been and always will be motion (*Phys* VIII.1–2), and claims that whatever is in motion is moved by something (*Phys* VIII.4). As a result, there should be continuous causal chains of motions in the universe. However, Aristotle then argues that it is impossible that every mover can be moved, otherwise the number of movers will be infinite, and the efficient causal chains will be infinite (*Phys* VIII.5), thus there must exist a first Unmoved Mover which is the primary efficient cause of all the motions (*Phys* VIII.6).

According to Aristotle's discussion, it is necessary to first examine why there has always been and always will be motion. I start my examination with Aristotle's critique of those who hold the view that there should be a beginning of motion (*Phys* VIII.1, 252a6–12). In Empedocles's view, there is a dual principle to be the beginning of motion, which can be understood as Love and Strife. Love and Strife alternately predominate and cause motion, while in the intermediate period of time there is a state of rest. Anaxagoras, however, believes in a single principle to be the beginning of motion, which he supposes to be Mind, and he claims that all things were together and at rest for an infinite period of time, and that subsequently Mind introduced motion and separated them. Concerning their views, Aristotle criticizes that it is impossible for there to be a beginning of motion, since that which holds by nature and is natural can never be disorderly, because nature is everywhere the cause of order (αἰτία πᾶσιν τάξεως), and there is no ratio in the relation of infinite to the infinite, whereas order always means ratio (*Phys* VIII.1, 252a14–16). Aristotle seems to be polemizing against Anaxagoras for assuming that in the cosmos things happen in a way that these things are no longer natural or a product of nature. In Aristotle's view, if a certain characteristic is natural, it either is so invariably or there is a ratio in the variation, for instance, fire is always naturally moving upwards. Thus, it is impossible that there is first a state of rest for an infinite time, and then motion is started at one moment. Aristotle suggests that—from the perspective that the universe is alternately at rest and in

motion, and therefore there is a certain order—Empedocles's view is better; however, Aristotle criticizes Empedocles for making mere assumptions and laying down unreasoned axioms: he should rather employ either inductive or demonstrative reasoning (*Phys* VIII.1, 252a22–25). Moreover, considering that the Love and Strife postulated are neither in themselves causes, nor is it of the essence of either that it should be so, the essence of the former being unity, while the essence of the latter is separation. Aristotle points out that Empedocles needs to adduce cases where such a state of things exists, and to go on to explain this alternate predominance (*Phys* VIII.1, 252a28–29). Empedocles points to the fact that among mankind, Love unites them while Strife separates them, hence according to the observed fact that this occurs in some cases, this leads to the hypothesis that it also happens in the universe. However, Aristotle thinks that Empedocles also needs to explain why each predominance lasts for an equal period of time (*Phys* VIII.1, 252a30–32). And Aristotle more generally observes that one should not assume that, for the fact that something always is or always happens this way, we have found an adequate first principle (*Phys* VIII.1, 252a33–34).

Compared with Empedocles's account, Aristotle thinks that Democritus's account comes closer to explaining why there always has been and always will be motion, since he reduces the explanation of nature to the fact that what happened in the past is the same as what is happening now; however, he does not think it is appropriate to seek for a principle to explain this 'always', so that although Democritus' theory is correct when applying to some individual cases, his theory is incorrect in treating it as universally applicable. Aristotle concludes by restating his view that 'there never was a time when there was not motion and never will be a time when there will not be motion' (*Phys* VIII.1, 252b5–6). In order to further support his view of the eternity and continuity of motion, Aristotle also responds to those who believe that motion is not eternal since there is a beginning of motion. Their view that there is a beginning of motion is based on the case of animate beings, since animals can produce a beginning of motion[179] (*Phys* VIII.2, 252b17–28). When there is no motion in animals, they are in rest, but when at some moment they are set in motion, they produce a beginning of motion in

[179] This is the case of self-motion in animals, see also *Phys* VIII.6, 259b5–15. On Aristotle's self-motion, see Gill (1994).

themselves without anything having set them in motion from outside[180], thus animals can move themselves. If this can occur in an animal, then it is possible that the same be true also of the universe as a whole, so it is possible that there is a beginning of motion. However, Aristotle criticizes the view that animals are capable to produce a beginning of motion, since there is always some part of the animal's body in motion, and the cause of the motion of this part is not the animal itself, but it may be its environment (*Phys* VIII.2, 253a12–15). More specifically, it may well be the case that many motions are produced in an animal's body by its environment, and some of these are set in motion the intellect or the appetite (ὄρεξις), and this again sets the whole animal in locomotion. Aristotle therefore argues that if in the case of the motion of an animal, it is impossible for an animal to completely produce a beginning of motion, the motion of an animal cannot be considered to be evidence that there is a universal beginning of motion. Therefore, Aristotle concludes that there never was a time when there was not motion, and never will be a time when there will not be motion, so it is a fact that motion is everlasting[181] and there always has been and always will be motion. Thus, it can be seen that Aristotle states and defends the doctrine that motion is eternal and continuous in the universe.[182]

It follows from this that all natural things in motion are moved by something. In Aristotle's view, the motion of all things is either natural or unnatural (*Phys* VIII.4, 255b12–14). On the one hand, for things that derive their motion from themselves, for instance, all animals, their motion is natural, since their motion is derived from themselves, and whenever the source of the motion of a thing is in the thing itself, the motion of this thing is natural. Aristotle here notes that the animal as a whole moves itself naturally, but the body of the animal may be in motion unnaturally as well as naturally, which depends upon the kind of motion that it may chance to be suffering and the kind of element of which it is composed (*Phys* VIII.4, 254b19–20). This explains why Aristotle considers the example mentioned earlier—where a part of an animal, set in motion by the environment, subsequently initiates the movement of the whole organism—a valid instance of

[180] But for inanimate things, they are always set in motion by something else from outside. (*Phys* VIII.2, 252b22)

[181] Solmsen (1960, 302) points out that Aristotle here for the first time (in relation to the chronology of the treatise assumed) establishes that motion is everlasting without introducing his own concept of the primary cause.

[182] See Blyth (2015, 23–25) on the everlasting motion in Aristotle.

'deriving one's motion from oneself.' More importantly, Aristotle distinguishes 'natural motion/change' from 'self-motion'. He identifies 'natural motion/change' as the motion of substantial bodies that are moved for the sake of something, and supposes that there are four basic kinds of natural motion/change: (1) locomotion—move/change with respect to place; (2) generation and corruption—move/change with respect to substance; (3) growth and diminution—move/change with respect to quantity; (4) alteration—change with respect to quality (e.g., form sickness to health). Every kind of motion/change is either one of these four, or it is not natural. (*Phys* III.1, 201a4–15).

On the other hand, Aristotle argues that the motion of things that derive their motion from something else is in some cases natural, in other things unnatural. For instance, I have discussed that the natural motion of fire is upward motion, while the natural motion of earth is downward motion[183], so the downward motion of fire is unnatural, while the upward motion of earth is unnatural. And the parts of animals can also move unnaturally when the character of their motion is abnormal. Aristotle notes that it is evident that, in unnatural motion, a thing that is in motion derives its motion from something else, since in these cases the motion is derived from something other than the thing itself (*Phys* VIII.4, 255b32–33). Moreover, as said above, all things which move naturally are also moved by something[184]. Aristotle demonstrates this through light things and heavy things, and explains that they are moved either by that which brought the thing into existence and made it light or heavy, or by that which released what was hindering and preventing it from moving. Thus, Aristotle thinks it is settled that all things that are in motion are moved by something (*Phys* VIII.4, 256a3).

Here Aristotle could have easily inferred that an efficient cause of motion is required from his definition of motion as a potentiality, which requires an agent to actualize it[185]. Moreover, in Aristotle's thought, what causes motion is relative to a cause of motion and the thing being moved, namely, the mover and the moved (*Phys* III.1, 200b31–32). The motion comes from the mover and occurs in the moved, and because whatever is in motion is moved by something, such things

[183] For the natural motions of element fire and earth, see chapter 2.3.1.

[184] Including those that are moved by themselves and those that are not moved by themselves.

[185] See Blyth (2015, 156). I also agree with his view (on the same page) that Aristotle's aim here is to argue as a physicist, not applying metaphysical notions, but appealing to concrete experience. In my mind, *Physics* VIII focuses on the investigation of a first mover in the sense of efficient cause.

will act and be acted upon by another in many ways: each of them will be capable at the same time of acting and of being acted upon, and thus, what causes motion as an agent can also be moved: when such a thing causes motion, it is itself also moved[186]. This allows Aristotle to analyze chains of moved movers in relation to their ultimate source and to conceive of the 'links' within these chains as acting upon the next simultaneously, thereby structuring continuous sequences of efficient causation throughout the universe.

However, although there are continuous efficient causal chains of motion in the universe and everything that is moved must be moved by something, this does not mean that Aristotle suggests these chains are infinite. The reason is that Aristotle supposes that it is impossible "for that through which a thing is moved to move it without being moved by that which imparts motion by its own agency; but if a thing imparts motion by its own agency, it is not necessary that there should be anything else with which it imparts motion, whereas if there is a different thing with which it imparts motion, there must be something that imparts motion not with something else but with itself, or else there will be an infinite series." Thus, Aristotle claims that if anything is a mover while being itself moved, the series must stop somewhere and not be infinite[187] (*Phys* VIII.5, 256a25–32). Aristotle brings forward the relationship of a hand and stick as an example: "if the stick moves something because of being moved by the hand, the hand moves the stick, and if something else moves with the hand, the hand also is moved by something different from itself. So, when motion by means of an instrument is at each stage caused by something different from the instrument, this must always be preceded by something else which imparts motion with itself."

This is enough to convince Aristotle that all chains of movers each causing another motion must originate with a first mover that operates as the primary and overall efficient cause of all the motions in the universe. Furthermore, the first mover must be unmoved. If a series of moved movers does not ultimately lead to an Unmoved Mover, it must terminate in a self-mover. However, a self-mover

[186] But Aristotle criticizes some people who suppose that every mover can be moved, since he claims that it is possible for a thing to cause motion, though it is itself incapable of being moved (*Phys* III.1, 201a22–27).

[187] This argument is closely related to *Phys* VII.1, 242a49–b52, where Aristotle argues that it is impossible that an infinite series of movers is shown to be equivalent to single infinite motion, so it is impossible if this is taken to constitute the evidence of a first Unmoved Mover. See also Ross (1956, 671–672), Wardy (1990, 331–332) and Johnson (2005, 252).

necessarily consists of a part that is itself moved. Thus, Aristotle establishes that the first mover is unmoved (*Phys* VIII.5, 256b13–24). Therefore, Aristotle concludes that 'there must necessarily be something eternal, whether one or many[188], that first imparts motion, and this first mover must be unmoved' (*Phys* VIII.6, 258b10–12).

Accordingly, in the eighth book of *Phys*, Aristotle makes it evident that there always has been and always will be motion, so the motion is eternal and everlasting. And since Aristotle proves that whatever is in motion is moved by something, it is apparent that the efficient causal chains of motion are continuous in the universe. But this does not mean that the chains of motion are infinite, otherwise the number of movers would be infinite. Thus, there must exist a first Unmoved Mover which is the primary efficient cause of all the motions, and the efficient causal chains which originally start from the first mover are continuous in the universe. By this point, it seems to me that the efficient cause can ensure a unified explanation, since the efficient causal chains of motions are continuous and everlasting in the universe.

Nevertheless, at first sight there may seem to be some tension between *Meta* XII and *Phys* VIII[189], since the first mover operates as a final cause in *Meta* while

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[188] For the number of the first movers, Aristotle thinks people should suppose there is one rather than many, and a finite rather than an infinite, since in things constituted by nature that which is finite and that which is better ought to be present rather than the reverse, and here it is sufficient to assume only one first Unmoved Mover, which is eternal and will be the principle of all motions in the universe (*Phys* VIII.6, 259a6–13).

[189] The exact connection between *Physs* VIII and *Meta* XII is a vexed issue. Blyth (2015, 358) claims that in *Phys* Aristotle argues as a physicist, not applying metaphysical notions as he does in *Meta*, but appealing to concrete experience. And according to Waterlow (1982, 172–173), Aristotle has an independent physical reason for inferring there must be a first mover in *Physics*, which is different from that in *Meta*. Ross (1956, 96) comments that Aristotle, in *Metaphysics* XII, describes the first mover as causing motion "as an object of desire" or "of love". According to Ross, this indicates that the first mover in *Metaphysics* is not a physical agent in the sense of producing motion through physical contact. Therefore, Ross suggests, the characterization of the first mover in *Metaphysics* is quite different from that in Physics, where the argument appears to proceed from physical considerations. Laks (2000, 243–245) also encounters this question, but he considers the tension as the ambiguity of Aristotle's argument. And Johnson (2005, 249–251) thinks perhaps the safest conclusion is that the Unmoved Mover of *Phys* VIII is not identical with that of *Meta* XII, but that there is no contradiction between the works, the differences being due to differences of perspective and procedure. It seems that many scholars have found a tension between these two texts, but my contention is that this 'tension' does not mean that Aristotle's argument is ambiguous, but means that Aristotle utilizes different causal explanations to guarantee the unified explanation of the universe in these two treatises, and I think this is also the evidence of Aristotle's attempt to utilize the combining descriptions of final and efficient causal explanations to guarantee the unified explanation of the universe.

it operates as an efficient cause in *Phys*. More precisely, in *Meta* XII, Aristotle discusses the first mover under the aspect of the final cause and claims that the Unmoved Mover pervades the universe as a final cause; while in *Phys* VIII, Aristotle investigates the Unmoved Mover in the sense of the efficient cause and supposes that the first mover is the primary and overall efficient cause of all the motions in the universe, so that the universe is unified by the continuous and everlasting efficient causal chains in the universe. More importantly, in my mind, the different role of the first mover in these two treatises can be viewed as evidence that a unified explanation of Aristotle's universe consists in combining final and efficient causal explanations[190].

3.1.2 The Continuous Efficient Causal Chains in the Cosmos: From the First Mover to the Heavenly Bodies

Having examined the existence of the first mover as the primary and overall efficient cause of all the motions in the universe, I go on to investigate the specific continuous efficient causal chains in the cosmos, in order to survey the role of efficient causes to a unified explanation in the cosmos.

As discussed above, there is a first mover that is unmoved and operates as the primary and overall efficient cause of all the motions in the universe, and thus the first mover must be the original source of the motions of heavenly bodies[191]. For the specific causal chains from the first mover, in *Phys* VIII.10, Aristotle first establishes the existence of the first everlasting moved body[192], which is the first body that is directly moved by the first mover. According to Aristotle, the first mover has no need to change along with that which it moves but it will be able to eternally cause motion, and this motion alone is regular since the first mover is

[190] For the combined descriptions of final and efficient causal explanation in a unified explanation of the universe, see chapter 4.

[191] According to the discussion above, I think it is clear that the first mover is somehow prior and operates as the efficient cause of all the heavenly bodies – even though Aristotle does not say so explicitly in *Physics*. Moreover, in *Metaphysics*, Aristotle clearly claims that the first mover is the efficient cause of the motions of heavenly bodies (Meta XII.8). On the first mover as the efficient cause of the motions of heavenly bodies in Aristotle, see also Apostle (1980, 324–325).

[192] In *Metaphysics*, Aristotle names 'the first everlasting moved body' as 'first moved body', or the 'the first heaven'.

never subject to any change. Aristotle says that in order that the motion may continue to be of the same character, the moved must not be subject to change in relation to it.

> So, it must occupy either the center or the circumference, since these are the principles. But the things nearest the mover are those whose motion is quickest, and in this case, it is the motion of the circumference that is the quickest: therefore the mover occupies the circumference.
>
> *Phys* VIII.10, 267b5–8 (trans. R. P. Hardie and R. K. Gaye)

In this passage, Aristotle establishes the location and character of the first moved body. By supposing that this mover should have no need to change along with that which it moves but will be able to cause motion all the time, and this motion alone is regular since the mover is never subject to any change, Aristotle posits that the motion in the universe must originate either from the center or from the circumference of the universe. Then he claims that the motion which is directly imparted by the first mover must be the fastest of all motions, since the impetus must die away in the process of transmission. And because of his astronomical observation that the motion of the circumference is the quickest, Aristotle concludes that all the motions in the universe are transmitted from the first moved body, which is the first body that is moved by the first mover and is in the outer sphere of the universe[193]. Moreover, given the fact that the first mover acts directly on the first moved body, it seems that the first mover should be outside the circumference of the universe. By this point, it is plain that the first mover directly acts on the first moved body which occupies the circumference of the universe. However, according to Aristotle, there is a difficulty in supposing it to be possible for anything that is in motion to cause motion continuously and not merely in the way in which it is caused by something repeatedly pushing (*Phys* VIII.10, 267b10–11), since in the latter case, the continuity of motions amounts to no more than successiveness. But such a mover must either itself continue to push or pull or perform both these actions, otherwise the action must be taken by something

[193] Aristotle attempts to provide something concrete for this generalization by showing how heavenly bodies, especially the Sun, produce meteorological phenomena through their motion, forming the living things in the sublunary world, giving sublunary events their general shape and character though the rhythm of the day and night, sowing and harvesting. See also Ross (1956, 95–96) and chapter 3.4.

else and be passed on from one mover to another. It seems that in either case the motion cannot be a single motion, but merely a continuous series of motions. Aristotle also demonstrates the case of things thrown to explain the continuity of motions, since the air, which is divisible, is a mover because of the fact that different parts of the air are moved one after another (*Phys* VIII.10, 267b14–15). Therefore, the only continuous motion is the motion which is caused by the first mover, since it remains always changeless, and therefore its relation to that which it moves remains also changeless and continuous[194]. So, it can be seen that the efficient causal chains of motions, which originate from the first mover, are also continuous and everlasting.

Given that the first mover directly acts on the first moved body which occupies the outer sphere of the universe, to examine the specific efficient causal chains in the universe, it is necessary to clarify the efficient causal chains from the first moved body to other heavenly bodies. Although there is no argument about the interaction between the first moved body and other heavenly bodies in *Phys*, we can find some relevant arguments in *Meta*[195]. In this treatise, Aristotle again emphasizes that the first mover is unmoved and operates it as the primary efficient cause of all the motions in the universe, and he explicitly says that the first mover is the efficient cause[196] of the motions of all heavenly bodies whose motion is also eternal[197] :

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[194] Graham (1999, 118–120) criticizes that Aristotle's supposition that there must be a first mover to cause everlasting movements in the world does not really support the claim that the first moved body is everlasting, only showing that it is intermediary, and thus Graham claims it is wrong that 'everlasting' must be supplied as an attribute of the first moved body, following the description of that body in the conclusion, since what is moved will only normally be moved as long as the mover or in contact. In my view, according to Aristotle it is clear that the first moved body is everlasting. On the one hand, the first moved body belongs to heavenly bodies and Aristotle supposes that all the heavenly bodies naturally do everlasting circular motion (since the heavenly bodies are made of aether which naturally do circular motion (for detailed discussions, see chapter 2.3.2)), so the motion of the first moved body is everlasting. (It should be noted that the first moved body must be moved by the first mover even if the motion of the first moved body is everlasting.) On the other hand, Aristotle says that the efficient causal chains of motions which originates from the first mover must be continuous and everlasting (*Phys* VIII.10, 267b9–17), and therefore the motion of the first moved body ought to be everlasting to ensure the continuity of the efficient causal chains in the universe. As a result, the motion of the first moved body must be everlasting.

[195] See note 198.

[196] Aristotle refers to 'efficient' causes many times ('that from which the origin of the motion comes from') in *Metaphysics* (e.g., VII.17, 1041a32–33; XII.4, 1070b34–35; XII.5 1071b7–8). The first mover, being unmoved, produces the primary eternal and single movement (*Meta* XII.8, 1073a26–28). Therefore, the first mover must be the efficient cause of the motions of all the heavenly bodies.

[197] The heavenly bodies, which naturally move in a circle, are eternal and everlasting. (See *Physics*

> The first principle or primary being is not movable either in itself or accidentally, but produces the primary eternal and single movement. And since that which is moved must be moved by something, and the first mover must be in itself unmovable.
>
> *Meta* XII.8, 1073a26–28 (trans. W. D. Ross)

Thus, the motion of each heavenly body must be caused by the first mover, and the first mover is eternal and prior to heavenly bodies, since movers are prior to the moved. For the efficient causal chains which originate from the first mover to the heavenly bodies, Aristotle assumes that one of the heavenly bodies is first and another second, and then another the third (*Meta* XII.8, 1073b17–19). So, the efficient causal chain seems to be: the first mover, first moved body (first heaven) which is moved by the first mover, the second moved body which is moved by the first moved body, and so on. It can be seen that such efficient causal chains, originating in the Unmoved Mover, are continuous and everlasting in the cosmos.

My contention, then, is that Aristotle's efficient cause is capable of guaranteeing a unified explanation in the field of cosmology, since there exist specific continuous and everlasting efficient causal chains in the cosmos, which originate from the first mover to the first moved body (first heaven), and then to other heavenly bodies, thus the efficient cause guarantees a good unified explanation of the universe in the field of cosmology.

3.2 The Role of Efficient Causation in Achieving a Unified Explanation in Aristotle's Elements

Having examined how the efficient cause contributes to a unified explanation in the field of cosmology, I now turn to survey the role of the efficient cause in the field of the motions of elements, in order to make it clear whether the efficient cause can ensure a unified explanation in this field. Aristotle announces five

VIII 8–9).

elements in the universe: the celestial element (aether) which naturally does circular motion; and the sublunary elements (earth, water, air and fire) which naturally do have rectilinear motion (*DC* I.2, 268b14–269a9). However, some scholars argue that there is a gap between the celestial realm and sublunary realm with respect to the fact that aether is eternal and imperishable, and thus has no interaction with the other four elements in the sublunary world. Therefore, in order to respond to these criticisms, it is necessary to explore whether there are continuous efficient causal chains between these five elements in Aristotle's project. Therefore, I divide my investigation of this section into two parts: the efficient causal chains between the celestial element (aether) and the four sublunary elements, and the role of efficient cause in the motions of the four sublunary elements.

3.2.1 The Continuous Efficient Causal Chains from the Celestial Element to the Four Sublunary Elements

Many scholars believe that the introduction of aether is Aristotle's great innovation within the elemental theory.[198] Other commentators have criticized Aristotle's introduction of the celestial element of aether,[199] since this would lead to a disconnection between the celestial region and sublunary region.[200] These

[198] For example, Solmsen (1960, 289) points out that Aristotle's aether endows the heavenly bodies with physical bodies, and therefore non-physical agents are again eliminated from the cosmos. Similarly, Longrigg (1975, 213) supposes that the innovation of aether enables Aristotle to abolish the psychophysical dualism of Plato and brings the heavens within the sphere of physical world. In my mind, Aristotle's innovation of aether brings the celestial world within the sphere of the physical world, and therefore brings the celestial world within the sphere of efficient causal explanation, since efficient causal explanation is sufficient to be applied to explain the physical world.

[199] For the reason why Aristotle supposes the existence of aether as the element of heavenly bodies, see note 111.

[200] Solmsen (1960, 299) comments that aether is quality-less and impassive, and hence, in principle, a stranger to generation and corruption, thus making the celestial world separate from the sublunary world. While Falcon (2005, 87–88; 101–102) thinks that Aristotle's celestial matter creates an important discontinuity between the celestial world and sublunary world, since aether is distinct from the ultimate material principles out of which everything in the sublunary world is constituted. Freudenthal (2009, 239) criticizes that considering the advantage of Aristotle's theory of matter alone, the sublunary world is now a closed system whose functioning depended solely on the laws of physics bearing on the bodies constituted of the four sublunary elements. However, although Hankinson (2009, 84) thinks that Aristotle is not (as is sometimes claimed) committed to supposing that there must be an individual element in the celestial world which is isolated from the other four

commentators apparently assume that aether separates the celestial sphere from the sublunary sphere, since there is no connection or interaction between aether and the four sublunary elements. So now it is questionable whether the efficient cause can guarantee a unified explanation in the field of elements, in other words, whether there are continuous efficient causal chains between aether and the four sublunary elements. But in my view, it should be noted that Aristotle does refer to interactions between aether and the four sublunary elements. In fact, throughout the Aristotelian corpus of natural philosophical treatises there are passages[201] that offer sufficient evidence for interaction between aether and the four sublunary elements. In what follows, I will focus on investigating these passages.

In *Meteor* I.3, 340b6–14, the circular motion of aether[202] is thought to be the efficient cause of the motions of sublunary elements, since Aristotle clearly says: 'Now the circular motion of the first element and of the bodies it contains dissolves, and inflames by its motion, whatever part of the lower world is nearest to it, and so generates heat'. The element of aether that constitutes the heavenly region exerts influence especially on the sublunary elements fire and air moving towards the upper region of the sublunary sphere, and thus closest to the celestial sphere surrounding the Earth[203]. The circular motion of aether has the power of dissolving and inflaming; it is capable of generating heat in whatever part of the sublunary realm which is nearest to the celestial realm. It is clear that there are interactions between aether and the four sublunary elements, since the heat, which is an important source of generation and corruption of the sublunary world[204], is generated by inflammation through the circular motion of aether.

Then, in *Meteor* I.3, 341a1–4, Aristotle shows the interaction between the aether and the sublunary element fire and air. The circular motion of 'the heaven', which consists of the element aether, carries the air with it and causes the circular motion of air, and then 'fire is being continuous with the upper element, and air

elements, he does not investigate the interaction between aether and the other four elements.

[201] See *Meteor* I.3, 340b6–14; *Meteor* I.3, 341a1–4; and *Meteor* I.3, 341b18–24; *GC* I.3, 318a1–6; *Cael* I.2, 339a23–33.

[202] For the natural circular motion of aether, see chapter 2.3.2.

[203] For better distinction, I prefer to use 'Earth' to show the planet Earth, while use 'earth' to express the element earth. In this way, I also choose to use 'Sun' to show the planet Sun, and use 'Moon' to show the planet Moon.

[204] For the role of heat as an efficient cause to the generation and corruption in sublunary, see chapter 3.4.1.

with fire'. Aristotle further supposes that this is also the efficient reason why air is not condensed into water. It thus becomes clear that the motion of aether functions as the efficient cause of the motions of air and fire, with the efficient causal chains linking aether to fire and air being continuous.

Next, in *Meteor* I.3, 341b18–24, Aristotle clearly indicates the interaction between aether and fire, since fire is ignited by the circular motion of aether owing to the fact that fire is part of the sublunary world which is the nearest to the heavenly bodies[205]. The specific interaction of aether and fire, then, is the starting point of the continuous efficient causal chains between aether and the sublunary elements.

Moreover, in *GC* I.3, 318a1–6, Aristotle emphasizes that the first mover and the heavenly bodies, which are always being moved by the first mover,[206] are the efficient causes of all the generations and corruptions in the sublunary world. Given that all generations and corruptions in the sublunary world are based on the interactions of these four elements, thus the heavenly bodies, which consist of aether, are thought to be the efficient cause of all the motions of these four elements. And similarly, in *DC* I.2, 339a23–33[207], the continuity between the celestial world and sublunary world is guaranteed by the fact that all motions in the sublunary world originate from the celestial world. The element of celestial bodies is eternal and complete, while the elements in the sublunary world, such as fire, receive their power of motion from the eternally moving bodies, thus there are continuous efficient causal chains between aether and the other four elements. Therefore, it seems that Aristotle holds that there is contact between aether and the elements in the sublunary world, since he makes explicit that the terrestrial elements are not self-sufficient and obviously aether directly acts on the sublunary elements by its circular motion.

However, Pearson comments that there seems to be an inconsistency in Aristotle's views about these events since Aristotle sometimes speaks of fire at the periphery of the sublunary region being ignited by the rotation of the lunar sphere,

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[205] For the reason why fire is nearest to heavenly bodies, see chapter 2.3.1 on the determinate place of fire.

[206] See also *Phys* VIII.6, 258b10f. For detailed discussions on the continuous efficient causal chains from the first mover to the motions of heavenly bodies, also see chapter 3.2.2.

[207] Scharle (2005, 156–157) has also discussed *DC* I.2, 339a23–33 and claims it shows the motions of sublunary elements are of necessity continuous with the upper motions.

but sometimes attributes such phenomena to dry exhalation, which is distinct from fire[208]. However, my contention is that, although in Aristotle's work there may be inconsistencies in his presentation of the interactions between aether and the terrestrial elements, these can merely be considered as different hypotheses about possible ways of contact, and do not affect the view that aether is capable of acting upon the terrestrial elements. Indeed, what Aristotle truly wants to express in these cases is the continuity between the motion of aether and the motion of four sublunary elements. Moreover, in Aristotle's thought, the dry exhalation[209] is also caused by the heat produced by the Sun, and since the Sun is made of aether, thus the dry exhalation in the sublunary world is also caused by aether. Therefore, both of these 'inconsistent views', can be resolved if we consider that fire is ignited by the motion of aether.

Accordingly, it seems to me that Aristotle's supposition of the existence of aether does not involve a disconnection between the celestial region and sublunary region, since Aristotle considers the circular motion of aether to be the efficient cause of the motions of four sublunary elements – which evidently implies interactions between aether and the sublunary elements. Therefore, with the role of Aristotle's efficient cause, there are continuous efficient causal chains between the celestial element (aether) and the four sublunary elements, and thus the celestial region and sublunary region are not disconnected.

3.2.2 The Efficient Causal Chains Between the Motions of the Four Elements in the Sublunary World

According to the discussion above, the efficient causal chains are continuous between aether in the celestial world and the other four elements in the sublunary world, so it seems that the efficient cause can ensure a unified explanation between

[208] In *Meteor* I.3, 341a29–36, Aristotle suggests that the elemental fire surrounding the air is often scattered by the motion of the Sun and driven downwards to Earth in spite of itself; while in *Meteor* I.4, 341b22–342a8, Aristotle says that when lots of dry exhalation is churned back to Earth by the heavenly motions, the heat in the upper layer should cool or moisten before it falls. For this inconsistency, which is pointed out by Pearson, see Gill (2010, 145). Moreover, here Gill also mentions another inconsistent view in Aristotle: if Aristotle takes fire's own place to be the extremity of the universe, the potency of fire to be in its place is never actualized.

[209] For the detailed discussions of the dry exhalation, see chapter 3.4.1.

aether and the other four elements. Now it is necessary to move on to examine the role of efficient causes in the motion of the four elements in the sublunary world, and to investigate the efficient causal chains between these four sublunary elements, namely, earth, water, air and fire.

Many of Aristotle's works discuss the behavior of these four elements, but most of his treatises investigate the interaction of these four elements in the process of forming compound bodies or in their own mutual transformations[210]. Given the fact that the sublunary world is made up from these four elements, many of the interactions of these four elements are part of phenomena happening in the field of meteorology[211] and biology[212]. In this section, however, I will focus on investigating the efficient causal chains in respect to the field of elements as such. Thus, it is necessary to explore the treatise *On Generation and Corruption*, where Aristotle utilizes the efficient cause to explain chains of interaction between these four elements in his analysis of the phenomena of generation and corruption in the sublunary world.

In *On Generation and Corruption*, Aristotle undertakes to describe the behavior of the four elements and explores the interactions of the four elements with respect to the formation of compound bodies and the circle of elemental mutual transformations. Before examining the efficient causal chains of interaction between these four elements in the generations and corruptions in the sublunary world, he emphasizes again that the first mover and the heavenly bodies, always being moved by the first mover,[213] are the efficient causes of all the generations and corruptions in the sublunary world (*GC* I.3, 318a1–6). Given that all generations and corruptions in the sublunary world are based on the interactions of these four elements, thus the first mover and the heavenly bodies are thought to be the efficient cause of all the motions of these four elements. Moreover, Aristotle claims that the generations and corruptions in the sublunary world happen everlastingly and continuously (*GC* I.3, 318a11–13)[214], and in order

[210] See also Gill (2010, 139–140; 2014, 343).

[211] For the efficient causal chains in the field of meteorology, see chapter 3.4.

[212] For the efficient causal chains in the field of biology, see chapter 3.5.

[213] See also *Phys* VIII.6, 258b10f. For the detailed discussions about the continuous efficient causal chains from the first mover to the motions of heavenly bodies, also see chapter 3.2.2.

[214] Here Aristotle claims that the generations and corruptions in the sublunary world happen continuously, and since generation and corruption are caused by the interaction of these four elements, thus it seems that the efficient causal chains in the four elements must be continuous.

to explain the continuity of these generations and corruptions, he focuses on examining the interactions of these four sublunary elements.

The four sublunary elements must be reciprocally active and susceptible, since they combine and are transformed into one another. Aristotle supposes four kinds of active or passive properties of these four elements, namely, hotness, coldness, wetness and dryness (*GC* II.2, 329b22–39). These four basic properties are utilized by Aristotle to explain the interactions between the elements. Hotness and coldness are active properties, while dryness and wetness are passive properties: the properties of hotness and coldness imply the power to act, while wetness and dryness imply susceptibility. Hotness is capable of associating things of the same kind while coldness is capable of bringing together homogeneous and heterogeneous things alike. And wetness is that which, being readily adaptable in shape, is not determinable by any limit of its own; while dryness is that which is readily determinable by its own limit, but not readily adaptable. These four properties are incorporated by Aristotle into an account of the process of the interaction of the elements.

In Aristotle's view, each element has two such distinguished properties. He ascribes to each of the elements' binary combinations of opposites: for earth is cold and dry, while water is cold and wet; and air is hot and wet, whereas fire is hot and dry (*GC* II.2, 330a1–330b8). The four elements interact with one another in the sublunary world because of these four properties. Aristotle argues that in the generation and corruption of the sublunary realm, opposites need to be allowed to function as independent principles, because it is obviously awkward to attach both of the opposites to one element as qualities. Moreover, in spite of the fact that this coupling of elements and opposites seems reasonable, since it is naturally plausible to ascribe wetness rather than coldness to water, it reflects Aristotle's thought about the interrelationship of the four elements with binary relations of opposites. If Aristotle considers the property of water to be wetness, he would distribute the properties of coldness and dryness between air and earth, since it is obvious that hotness is the property of fire. However, since the air is obviously hot and wet[215], its basic properties may be neither cold nor dry. In this regard, it is necessary to characterize water as cold. It can be seen that different elements have different properties, and these four elements interact with one another in the

[215] Aristotle supposes the air is hot and wet since he considers air as a sort of vapor (see *GC* II.3, 330b3–4).

sublunary world in virtue of their different properties. Now it is obvious that these four elements interact with each other in the composition of compound bodies and in their own transformations of the sublunary world, which are based on their four properties[216]. The interactions of these four elements are continuous and will never stop in the sublunary world; therefore, the generations and corruption are continuous and the existence of natural things in the sublunary is guaranteed. The continuous efficient causal chains thus exist in the chains of interaction between these four sublunary elements.

Furthermore, Aristotle observes that the transformation of these four elements seems to resemble a circular motion[217] (*GC* II.10, 337a1–10). For when water is transformed into air, air into fire, and the fire back to water, this generation has completed the circle, since it is back again at the beginning. It seems that the circle of transformations of the four elements is continuous and everlasting, just as the circular motion of the heavenly bodies is continuous and everlasting. Therefore, by imitating the circular motion of the heavenly bodies, the chains of transformations of the four elements are also continuous.

Accordingly, the four elements interact with one another in the sublunary world because of their different properties, and their interactions must be continuous and everlasting. Aristotle's utilization of efficient causes directly explains chains of interaction between the four elements in the sublunary world. With the role of efficient cause, there are continuous efficient causal chains between these four elements, thus the sublunary world is unified by the efficient cause in the field of elements. Moreover, considering that the circular motion of aether is the efficient cause of the motions of four sublunary elements and thus evidently initiates the interactions between aether and the sublunary elements, there are continuous efficient causal chains between the celestial element (aether) and the four sublunary elements. Therefore, with the role of efficient cause, there are continuous efficient causal chains among the five elements in the universe, and thus Aristotle's efficient cause ensures a unified explanation in the field of

[216] For the specific meteorological phenomena of rainfall, which are based on the interactions of sublunary elements, see chapter 2.4 and 3.4.

[217] Johnson (2005, 151) ascribes Aristotle's arguments that the transformation of these four elements into each other seems to resemble the circular motion to his explanation of the final cause. I tend to believe, however, that this is also Aristotle's utilization of efficient cause, since Aristotle here wants to show that the interactions of elements in their transformation form a circle, and therefore Aristotle says that their interactions are continuous by imitating circular motion (*GC* II.10, 337a9).

elements.

3.3 The Role of Efficient Causation in Achieving a Unified Explanation in Aristotle's Meteorology

Having examined the role of the efficient cause in a unified explanation in the field of the motions of the elements, now I move on to investigate the role of the efficient cause in the explanation of Aristotle's universe in the field of meteorology. As I have discussed in Chapter 2.4, Aristotle's final cause cannot be applied to the field of meteorology and is not capable of ensuring a unified explanation in this field, so in this section, I will focus on examining the role of the efficient cause and try to answer the question of whether there are continuous efficient causal chains in this field.

Aristotle has investigated various meteorological phenomena between the upper and lower realms of the universe with reference to the matter and sources of motions. The meteorological phenomena happen both (1) as a result of the four sublunary elements (earth, water, air and fire) being the cause of 'the events - in matter' – which seems to express that these four elements are not only the material causes of meteorological phenomena[218] (or more broadly, all sublunary events), but also 'subjects being affected' (*Meteor* I.2, 339a28–29), and (2) as a result of the eternally moving bodies as 'the cause whence the motion originates'[219] (*Meteor* I.2, 339a30–31). Thus, Aristotle's efficient cause plays an important role in meteorological phenomena between the celestial sphere and sublunary sphere. In this respect, I divide my investigation of this section into two parts. First, the important role of the Sun needs to be discussed. The Sun acts as an efficient cause to generation and corruption in the sublunary world. Secondly, I will examine the continuous efficient causal chains between the celestial world and sublunary

[218] According to the original text, it is 'the events in this world'; but according to the context, it should be 'all sublunary events'; however, based on the full book of *Meteorology*, Aristotle is mainly talking about the meteorological events.

[219] 'The cause whence the motion originates' is the efficient cause. For the definition of Aristotle's efficient cause, see chapter 3.1.

world in the field of meteorology.

3.3.1 The Sun Operates as an Efficient Cause to Generation and Corruption in the Sublunary Word

In Aristotle's field of meteorology, the Sun is the most important heavenly body to the sublunary world, since Aristotle realizes that the sublunary world cannot be self-sufficient, taking into account that the Sun warms it. In this section, I will focus on examining the role of the Sun which acts as an efficient cause to generation and corruption in the sublunary world. It is clear that Aristotle does not consider the Sun to be hot itself[220]; in order to explain how the Sun generates heat, Aristotle proposes two kinds of explanations[221].

In his first explanation (*Meteor* I.3, 341a19–28), Aristotle supposes that the motion of the Sun in the celestial sphere—being both rapid and near— is sufficient to account for the origin of heat; the Sun produces heat by inflaming the air. According to Aristotle, the analogy of terrestrial phenomena makes it reasonable that more heat should be generated in the presence of the Sun, since here, it is the air that is nearest to an object in rapid motion which is heated most. So, it is the nearest air that is most inflamed by the motion of the Sun, and this is one reason why heat reaches the terrestrial world. As the reason why heat reaches our world, Aristotle brings forward (*Meteor* I.3, 341a29–36) that the elemental fire surrounding the air is often scattered by the motion of the heavens and driven downwards to Earth in spite of itself. Aristotle further indicates that the phenomena of shooting-stars also suffice to prove that the celestial world is not hot and fiery, since they do not occur in the celestial world but in the sublunary world[222]. However, the more and faster a thing moves, the more likely it is to catch fire, and this is the reason why shooting-stars occur. Moreover, Aristotle notes that

[220] Aristotle denies that the heavenly bodies are themselves naturally hot. (See *Meteor* I.3, 341a14–18).

[221] The first explanation is discussed in *Meteorology*, while the second explanation is discussed in *DC*. It should be noted that Aristotle is just thinking about two kinds of possibilities to explain how the Sun generates heat without talking about which one is the best, or which one is right.

[222] Aristotle then posits that the phenomenon of shooting-stars which happens in the sublunary world is due to the combustion of the exhalation (*Meteor* I.4, 342a16–20).

the Sun is white and not fiery.

The second explanation[223] is proposed in *DC*, where Aristotle suggests that the Sun produces heat by the friction between it and the air in the sublunary world (*DC* II.7, 289a2532). Aristotle here utilizes the example of missiles to explain this explanation. Missiles moving are themselves fired so strongly that leaden balls are melted, and if they are fired, the surrounding air must be similarly affected. Now while the missiles are heated in virtue of their motion in air, which is turned into fire by the agitation produced by their movement, the heavenly bodies are carried on a moving sphere. Therefore, they do not catch fire themselves, however, the air under the sphere of the rotating object must be heated by its motion, especially in the part where the Sun is attached to it. Thus, Aristotle claims that warmth increases as the Sun gets nearer or higher or overhead. Regarding the second explanation, I concur with Wilson's assessment that certain difficulties arise in interpreting Aristotle's account; however, I disagree with his proposed solution. In *DC* IV.4–6, Aristotle appears to suggest that elemental fire does not exist in the heavenly realms except for the fire generated by air and sustained through the friction of the celestial bodies. This interpretation seems problematic, as it conflicts with Aristotle's elemental theory, according to which fire and air are independent elements rather than derivative phenomena. Conversely, if the heavenly sphere itself contained fire, this too would contradict Aristotle's framework, as Aristotle explicitly states that the heavenly sphere is neither hot nor fiery. To resolve these difficulties, Wilson proposes that Aristotle conceptualizes air as a form of smoke, which he equates with elemental fire. He further suggests that air transforms into fire through friction, arguing that, while Aristotle does not explicitly refer to smoke in this context, he elsewhere describes smoke as capable of combustion, thus linking it to the properties of fire. However, I find this interpretation unconvincing. Aristotle never refers to smoke in his discussions of the Sun's production of heat, nor does he suggest that heat generation in the celestial realm involves any transformation of air into fire. To infer such a conclusion solely on the basis of one shared property—namely, that both air and

[223] This description suggests that elemental air is transformed into elemental fire and that friction is the cause of the heat associated with that region, So, in the case of missiles moving through air, the surrounding air becomes fire. And it seems to be a modification of Anaxagoras' view that the stars shine because of the resistance and breaking round of the aether (λάμπειν ἀντερείσει καὶ περικλάσει τοῦ αἰθέρος), For the comparison between Aristotle and Anaxagoras on the generation of heat, see Wilson (2013, 57–49) and Anaxagoras A 12, II.9, 34–35 DK.

smoke can burn—seems tenuous and speculative. In my view, Aristotle's purpose in offering these two explanations is not primarily to resolve conceptual difficulties but to illustrate the efficient causal process underlying the production of heat. His argument aims to demonstrate that the motion of the heavenly bodies serves as the efficient cause of generation and corruption in the sublunary world—a topic I will examine in detail in Chapter 3.3.2. Thus, the question of whether there are interpretative difficulties in his account is secondary to his primary concern, which is to establish the causal role of celestial motion in terrestrial phenomena.

However, although Aristotle offers two explanations for how the Sun generates heat, he does not provide a clear account of how this heat reaches the Earth's surface. In traditional thought, change occurs through direct contact, yet this view conflicts with Aristotle's claim that the upper regions of the atmosphere are colder than the Earth's surface. The requirement of contact for change (*GC* I.6, 322b21–25) is hard to reconcile with his assertion that the higher atmosphere is cold (*Meteor* I.3, 340a26–32) and the traditional assumption that heat transfer requires proximity (*Meteor* I.12, 348a14–18). Moreover, if heat is transferred efficiently downward, Aristotle faces another explanatory challenge: heat naturally causes matter to become lighter and rise, as observed in the ascent of steam (see *Meteor* I.9–10). If heat tends to ascend, how does the Sun's heat effectively warm the Earth? To address this, Aristotle hypothesizes the existence of rays that transport heat, implying that the heat carried by these rays differs from the general heat present in the upper atmosphere (*Meteor* I.3, 320a26–32). However, Aristotle's account of light does not fully explain how light itself is generated, leaving a gap in his explanation of solar heating. As Freudenthal also notes, Aristotle does not present a fully coherent mechanism for how the Sun heats the sublunary world.[224] Nevertheless, despite these difficulties in understanding the Sun's heat production, Aristotle employs efficient causation to explain the Sun's role as the efficient cause of warming the terrestrial sphere. While his account remains incomplete in certain respects, it underscores his broader commitment to explaining natural processes through causal principles rather than attributing them to mere necessity or coincidence.

Accordingly, these two explanations show the efficient causal processes of the

[224] See Freudenthal (2010, 239).

Sun producing heat to the sublunary world: the first explanation supposes the motion of the Sun produces heat by inflaming the air, and then the elemental fire surrounding the air is often scattered by the motion of the Sun and driven downwards to Earth in spite of itself; while the second explanation proposes the revolving Sun produces fire by the friction between it and the air underneath. Although these two explanations express different ways of the Sun producing heat and Aristotle does not express which explanation he most prefers, both of these two explanations explain the same fact that the heat in the sublunary world is produced by the motion of the Sun. Thus, it seems that Aristotle utilizes the efficient cause to explain how the Sun generates heat, and specifically the fact that the Sun acts as the efficient cause by warming the terrestrial sphere.

By this point, it is plain that Aristotle utilizes the efficient cause to explain the process of the Sun generating heat to the terrestrial world; now I move on to explore the more specific process in which the Sun acts as an efficient cause to the occurrence of the meteorological phenomena in the sublunary in virtue of two exhalations:

> When the Sun warms the earth the exhalation which takes place is necessarily of two kinds, not of one only as some think. One kind is rather of the nature of vapor, the other of the nature of a windy exhalation. That which rises from the moisture contained in the earth and on its surface is vapor, while that rising from the earth itself, which is dry, is like smoke.
>
> *Meteor* I.4, 341b6–9 (trans. E. W. Webster)

In this passage, the Sun acts as the efficient cause by means of the two exhalations: the first kind is of the nature of vapor, which can be called wet exhalation; and the other is of the nature of wind, which can be called dry exhalation[225]. When the Sun warms the earth, the two kinds of exhalations occur and affect the phenomena which take place in the upper atmosphere. Aristotle points out that when meteorological phenomena are formed in the upper region of the sublunary world, it is due to the combustion of the dry exhalation (*Meteor* I.4, 342a16–20). When it takes place at a lower level in the sublunary world, it is due

[225] In the relevant passage in *Meteorology*, it seems that Aristotle merely hints at the two exhalations; more investigation is necessary since these two exhalations are indispensable part of the continuous efficient causal chains from the heat produced by the Sun to the sublunary world in the field of meteorology.

to the ejection of exhalation by the condensing and cooling of the wet exhalation, for the latter as it condenses and inclines downward contracts, and thrusts out the hotness and causes it to be thrown downwards. Aristotle emphasizes that the motion is upwards or downwards or sideways with respect to the way in which the exhalation goes and its disposition in respect of breadth and depth. In most cases, the direction is sideways since two motions are involved, a compulsory motion downwards and a natural motion upwards, and under these circumstances an object always moves obliquely. Hence the exhalation is considered to be the cause for all these phenomena in the atmosphere.

Furthermore, these two exhalations are closely related to Aristotle's theory of the four elements and their transformations[226]. The dry exhalation and the wet exhalation can mix to form the air. And given that all matter in the sublunary world must generate and corrupt into opposites and the heat in the upper layer should cool or moisten before it falls, when lots of exhalation is brought down to earth by the heavenly motions[227], wet exhalation is capable of condensing into water in its own circle of change, while dry exhalation is capable of condensing into earth in its own circle of change[228]. In this way, both the dry exhalation and the wet exhalation may transform into its sublunary element. And, even if these two exhalations simply return to earth in their own form, the balance of the sublunary world will still be maintained[229]. It should be noted that Aristotle believes that fire can be caused merely by dry exhalation, because the amount of water on earth is insignificant compared to the size of the heavenly realms, and if the water nourishes the stars, then burning would cause the oceans to evaporate completely[230]. Moreover, Aristotle has convincing reasons for the backflow of dry

[226] For the elemental transformations in the four sublunary elements, see also chapter 3.3.1.

[227] In fact, Aristotle thinks that we rarely see downward movement of dry exhalation in the phenomena of meteorology, so he did not do too much investigation on it. For instance, even if lots of dry exhalation is churned back to Earth by the heavenly motion, Aristotle does not say how it got back to Earth (see *Meteor* I.4, 341a30–31.

[228] See *Sens* V.4, 443a21–31 and *Meteor* I.4, 342a27–29.

[229] There is also the meteorological case that rain absorbs the dry exhalation, which falls into sea as salt water, so, this transition happens to balance out the exhalation of the ocean (see *Meteor* II.3,358a24-29).

[230] In order to understand Aristotle's dry exhalation, the most difficult thing is what happens after it rises from the ground and produces the meteorological phenomenon of wind and fire. These winds may rise to the outermost layers of the atmosphere, but according to Aristotle's description of shooting-stars and lower comets, these exhalations burn up and disappear, but when judging from his view about matter, it should be transformed into some other form of matter. (See *Meteor* II.4)

exhalation to the earth. He emphasizes that rain and its congeners are part of the cycle, 'rivers of the oceans', and he refutes the arguments of predecessors that claim water on earth is being constantly consumed by the heavenly bodies[231]. He also noted that when dry exhalations arise from the earth, their source decreases. Therefore, no matter how slow this process is, the earth should be completely transformed into exhalation and disappear. More importantly, it should be noted that these two exhalations are incapable of mutual transformation, since Aristotle rejects the moistening of the dry exhalation into vapor while he holds that fire can only arise from dry exhalation, so as to avoid a possible transformation of dry and wet exhalations[232].

By this point, according to the discussion about the role of the two exhalations, it seems to me that the heat produced by the Sun functions as the efficient cause of all generation and corruption (including all the phenomena in the atmosphere) in the sublunary world through two exhalations, thus organizing continuous efficient causal chains from the Sun to the meteorological phenomena in the sublunary world.

3.3.2 The Continuous Efficient Causal Chains between the Celestial World and the Sublunary World in Meteorology

Having examined the role of the Sun as the efficient cause through warming the sublunary world and having investigated the more specific process that the Sun operates as an efficient cause to the occurrence of the meteorological phenomena in the sublunary world in virtue of the two exhalations, it can be seen that there are continuous efficient causal chains between the celestial world and the sublunary world. More importantly, Aristotle clearly says that the Sun is the main efficient cause of the motions and changes in the sublunary world:

> The efficient and chief and first of the principles is the circle in which the Sun moves. For the Sun as it approaches or recedes, obviously causes

[231] See *Meteor* II.4.

[232] On the impossibility of mutual transformations between wet and dry exhalation, see Wilson (2013, 57–60),

dissipation and condensation and so gives rise to generation and destruction.

Meteor I.9, 346b23–25 (trans. E. W. Webster)

According to this passage, the efficient cause of generations and corruptions in the sublunary world is identified to be the motion of the Sun, which is also considered one of the main influences of the celestial world on the sublunary world[233]. The Sun warms the earth by producing heat in the sublunary world, and produces two kinds of exhalations which effectively cause all the meteorological phenomena in the sublunary realm. For instance, the meteorological phenomenon of rainfall cycles is also caused by the motion of the Sun acting on the elements in the terrestrial world. When heat rises, moisture rises, and when it gets cold, the moisture descends to the ground. These processes, in some cases, have special names to distinguish their varieties: when water drops into small droplets, it is called drizzle; and when the drops are larger, it is rain (*Meteor* I.9, 347a9–12). Moreover, the motion of the Sun brings about seasons' changes[234] and keeps the four elements from settling into four stable, changeless, and concentric spherical layers (*DC* II.3, 286b1–9). In addition, there are also some specific phenomena which are caused by the Sun's motion. Aristotle occasionally refers to a special phenomenon caused by the Sun's motion, namely, land changing into sea or sea into land, which is an ordered phenomenon produced by the Sun as an efficient cause, since the regions of the earth experience periodic aging and rejuvenation according to the amount of wet exhalation present in the ground (*Meteor* I.14, 351a30–b35). Thus, the change of land into sea and vice versa, is caused by the hot and cold in the earth, which are caused in turn by the Sun and its revolution, thus this special phenomenon could also be treated as the Sun's influence as an efficient cause. Therefore, it is clear that continuous efficient causal chains exist from the Sun to the sublunary world with respect to the fact that the Sun is thought to be the main efficient cause of the meteorological phenomena in the sublunary world.

By this point, I have discussed the continuous efficient causal chains from the Sun to the sublunary world in the field of meteorology, but what is the role of other heavenly bodies in the sublunary world? In fact, Aristotle explicitly says that

[233] See also *GC* II.10–11.

[234] Aristotle adds to the Sun's simple diurnal revolution its annual northern advance and southern retreat, which explain seasonal changes and climatic differences (see *Meteor* I.2, 339a20-22).

more than one circular body is necessary for generation (*DC* II.3, 286b5–8), which means that the Sun is not the only heavenly body that acts on generation and corruption in the sublunary world. Moreover, Aristotle considers the heavenly bodies to be the source of all motions and changes in the sublunary world, and supposes that the sublunary world necessarily has a certain continuity with the upper motions since its power is derived from them (*Meteor* I.2, 339a22–28). Moreover, Aristotle illustrates many meteorological cases of the generation and corruption in the sublunary world, which are caused by the motion of the Sun (*Meteor* I.14, 351a30–b35). Since Aristotle considers the heavenly bodies to be the efficient cause of all generations and corruptions in the sublunary world, it is necessary to explore the role of other heavenly bodies which work as efficient causes of generation and corruption in the sublunary world. However, Aristotle has mentioned only some few phenomena which he believes are caused by other heavenly bodies. For instance, Aristotle treats the Moon's motion as the cause of the timing of women' menses (*GA* II.4, 738a8–18). The uterus's region within the female body includes two blood-vessels, the great vessel and aorta, which are divided higher up, with many fine vessels terminating in the uterus. Since they transmit many nutrients, female nature is incapable of concocting them since it is colder than the male's nature, and therefore when blood flows into the uterus through very thin blood vessels, these vessels are incapable to receive the excessive quantity because of their narrowness, and the result is a sort of hemorrhage. A woman's menstrual cycle is not precisely defined, but it tends to return during the waning of the Moon. Aristotle thinks this is what we should expect because the bodies of animals get colder when the environment gets colder, and the time of change from one month to another is colder because of the absence of the Moon, which also causes more storms at this time than in the middle of the month. Moreover, Aristotle also considers the Moon's motion to be the efficient cause of earthquakes (*Meteor* II.8, 367b20–b31). Earthquakes sometimes coincide with an eclipse of the Moon because as the Moon's path approaches the point where the eclipse of the Moon occurs, the Moon's heat decreases, causing earthquakes. More precisely, when the earth is on the verge of being interposed, but the Sun's light and heat have not completely disappeared from the air but are gradually disappearing, the winds that cause earthquakes enter the earth before the eclipse, and calm follows. And because there is usually wind before an eclipse: at nightfall if the eclipse occurs at midnight, and midnight if the eclipse occurs at dawn. They are caused by a drop in the Moon's temperature as the Moon's path

approaches the point at which the eclipse will occur. Thus, the influence of suppressing and calming the air is weakened, the air moves again, and the later the wind rises, the later the eclipse will be. Therefore, although Aristotle does not say so much about the other heavenly bodies' influence on the sublunary world, he supposes the heavenly bodies to be the efficient cause of all generations and corruptions in the sublunary world.

Eventually, according to the discussion above, we now come to the conclusion that continuous efficient causal chains exist from the heavenly bodies to the sublunary world in the sense that the heavenly bodies are the efficient causes of all generations and corruptions in the sublunary region. Thus, through the efficient causal chains from the celestial region to the sublunary realm there is a causal connection between these two regions, and therefore Aristotle's efficient cause can ensure a unified explanation in the field of meteorology.

3.4 The Role of Efficient Causation in Achieving a Unified Explanation in Aristotle's Biology

In the discussion above, I have investigated the role of Aristotle's efficient cause in a unified explanation in the field of cosmology, both with regard to the motions of the elements and in the field of meteorology, that is, at the level of the inanimate world. In this section, I will turn to explore the role of the efficient cause to a unified explanation at the level of the animate world, namely, in the field of biology. It should be noted, however, that some scholars have doubted whether the efficient cause can fully explain the existence of living things[235].

[235] For instance, Gotthelf (1987b, 225–231) claims that Aristotle is motivated to stress the final cause in scientific explanation because of the impossibility of fully explaining living things according to other causes, namely efficient cause. In my view, Gotthelf is arguing that for the explanation of living things a final cause is necessary in addition to a natural action and interaction of the elements. For instance, see p.225: "Given the simplicity of Aristotle's chemistry, he can only believe that the outcome of organic development is too complex, too orderly, possessing too much of limit, logos, and form, to be the result merely of the unlimited, relatively indefinite natural action and interaction of the elements. The development must be for the sake of its outcome – i.e., essentially and irreducibly a development to order – i.e., to form. The development, in short, must be the actualization of the irreducible potential for form." See also p.231: "the potential is 'irreducibly' for some complex end when the production of that end is not due wholly to the actualization of element-

For the role of the efficient cause in Aristotle's biology, it seems that there are efficient causal chains from the heavenly bodies to the generation of living things in the sublunary realm, since in Aristotle's work there are various passages that describe the role of the heavenly bodies as the efficient cause of these things. For instance, Aristotle has a famous perspective that 'a human being is produced by a human being and the Sun'[236], and it seems that the heat produced by the Sun is the efficient cause of the generation of human beings. Moreover, the case of spontaneous generation, which cannot be explained by the final cause[237], can be explained through the efficient cause, since according to Aristotle it is brought about by the heat produced by the Sun[238]. Besides, the length of the life of an animal species is also taken to depend on the motion of heavenly bodies[239]. Therefore, in this section, I will first investigate the role of the heavenly bodies[240] as efficient causes to the generation of living things, and then I will examine whether there are continuous efficient causal chains to guarantee the unified explanation of the universe in the field of biology.

3.4.1 The Continuous Efficient Causal Chains from the Celestial World to the Sublunary World in Biology

For the investigation of the role of the efficient cause to a unified explanation in the field of biology, the most important part is the exploration of the role of the

potentials." Similarly, Johnson (2005, 185) believes that the living things could not be explained without the appliance of final cause. Charles (1988, 8–9) implies that there may exist the possibility that physical coherence is sufficient in Aristotle's biology, but he does not express this thought. Cooper (2009, 203–204) further indicates the first kind of principle is considered to be the final causal principle which can be applied to the natural kinds of living things to govern their development and behavior. Moreover, Cooper implies the second kind of principle is considered as an efficient causal principle to govern living things' behavior in given conditions. In my interpretation, Cooper seems to have realized the specific role of efficient cause to be applied to the scope of biology.

[236] See *Phys* II.2, 194b13; *Meta* XII.5, 1071a15; *GA* IV.10, 777b35.

[237] For the detailed discussion on the limited role of final cause in spontaneous generation, see chapter 2.5.3.

[238] See *GA* III.11, 762a19–32.

[239] See *GA* IV.10, 777b10–19.

[240] Since Aristotle rarely discusses the role of other heavenly bodies (except the Sun) to the generation of living things, in this section I mainly investigate the role of the Sun to the generation of living things.

vital heat[241] produced by the Sun which acts as the efficient cause to the generation of living things in the sublunary world[242].

In *GA*, Aristotle puts forward the notion of 'vital heat' (θερμότης ψυχική) (*GA* III.11, 762a20) and defines the heat produced by the Sun as such[243]. His notion of 'vital heat' is developed on the basis of Socrates' views concerning the heat produced by the Sun[244], and distinguishes the vital heat produced by the Sun from the ordinary heat generated by the Sun with respect to their different functions of 'concoction'. According to Aristotle, 'heat' is an active factor which acts on the passive ones, and brings about the process of 'concoction'[245]. He considers all processes of 'concoction', whether natural or artificial, to have in common that they combine things of the same kind to result in a homogeneous substance, and thus foreign objects, such as ashes and residues, are eliminated. This kind of process leads to a homogeneous substance with uniform texture throughout and which has the characteristic ratio of its components[246]. In this process, some

[241] Aristotle clearly puts forward the concept of 'vital heat', extracting the 'vital heat' from the heat of the Sun for research and giving it the role of generating living things. Although Aristotle himself did not explicitly put forward the concept of 'ordinary heat', his theory of the heat produced by the Sun actually divides the heat produced by the Sun into 'vital heat' and 'ordinary heat'. For this distinction, see also Longrigg (1975, 213–214).

[242] Aristotle clearly puts forward the concept of 'vital heat', extracting the 'vital heat' from the heat of the Sun for research and giving it the role of generating living things. Although Aristotle himself did not explicitly put forward the concept of 'ordinary heat', his theory of the heat produced by the Sun actually divides the heat produced by the Sun into 'vital heat' and 'ordinary heat'. For this distinction, see also Longrigg (1975, 213–214). And I have also discussed the role of the heat produced by the Sun as an efficient cause to the generation and corruption in the sublunary with respect to the field of meteorology (see chapter 3.3).

[243] See *GA* II.3, 736b32–737a5: in all cases the semen contains within itself that which causes it to be fertile—what is known as "vital heat" substance, which is not fire nor any similar substance, but the pneuma which is enclosed within the semen or foam-like stuff and the natural substance which is in the pneuma; and this substance is analogous to the element which belongs to the stars.

[244] In *Memorabilia* IV 7.6–7, Xenophon describes how Socrates deplores the insanity Anaxagoras showed in attempting to explain the phenomena of the heavens and in claiming that the Sun is fire, and accuses Anaxagoras of utter ignorance in failing to observe the vast difference between fire and sunlight –clearly implying that the heat of the heavenly bodies is far superior to fire. Aristotle himself, like Socrates in this passage, distinguished two types of heat when he claimed that the heat in living things is more akin to the element of the stars and the heat of the Sun than to ordinary fire (*GA* II.3, 736b33–737a7). Obviously, in talking of the vital heat, Aristotle distinguishes vital heat from ordinary on purpose, and meant them to be different kinds of heat from the Sun. He could easily have assigned it a dignity far above that of the material substances we encounter in our immediate environment. On the discussion on heat in Xenophon's *Memorabilia*, see Hahm (1982, 63).

[245] See *GC* II.2, 329b24–31; *Meteor* IV.1, 378b10–25; and *GA* I.18, 724b20–27.

[246] Freudenthal (1995, 22).

moisture evaporates or some dry matter is mixed with moisture, and thus the emerging substance gradually acquires a definite shape. The process will eventually serve the purpose of establishing some sort of stable mark between moist and dry, in which the substance acquires an appropriate form or nature. Therefore, the concoction process produces a specific substance in which moisture has been controlled in a characteristic way: further heating destroys it, sometimes transforming it into another substance. Indeed, it seems that the concoction process is the process of turning a loose heap into a unified and organized whole. Aristotle also brings forward ripening as a process of concoction since we call it ripening when there is a concoction of nutriment in fruit. And since the concoction process is a sort of perfecting process, the process of ripening is perfected when the seeds in the fruit are capable of reproducing the fruit in which they are found. More importantly, his typical demonstrations of the concoction process seem to be those which are produced in living things (*Meteor* IV.3, 380a18–26). Vital heat in the heart, stomach and other places continuously transform food first into blood, and then into part of animals' organs, such as flesh and bone, while the excess blood is further concocted into fat, menstruation, semen, etc. Therefore, under the influence of the concoction process of vital heat, a variety of foods are transformed into different living substances, each with its own unique form and nature. A similar situation occurs during the ripening of fruit, as plants also tap into the vital heat. Thus, it can be seen that the concoction process of 'vital heat' is the process of turning a bunch of loose matter into a unified and organized whole. This concoction process is the generating process of living things, while the concoction process of 'ordinary heat' is incapable of generating living things.

Now it is clear that the vital heat produced by the Sun acts as the efficient cause in the process of the generation of living things. However, vital heat not only provides 'heat' to promote the generation of living things, but also plays an important role in the formative process of living things. Aristotle says that vital heat is not ordinary heat—rather it is formative heat, the embodiment of soul[247] (*GA* II.3, 737a1–7). The vital heat produced by the Sun does affect the living being's generation by operating through semen or any other natural residue that

[247] Because of its formative power, vital heat can be considered as the embodiment of soul. According to the formative process of living beings, we can find how vital heat operates on the formative process of living beings as the embodiment of soul. See also Freudenthal (1995, 116) on vital heat as the embodiment of the soul in Aristotle.

may have within it a principle of life. In living being's formative process, vital heat has the formative power, which operates as the embodiment of the soul, to inform the proper matter to be a living thing.

In order to have a better understanding how vital heat operates itself as the embodiment of soul in the formative process of living beings, it is needed to focus on his discussion of animal's reproduction. The most typical example of vital heat's formative process is the process by which semen acts on menstruation (*GA* IV.3, 767b17–21; 768a21–27)[248]. According to Aristotle, the offspring is endowed with its form from a male parent, through the vital heat it had received during the concoction in the male's body, informing the matter provided by the female (the menstrual fluid). When the generative residue in the menstrual fluid is properly concocted, the movement imparted by the male will make the form of the embryo in the likeness of itself. The condition under which this happens is that the semen carries enough vital heat to fully grasp the relatively cold female matter: the vital heat thus generates in the matter the most perfect form, that of the father. However, assuming that the causal dependence of the form of the offspring rests on the vital heat of the male parent, then the vital heat of the male parent determines the characteristics of offspring, especially the sex of the offspring. Moreover, Aristotle emphasizes that the successive reductions in the male parent's vital heat lead to a series of declines in the quality of the offspring, extending from the most perfect form (similar to the father) to the lowest form (the monster). Therefore, the vital heat appears as a physiological factor in the form of living things, because the more active the heat, the more perfect the form. According to Aristotle, changes in the vital heat carried by a male's semen lead to corresponding changes in the perfection of the resulting form of the offspring. Thus, Aristotle interprets the vital

[248] Although many scholars have discussed this formative process, they do not mention the important role of vital heat in this process. Peck (1953, 111–121) indicates the action by which matter is informed is often referred to by Aristotle as 'setting' process, and says that 'setting' (see *GA* II.4, 73923;729a10f.; IV.4, 771b24f.) is most typically brought about by semen, which acts on menstruation. However, although Peck is aware of the role of semen in the informed process, he ignores the role of vital heat in this process. While Balme (1987, 291–312) does realize the fundamental difference between animals is the difference in their natural heat, he does not realize it is Aristotle's 'vital heat', nor discuss its formative process. In his study of Aristotle's theory of animal reproduction and embryology, Cooper (2009, 174–203) aims at showing that Aristotle did intend his biological theory of forms to be a continuous development and extension of whatever theory of substantial forms he meant to be the upshot of his discussion in the central books of his *Metaphysics*. But Cooper did not pay attention to the formative process of the generation of animals. Furth (1988, 114–118) has also described the biological process of the generation of living things, but he does not mention its formative process.

heat as an informing power, which is also confirmed by his description of 'spontaneous generation', for instance, generation in the absence of semen. The generation of animals in decaying animal matter is attributed to the vital heat produced by the matter through concoction:

> Now all things formed in this way, whether in earth or water, manifestly come into being in connexion with putrefaction and an admixture of rain-water…Animals and plants come into being in earth and in liquid because there is water in earth, and air in water, and in all air is vital heat, so that in a sense all things are full of soul. Therefore, living things form quickly whenever this air and vital heat are enclosed in anything.
>
> *GA* II.11, 762a10–23 (trans. A. L. Peck)

It seems that the vital heat derived from the Sun is sufficient to give form to matter, just as the vital heat carried by semen in spontaneous generation. Also, for spontaneous generation, Aristotle explains that animals and plants come into being on earth and in liquid since there is water in earth, and air in water, and in all air is vital heat, so in a sense, everything is full of soul. Thus, living things form quickly whenever this air and vital heat are enclosed in anything. When they are so enclosed, the corporeal liquid is heated, and there arises as it were a frothy bubble. Whether what is formed is to be more or less honorable in kind depends on the embracing of the vital heat. Aristotle describes this process in two stages. First, the heat of the Sun heats matter (an enclosed quantity of water and earth), thereby endowing it with vital heat; and then, the vital heat in turn leads to the formation of plants and animals. The reason why vital heat is capable of generating living things is that vital heat has the capacity to generate souls. The vital heat also operates in the body of animals, more precisely, vital heat works not only in the semen of animals, but also regardless of any other residue of the animal nature there may be, there is still a vital principle (namely vital heat) in it (*GA* I.3, 737a3–5). Moreover, in the case of spontaneous generation from putrefying matter, for instance, in rennet and fig juice, it is the vital heat inside that allows them to inform suitable matter on which they come to act in the process of concoction of living things. Therefore, vital heat has the formative power, which not only heats, but also informs the proper matter to be a living thing, and

it can be seen that more vital heat produces more perfect forms.[249]

Then I move on to investigate the role of vital heat in determining the scale of living things[250]. Aristotle hypothesizes a general rule that the vital heat determines the scale of living things and supposes that more perfect animals are those which are by their nature hotter and more fluid and not earthy (*GA* II.1, 732a15–733b17). This means that more vital heat brings about greater perfection, greater motive power and therefore greater size and mobility, and more fully developed offspring. And this also means that more vital heat provides greater strength. Considering that the scale of living things depends on the attribute of vital heat as the fundamental underlying factor, we can perceive it as the scale of the soul of living things. Therefore, vital heat is also the basis for determining the scale of living things. In this sense, with respect to vital heat, the scale of living things could be divided as follows. Firstly, in the scale of living things, the lowest is the plant, which has the least 'vital heat'. Plants obtain a certain 'vital heat' from the Sun, but the vital heat obtained by plants is less than that of animals (*PA* II.3, 650a5–15). The second is animals, which are endowed with more vital heat than plants. So, the scale of animals is higher than that of plants. The third is man. Aristotle believes that man is the only upright animal since man is endowed with the greatest quantity of vital heat[251], and has a unique rational thinking ability (*PA* IV.10, 686b10–25). In Aristotle's thought, more vital heat leads to a more upright position, and therefore to diminished earthiness and to purer blood, which in turn leads to keener perception and intelligence, as well as an increase in certain physical capacities, such as movement. In sum, an animal is more perfect when it has a greater proportion of vital heat. In addition, Aristotle supposed that the reason why some creatures have this part (lungs), and why those having it need

[249] Aristotle clearly says that the vital heat comes from the heat which is generated by the Sun, but in his treatises, he does not mention where the vital heat takes this generative form from.

[250] For the relation between vital heat and the scale of living things, see, for instance, Balme (1987b, 10–11), who noticed that Aristotle interpreted vital heat as a key indicator of the difference between higher and lower animals. Ross (1995, 113–116) comments that Aristotle has established the close relationship between the vital heat in living things and the scale of living things, and in fact Aristotle built the concept of the latter on the basis of the former, therefore theoretically tying together a number of otherwise unrelated factors of living things.

[251] See also Balme (1987b, 10–12), who has also discussed the generation of human beings in Aristotle and comes out with the conclusion that humans are generated by humans since humans are endowed with different natural heat from other living beings. For Aristotle's discussion that a human being is produced by a human being and the Sun, see *Phys* II.2, 194b13; *Meta* XII.5 and 1071a15; *GA* IV.10, 777b35.

respiration, is that the higher living things have a greater proportion of vital heat. And that at the same time they must have been endowed with a higher kind of soul, and they are on a higher scale of nature than plants [252]. Therefore, it can be seen that an animal which has more vital heat has a higher soul and is placed higher on the scale of living things, suggesting that the differences of vital heat establish a hierarchy of souls. The same results also come from the analysis of the effects of changes in the vital heat of semen on subsequent offspring. The greatest vital heat also produces the most perfect form, which is a male resembling the male parent, and the successive reduction of the vital heat leads to a decrease in the perfection of the form of the offspring. So, it can be seen that vital heat determines the scale of living things[253].

According to the discussion above, the vital heat produced by the Sun acts as an efficient cause in the generation process of living things, which can be considered as the embodiment of the soul and has the formative power to inform the proper matter to be a living thing, and also determines the scale of living things. Thus, there are continuous efficient causal chains from the celestial world towards the field of biology through the vital heat produced by the Sun.

3.4.2 The Continuous Efficient Causal Chains from Vital Heat to the Body of Living Things

Having examined the role of the vital heat produced by the Sun as an efficient cause to the generation of living things and its formative power in generating living things, now I go on to explore the specific efficient causal chains from the vital heat to the body of living things, especially to the body of animals. As I have discussed above, for Aristotle, vital heat is the embodiment of the soul and has the formative power to inform the proper matter to be a living thing, and also determines the scale of living things. And it is precisely because of the role of vital

[252] See *Resp* 19, 477a13–24.

[253] With greater and purer vital heat, a more perfect and higher form arises. This explanation of the scale of living things supposes that the realm of living things is continuous, since when comparing the scale of living things to the measure of vital heat, a continuous curve appears. In fact, Aristotle repeatedly and clearly assumes that the scale of living things is continuous, from the lowest form to the highest form of living things. See *HA* VIII.1, 588b2–589a15; *PA* II.10, 656a2–10 and IV.5, 681a10–30.

heat inside the living things' bodies that their forms are preserved, in other words, the destruction of vital heat means the destruction of the living thing's form (*Meteor* IV,11, 389b5–15; *PA* II.9, 654b6–18). For example, when blood, semen, or bone marrow lose the vital heat, they also lose their intrinsic properties, as they have only material elements, but lose their form. Therefore, vital heat is of great significance for the existence of life forms. But how does vital heat work within a living thing's body? It depends upon the specific efficient causal chains from vital heat to the living thing's body, typically in an animal's body.

In order to explore these efficient causal chains, it is necessary to examine an important assumption about the heart. Aristotle supposes that the physical part where the form of living things is located is the heart, which is the center of the body and can undertake all the capacities of living things[254]. In this sense, the heart is treated as the most important organ of living things since it is the concrete location of the forms of living things. Moreover, vital heat from the Sun is stored in the heart of the living thing and is continuously transported from the heart to the various parts of the body. However, vital heat is not a substance, and thus it cannot be assumed to move on its own, since 'heat and straightness can be present in every part of a thing, but it is impossible that the thing should be nothing but hot or white or straight; for, if that were so, attributes would have separate existence' (*Long* 3, 465b10–15). And even if it were a substance, it could not have a natural movement to all the parts of the body. It seems that what Aristotle is trying to emphasize here is that whatever the vital heat is, vital heat cannot move itself, nor can it move naturally to all parts of the body. Therefore, according to Aristotle, the movement of vital heat in the living thing's body must rely on some matter, since vital heat cannot naturally move to all parts of the body. In this regard, a question arises: by means of what substances and through what channels does the vital heat in the heart reach all parts of the body to maintain the form and function of living things?

For this question, Aristotle supposes that inside the body, there is only one network of transport: blood vessels. He believes that blood or something similar is transmitted throughout the whole body[255], so that vital heat must be transmitted to all parts of the body through the blood vessels as transport channels. Obviously,

[254] See *Motu* 9, 703a1–5; 10, 703a31–37; *DA* II.8, 420b21–29.

[255] See *PA* II.1, 647b2–10; II.3, 650a30–38; III.5, 668a4–20.

taking into account that blood flows in the blood vessels, the question arises whether the vital heat is transmitted to various parts of the body through the blood in the blood vessels? Aristotle himself, however, makes clear that the blood itself does not have the role of transporting vital heat[256], so vital heat is not transmitted through the blood. Moreover, Aristotle has also mentioned in *Politics* that blood is not essentially hot (*Pol* I.2, 1252b1ff). The vital heat derives its heat from the Sun, so vital heat itself has the property of heat, which further proves that it cannot be the case that vital heat is transmitted through the blood taking into account the fact that blood is not essentially hot. However, since blood vessels are the only network channels leading to the whole body, vital heat needs to reach all parts of the body through blood vessels. Therefore, taking into account that vital heat cannot be transmitted through blood, we are left to wonder how the vital heat is transmitted to various parts of the body?

This question needs to be linked to another important concept in Aristotle's thought: pneuma (πνεῦμα). As discussed above, in living being's formative process, vital heat has the formative power, which operates as the embodiment of the soul, to inform the proper matter to be a living thing. The vital heat does affect the living being's generation by operating through semen or any other natural residue which there may be that has a principle of life within it. Aristotle says that in all cases the semen itself contains a substance owing to which it has the ability to generate; this substance is neither fire nor anything like that, but is encapsulated in semen or a foam-like substance which is considered as the substrate of vital heat (*GA* II.3, 736b13–21). This is also the reason why ordinary heat cannot generate any living thing while vital heat can. This special substance is pneuma.

Pneuma is produced naturally and continuously through the action of vital heat on the blood, and the existence of pneuma is the inevitable consequence of the presence of both liquid and heat. The vital heat is active while the liquid substance is acted upon (*GA* II.6, 742a9–20). Moreover, from the viewpoint of physics, the phenomenon is similar to the formation of vapor through boiling, since 'boiling is due to the volatilization ('pneumatization') of the fluid by heat' (*Resp* 26, 479b26–30). Thus, pneuma serves as the medium through which vital heat is distributed throughout the body. According to Aristotle, pneuma—composed of tiny bubbles of warm air inherently present in the blood—acts as the vehicle for carrying vital

[256] *PA* II.1, 647b2; II.3, 650a35; III.5, 668a4f.

heat to every part of the living organism. Since Aristotle states that all pneuma contains vital heat (*GA* III.11, 762a15–25), pneuma is not merely a passive substance but plays an active role in sustaining the physiological processes of living beings. However, rather than being simply the material substrate of vital heat, pneuma functions as the instrumental carrier through which vital heat is distributed. Moreover, vital heat and pneuma exist in a dynamic interplay: vital heat acts upon the blood, generating pneuma as part of an ongoing physiological process, ensuring that the transmission of vital heat remains continuous throughout the body. This reciprocal relationship allows vital heat to be both dependent on and sustained by pneuma, without reducing pneuma to a mere product of vital heat. Aristotle's biological model thus presents pneuma not as the underlying substrate of vital heat but as its conduit, facilitating its circulation and ensuring the vitality of the organism.

As a result, vital heat exists in the heart and is transported to various parts of the body through the blood vessels. Even though vital heat cannot be transported through the *blood* in the blood vessels, it can through the pneuma. Moreover, vital heat continuously acts upon the blood, ensuring that pneuma remains present and actively engaged in physiological processes. vital heat depends on pneuma for its transmission, while at the same time, it sustains and actualizes pneuma within the living organism. In this way, pneuma ensures the continuous circulation of vital heat, supporting the physiological functions necessary for life. In addition, Aristotle assumes the semen contains the substance of pneuma that which causes it to be fertile (*GA* II.3, 736b30ff). So, it is the pneuma that has the ability to transmit vital heat to all parts of the body, and it is also the pneuma which contains vital heat in the semen, providing the semen with the generative power.

Accordingly, it is clear that there are continuous efficient causal chains from the vital heat produced by the Sun to the living thing's body. Vital heat operates as an efficient cause to the generation and maintenance of living things in the field of Aristotle's biology, since pneuma is considered as a substance which provides a base to the power of vital heat. Thus, the efficient cause can guarantee a unified explanation in this field.

Chapter 4: How the Relation between Final and Efficient Causation Establishes Aristotle's Unified Explanation of the Universe

In Aristotle's philosophy, final causation explains the *why*—the ultimate purpose or goal of phenomena—while efficient causation explains the *how*—the processes or mechanisms by which those goals are realized. Together, these two causes form a complementary system that bridges purpose and process, ensuring the intelligibility and unity of Aristotle's universe. The relationship between final and efficient causation is one of mutual reinforcement rather than competition. Final causation provides the teleological framework that gives direction to natural processes, while efficient causation actualizes these teleological aims through dynamic causal chains. Efficient causation, therefore, operates as the mechanism that realizes the ends posited by final causation. This relation ensures that the cosmos is not merely purposive but also dynamically interconnected.

Although final causation occupies a central role within Aristotle's teleological framework, its explanatory scope can appear constrained in certain contexts. Natural phenomena such as meteorological events or the behavior of inanimate elements often elude clear teleological interpretation. In such instances, final causation may prove insufficient to fully account for the how or even the why of these occurrences. This apparent limitation highlights the need to integrate efficient causation into Aristotle's explanatory framework, thereby addressing these gaps and ensuring the continuity and coherence of his philosophical system.

In this chapter, I aim to examine how the relationship between final and efficient causation establishes Aristotle's unified explanation of the universe. For the sake of clarity, the discussion is divided into four sections. Section 4.1 explores the relation between final and efficient causation in Aristotle's *Meteor* and *PA*. Section 4.2 analyzes the fundamental role of final causation in Aristotle's unified explanation of the cosmos. Section 4.3 investigates how efficient causation complements the teleological framework provided by the final cause. Section 4.4 explores the commensurability and non-competition between final and efficient causation.

4.1. The Relation between Final and Efficient Cause in *Meteorology*, *De Partibus Animalium* and *Physics*

In this section, I focus on discussing *Meteor* I.9, IV.11, and IV.12, along with *PA* I.1 and II.9, to explore the relationship between Aristotle's efficient and final causes because these texts provide a comprehensive framework for understanding how these two causal principles interact across different domains of nature. In *Meteor*, Aristotle examines inanimate phenomena such as meteorological events and the formation of minerals, where efficient causes dominate but are subtly linked to teleological considerations, illustrating the boundaries of teleology in non-biological contexts. Conversely, in *PA*, Aristotle's causal framework is applied explicitly to biological entities, where final causation is central to explaining the purposive structures and processes of living organisms, complemented by efficient causes. By engaging with these texts, I aim to show how efficient and final causes function in different yet interconnected ways to account for both the mechanisms and purposes of natural phenomena, highlighting their complementary roles and the scope of teleology in Aristotle's philosophy.

4.1.1 The Relation between Final and Efficient Cause in *Meteorology*

Aristotle's Meteorology provides a valuable framework for examining the relationship between efficient and final causes, particularly in the context of natural processes such as meteorological phenomena (e.g., rainfall) and the formation of minerals. While efficient causes dominate the explanations in these discussions, Aristotle's teleological framework remains present, albeit in a more implicit and nuanced form. The passages in *Meteor* I.9, IV.11, and IV.12 reveal the relation between these two causal principles, while also illustrating the boundaries of teleology when applied to inanimate phenomena.

In *Meteor* I.9, Aristotle examines processes such as rain, evaporation, and wind, emphasizing the role of efficient causation in generating these phenomena. He explains that the sun's heat causes water to evaporate, which, upon cooling, condenses into clouds and ultimately falls as rain (*Meteor* I.9, 346b23–347a7). Heat and cold, as fundamental qualities of sublunary elements, are intrinsic to their material composition (and thus relate to material causation), yet they also act as efficient causes in meteorological processes by driving evaporation and condensation. However, Aristotle does not view these processes as mere mechanistic occurrences. He situates them within a broader teleological framework, asserting that rainfall occurs "for the sake of" sustaining life by nourishing plants and animals. Here, final causation complements efficient causation by providing a purposive explanation that aligns these processes with the overarching good of the cosmos. Nevertheless, Aristotle acknowledges the difficulty of consistently applying teleological explanations to meteorological phenomena, particularly when such events—like excessive rainfall or drought—seem to disrupt rather than sustain life. This tension underscores the limits of teleology in inanimate domains.

The focus shifts in *Meteor* IV.11 to the formation of metals and minerals, where efficient causation takes center stage. Aristotle describes how interactions between hot, cold, and the inherent properties of earth and water drive these transformations (*Meteor* IV.11, 390a10–391a5). For instance, the hardening of metals results from the drying and cooling effects of heat, while other combinations of elements yield different substances. Efficient causes thus provide the primary explanatory framework for these processes. Yet, Aristotle's teleological perspective subtly persists. The properties of metals, such as their durability and malleability, serve specific functions within nature or human activity, suggesting that their existence contributes to the stability and utility of the cosmos. These purposes reflect an underlying teleological order, even if it is less explicitly articulated compared to biological contexts.

In *Meteor* IV.12, Aristotle delves further into the properties and formation of metals and minerals, offering a more detailed account of the interaction between efficient, formal, and final causation. Efficient causation governs the immediate processes of solidification and transformation, such as the effects of heat and moisture on the composition of earth and water (*Meteor* IV.12, 391a5–392a12). For example, the production of iron or other metals depends on the action of

external forces like heat, which activate the matter's inherent potentialities. However, Aristotle also considers formal and final causes in explaining the broader role of these substances. The structural properties of metals, such as strength and durability, arise from their formal cause, which determines their essential nature. These formal properties, in turn, render metals suitable for applications in construction, cutting, and stabilization. Yet Aristotle does not treat metals merely as physical byproducts of natural processes; rather, their existence aligns with the broader purposive order of nature. In this sense, their final cause is not simply their structural suitability but their contribution to the functionality and order of the natural world. Thus, final causation situates these efficient and formal causal processes — operative on matter — within a teleological framework, linking them to the good and structure of the cosmos.

Across these discussions, Aristotle demonstrates a complementary relationship between efficient, formal, and final causes, yet their relative explanatory roles differ depending on the domain of inquiry. Efficient causes explain the immediate mechanisms behind natural phenomena, detailing how processes like evaporation, condensation, and solidification occur. Formal causes contribute by determining the essential nature of substances involved in these formative processes. In biology, final causes provide direct explanations for structures and functions, clarifying their role in the survival and reproduction of living beings. However, in non-living domains such as meteorology and mineralogy, the explanatory role of final causation becomes more abstract and indirect. Aristotle suggests that even these processes are not arbitrary but occur within an ordered cosmos, where natural phenomena exhibit regularity and interconnectedness. Nevertheless, rather than attributing each individual occurrence to a teleological purpose, Aristotle often explains their non-arbitrariness and continuity through chains of efficient causation. As my discussion of *Meteor* IV.12 suggests, by tracing causal connections among seemingly disparate events, one can illustrate how different elements of nature are integrated into a structured whole. This approach allows Aristotle to preserve the intelligibility of the cosmos without necessarily assigning a direct final cause to every phenomenon. A parallel can be drawn with Aristotle's approach in biology. In cases where certain traits or behaviors seem anomalous—such as the large antlers of deer or the brief lifespan of the dayfly—explanation in terms of material, formal, and efficient causes may do. A similar strategy may apply in meteorology

and mineralogy: while final causes may frame the overall order of the cosmos, the intelligibility of specific natural events often relies more heavily on their material and efficient causes. This suggests that, in Aristotle's natural philosophy, purpose (telos) is best understood not as a property of individual inanimate phenomena but as a structural principle that emerges from the causal interconnections governing the cosmos as a whole.

However, these passages also highlight the boundaries of Aristotle's teleological framework. In many cases, efficient causation provides a sufficient explanation for natural processes, leaving final causation more implicit or secondary. For example, while the physical mechanisms of rain formation or metal solidification can be fully explained by the operation of efficient causes, their alignment with a purposive order is less immediately apparent. This limitation becomes especially evident in cases where natural phenomena seem to lack clear alignment with the good, such as destructive weather events or irregularities in mineral formation. Such examples reveal the challenges of extending Aristotle's teleology beyond living organisms to encompass the inanimate realm.

In *Meteor* I.9, IV.11, and IV.12, Aristotle offers a nuanced interconnection of efficient and final causes, balancing mechanistic explanations with a broader teleological vision. While efficient causation dominates the discussion of inanimate processes, final causation ensures that processes in this domain are not divorced from the purposive order of the cosmos. By examining these key passages, Aristotle's causal framework emerges as both adaptable and constrained, reflecting its strengths in unifying natural phenomena while acknowledging the complexities and limits of teleology in explaining the nonliving world.

4.1.2 The Relation between Final and Efficient Cause in *De Partibus Animalium* and *Physics*

Aristotle's account of causality, particularly the relation between efficient and final causes, forms the foundation of his biological investigations in *PA*. In *PA* I.1 and *Phys* II.9, Aristotle demonstrates how these causal principles complement one another in accounting for the processes and purposes inherent in natural entities. While efficient causes explain the mechanisms by which natural phenomena occur, final causes provide the teleological context that makes these mechanisms

intelligible. The question of their compatibility, however, has been the subject of significant scholarly discussion. As Hankinson argues, the challenge lies in reconciling teleological explanations with the material and mechanistic necessities that underlie natural processes.[257] This issue requires careful examination of how Aristotle integrates these causes without reducing one to the other or rendering them incompatible.

In *PA* I.1, Aristotle establishes the methodological principles that guide his study of living beings, insisting that "In the case of all natural objects, we must inquire not only into their material and efficient causes but also their formal and final causes" (*PA* I.1, 639b11-13). This methodological claim reflects Aristotle's fundamental departure from the pre-Socratic natural philosophers, who focused primarily on material and efficient explanations. By contrast, Aristotle argues that the study of living beings necessarily requires attention to their form (what a thing is) and their final cause (what it is for), because biological phenomena exhibit purposiveness and functional organization that cannot be reduced to material composition or mechanical motion alone. This assertion underscores Aristotle's conviction that biological phenomena cannot be adequately explained by material and mechanistic processes alone; their inherent purposiveness must also be accounted for. And then, Aristotle further refines this principle, emphasizing the centrality of teleological explanations to the study of nature. He states, "to know what a thing is, we must know its purpose" (*PA* I.1, 639b18-19). For Aristotle, the anatomy and behavior of animals are not merely the result of physical processes but reflect functional roles within the organism. For example, teeth are hardened through developmental processes—an efficient cause—but their sharpness and form exist to serve the purpose of cutting and grinding food, which is their final cause. Aristotle elaborates that "what is primary in formula and substance is last in the order of generation" (*PA* II.1, 646a24–30), indicating that material and efficient causes operate as means toward the realization of final causes. However, this realization is not independent of formal causes, which provide the structural and essential blueprint that guides the developmental process. In Aristotle's biological framework, form and function are deeply interwoven: the formal cause defines the essence of an organism's structures, while the final cause explains their purposive organization. This interdependence underscores Aristotle's

[257] Hankinson (1998, 141-143).

methodological commitment to understanding biological entities as teleologically and structurally integrated systems.

The relation between efficient and final causes becomes even more explicit in *PA* I.1, where Aristotle examines the relationship between necessity and purpose in natural processes. He famously declares, "Nature does nothing in vain, but always what is best in view of the possibilities allowed by the essence of each kind of animal." (*PA* I.5, 645a24–27), emphasizing that every part of an organism exists for a specific function. Aristotle criticizes accounts that rely solely on material or efficient causes, arguing that they fail to explain the purposive organization observed in living beings. He writes, "Why are teeth hard and sharp? For the sake of cutting food. Their final cause is what they are 'for the sake of,' but they grow and harden due to the processes of development" (*PA* II.1, 647a25–27). Here Aristotle introduces the general principle that anatomical features in animals exist not by chance, but for a specific purpose, exemplifying his theory of final causality. While this passage articulates the teleological framework in broad terms, the specific functional differentiation of teeth is elaborated later in *PA* III.1 (661b8ff.), where Aristotle explains that incisors are sharp for cutting, whereas molars are broad and flat for grinding. Taken together, these passages encapsulate Aristotle's dual causal explanation: the processes of development account for how teeth come into being (efficient cause), while their differentiated forms and functions are intelligible only in relation to the organism's nutritive needs (final cause).

A pivotal concept in *Phys* II.9 is Aristotle's treatment of necessity, particularly through the notion of "hypothetical necessity." Aristotle explains that while certain material conditions are required for an end to be achieved, these conditions are subordinate to the final cause. For example, "It is necessary that [a saw] be made of iron if it is to perform its function; this necessity is hypothetical, and not as an end is" (*Phys* II.9, 199b33–200a15). Similarly, in biological systems, developmental processes operate under material and efficient necessity but are ultimately directed toward the realization of specific functions. The sharpness of teeth, for instance, is a necessary condition for their ability to cut food, yet this necessity is intelligible only within the teleological framework of their purpose.

Aristotle's methodological commitment in *PA* I.1 and his application of teleology in *Phys* II.9 reveal his overarching view of nature as a purposive and intrinsically organized system. In *PA* I.1, he articulates this idea further by

insisting that biological study must prioritize understanding the purposes of parts and functions. He writes, "We must first grasp the what and the for the sake of which of each part before examining its material and efficient causes" (*PA* I.1, 639b14–18). This passage underscores the importance Aristotle places on first understanding the definition and purpose of a part before delving into its material and efficient causes. This methodological directive aligns with his view that form and purpose—final causes—serve as the organizing principles behind natural phenomena. Without acknowledging these, the study of nature would remain superficial, unable to account for why biological structures are the way they are.

Hankinson underscores the compatibility between efficient and final causes in Aristotle's thought, emphasizing that Aristotle's teleological explanations avoid reductionism by treating final causes as immanent in nature.[258]Aristotle's assertion that "All things which come to be by nature do so either invariably or for the most part" (*Phys* II.8, 198b34–35) reflects his belief that natural regularities demand explanations that account for their directedness toward specific ends. Final causes, as Hankinson notes, do not compete with material and efficient causes but rather incorporate them into a comprehensive explanatory framework.

This relation between efficient and final causes is exemplified in Aristotle's account of biological development and function. Teeth develop through processes that can be described in terms of material and efficient causation, yet their sharpness and hardness exist to fulfill their purpose in cutting food. Without recognizing this purposive dimension, any explanation of their development remains incomplete. Aristotle's framework thus integrates mechanistic and teleological principles, affirming that efficient causes, while indispensable, operate in service of the final causes that provide the ultimate reason for the existence of biological structures.

Moreover, Aristotle's teleological perspective extends beyond individual parts to encompass the organization of entire organisms. He views living beings as integrated wholes, where each part contributes to the organism's survival and flourishing. This holistic view is evident in his claim that "the order of generation is the opposite of the order of being" (*PA* I.1, 640a10–12), meaning that while material and efficient causes precede the realization of form in time, it is the final cause that ultimately determines the organization of these processes. Hankinson

[258] Hankinson (1998, 141-143).

highlights that this inversion of priority reflects Aristotle's non-reductive approach: material interactions are necessary, but their coherence and regularity derive from their purposive orientation toward specific ends.

Ultimately, Aristotle's biological methodology in *PA* I.1 and *Phys* II.8–9 reflects his holistic approach to causation. Final causes, as Hankinson elucidates, are not external impositions but intrinsic to the nature of living beings. By uniting efficient and final causes, Aristotle offers a robust explanatory model that continues to inform contemporary discussions of teleology and causation in both philosophy and biology. Aristotle's insights into the purposive organization of living systems underscore the enduring relevance of his approach, offering a nuanced framework for understanding the interplay between mechanisms and purposes in natural phenomena.

4.2. The Fundamental Role of Final Causation in Aristotle's Unified Explanation of the Universe

Having investigated the relation between final and efficient causation in Aristotle's *Meteor* and *PA*, I divide my investigation of this section into two parts. First, I will examine the fundamental role of Aristotle's final cause with respect to the fact that the final cause is always taken as primary within Aristotle's unified explanation of the universe. Secondly, I will examine the fundamental role of Aristotle's final cause with respect to the fact that the continuous efficient causal chains are directed toward the final cause.

4.2.1 Final Causal Explanation is Always Taken as Primary

By this point, I turn to examine the priority of causes concerning Aristotle's explanation of the natural world[259]. I will first investigate the priority of the final cause over the efficient cause in Aristotle, and then prove why final causal

[259] Some scholars have discussed the priority of final cause over efficient cause in the field of Aristotle's biology, for instance, see Code (1997) and Johnson (2005, 180–182).

explanation is always taken to be the primary.

The evidence of the priority of the final cause over the efficient cause is clarified by Aristotle in his biology:

> For there is a difference between the end or final cause and that which exists for the sake of it; the latter is prior in order of development, the former is prior in essence. Again, that which exists for the sake of the end admits of division into two classes, first the origin of the movement, and then that which is used by the end; I mean, for instance, that which can generate, and that which serves as an instrument to what is generated, for the one of these, that which makes, must exist first.
>
> *GA* II.6, 742a19–25 (trans. A. L. Peck)

In this passage, Aristotle makes a distinction between the final cause and efficient cause, and supposes that the final cause is prior to the efficient cause in essence since the final cause is prior and must exist first. In the process of generation, the aim or the purpose must first exist, and therefore the efficient causal chain in this process is capable of being directed toward the final cause. In the generation of living things[260], the male parent and the male parent's seed should be treated as the efficient cause in the generation of living things. Thus, the actual efficient cause in the process is the male parent, and the male parent's seed is an efficient cause in the sense that male parent utilizes the seed to produce future generations because the 'potential form' is inside the seed. But the whole generation procedure of living things is for the sake of a final end, which is the living things' nature. All the processes of generation are for the sake of a final end, and the living thing's form is the end of this process. Indeed, the final cause has priority over the efficient cause since the final end determines the aim of the generation process of living things. Thus, the final cause is presented as the starting point of Aristotle's biological examination. In addition, Aristotle also argues that the final cause must be established before the efficient cause by saying that "the manner of a thing's existence should be stated before its genesis" (*PA* I.1, 640b1–4).

However, although Aristotle did not specify this priority in other parts of his work, there are many demonstrations in his other treatises where the priority of

[260] See e.g., *GA* I.2, 716a4–7; I.20, 729a9–11, 28–31; b9–18.

the final cause over the efficient cause is implied. As discussed above, in the process of generation, Aristotle implies that the final cause is prior to the efficient cause in essence since the final cause is prior in essence and must exist first (*GA* II.6, 742a19–25). Moreover, another typical example is in Aristotle's treatise *Meta*, where he invokes the example of the production of artwork to explain his viewpoint that the final cause is prior to the efficient cause[261], since in every production process of artwork, the artist must first think about the design of the production which determines the final outcome of this procedure. Focusing on the goal, the artist then works to achieve his goal. In this process, the design of the final achievement could be treated as the final cause, for the work of the artist is to finish the final production; while the skills of the artist are the efficient cause, for artists are only able to finish the work through their skills. Hence, it is clear that in this demonstration, the final cause is prior to the efficient cause. Furthermore, when we look to *Nicomachean Ethics*[262], there are many illustrations to prove such a principle in Aristotle's discussion about human's deliberation about what contributes to the end. For instance, in the process of doctor's treatment of patients, the purpose of the doctor is to heal the patient; in the speech activity of an orator, the orator's aim is to convince others; as well as concerning the work of a statesman, the stateman's aim is to produce law and order. In respect to such cases, the end has been set first and concerning the end, people deliberate how and by what means it is to be attained. Aristotle then posits that "what is last in the order of analysis seems to be first in the order of becoming" (*NE* III.3, 1112b22). Truly, the final cause always takes priority over the efficient cause because the function of efficient cause involves a goal-directed process.

By this point, it can be seen that the final cause is prior to the efficient cause within Aristotle's explanations since the final cause must be established before the efficient cause can be specified. Furthermore, Aristotle takes the final cause as prior (*PA* I.1, 641b10-24). He supposes that everything which is produced in the universe exists for the sake of something. For just like art is present in the products of art, so in the things themselves there is evidently an analogous cause or principle derived like hotness and coldness from the environing universe. Moreover, Aristotle considers the celestial realm to be generated and maintained by the final cause, and therefore it also can be understood that the living things

[261] See *Meta* VII.7, 1032a11–b29.

[262] See *NE* III.3.

are generated and sustained by the role of the final cause, since order and definiteness are much more plainly manifest in the celestial bodies than in the framework of living things, while change is characteristic of the perishable things of sublunary world. Again, whenever a movement clearly achieves an end without interference, we can recognize that this end functions within a broader teleological structure. In Aristotle's framework, purposes in nature are often nested: a particular function, such as the growth of a plant, serves a larger biological or ecological role. However, this does not immediately entail that all natural purposes must converge into a single, ultimate purpose for the entire cosmos. Instead, Aristotle considers final causes as hierarchically ordered, where each level of organization in nature operates for the sake of something beyond itself. This hierarchy suggests that the natural world as a whole is not random but structured, though the exact nature of its ultimate purpose remains a matter of interpretation. Hence, it seems that whatever is produced in the universe is produced for the sake of a final end since the final cause is always taken as prior in Aristotle.

Accordingly, it can be seen that final causal explanation is taken as the most primary since the final cause is considered as the fundamental basis of the whole universe.

4.2.2 The Continuous Efficient Causal Chains are Directed toward the Final Cause

In order to prove that efficient causal chains are directed toward the final cause, I divide my examination into two parts. First, I will explore the role of the Unmoved Mover which can be not only viewed as a final cause, but also operates as the starting point of all the efficient causal chains in the universe. Secondly, I will examine the specific role of the soul in the field of Aristotle's biology, which performs not only as a final cause, but also as an efficient cause of living things, especially in their generation process.

The first evidence that continuous efficient causal chains are directed towards the final cause is the existence of the first mover. As discussed above, the unmoved first mover performs the function of final cause to unify the universe in *Meta*

XII[263], while in *Phys* VIII[264], it operates the first mover as the primary efficient cause of all the motions in the universe, and therefore the first mover is the starting point of all the continuous efficient causal chains in the universe. In this sense, the continuous efficient causal chains are directed toward a final cause, which is the unmoved first mover in the universe[265]. Moreover, although the first mover is identified as a final cause in *Meta*, there are also some clues in *Meta* which show the coincidence of the final cause and efficient cause with respect to the first mover. For instance, *Meta* XII.6 shows the existence of a primary Unmoved Mover which is the ultimate cause of all the motions in the universe. Aristotle also suggests that final cause and efficient cause coincide by indicating that the first mover can be understood as both kinds of causes[266] (*Meta* XII.10, 1075b8–10). Thus, with respect to the role ascribed to the unmoved first mover, we may conclude that all the continuous efficient causal chains are directed toward the final cause.

Another item of evidence of the continuous efficient causal chains which are directed toward the final cause can be found with respect to the role of the soul in the field of biology. According to Aristotle, on the one hand, the soul is the final cause of living things since nature always does whatever it does for the sake of something which is its end (*DA* II.4, 415b15–20). To that something corresponds in the case of animals the soul and in this it follows the order of nature, and that all natural bodies are organs of the soul. This is true of those that enter into the constitution of plants, and of those which enter into that of animals. This shows that that for the sake of which they are is soul. That for the sake of which has two senses: the end to achieve, and that for the benefit of which. On the other hand, the soul is also the efficient cause of living things as the original source of

[263] For detailed discussions, see chapter 2.2.1.

[264] For detailed discussions, see chapter 3.2.1.

[265] Many scholars hold the view of the coincidence of final cause and efficient cause with respect to the first mover. For instance, the viewpoint that the tendency towards 'first mover' can be found on all levels of the cosmos in Aristotle is asserted by Furley (2002, 69–70) in his discussion about the activities of first mover, where he argues that all causes in the universe originate in the Unmoved Mover. As David (2000, 175) points out in his commentaries on *Meta* XII.10, all things are related by a single chain of pure efficient cause, transmitted downwards from the prime mover, the sublunary things being also related to this chain directly though the Sun's daily and annual orbits. Furthermore, in Michel's (2000, 152–153) interpretation of *Meta* XII. 4, he considers the first mover as the first efficient cause in the universe and emphasizes the first mover is the unique starting-point of all efficient causal series. Johnson (2005, 253–254) also agrees that Aristotle frequently talks about combination of causes, and it is reasonable to allow that the first mover be considered 'both an efficient and a final cause'.

[266] See Ross (1997, 258).

locomotion (*DA* II.4, 415b22–24). Aristotle notes that this capacity, however, does not belong to all living things. But change of quantity and change of quality are also due to the soul. Perception is held to be a qualitative alteration, and nothing except what has soul in it is capable of perception. The same holds for growth and decay; nothing grows or decays naturally except what feeds itself, and nothing feeds itself except what has a share of life in it. More specially, in the generation process of living things, the soul acts not only as a final cause, but also as an efficient cause. Soul is a final cause in the process of coming into being for all living bodies, which is clearly demonstrated by Aristotle[267]. Moreover, Aristotle puts forth the idea that there are different kinds of soul in different levels of living things, where higher living things possess more complex capacities and faculties. As for plants, their capacities are merely nutrition and reproduction, hence the end of plants consists in growth and reproduction in respect of the function of the soul they have. For the animals, they not only have the function of nutrition and reproduction, but also have higher functions of appetite, perception and locomotion, so the end of the life of animals is perception and movement. Human beings possess all the functions of animals and plants, plus the capacity of deliberation, which is their end or purpose. Thus, Aristotle presents his conception of soul as a final cause of living things.

Moreover, although Aristotle did not point out explicitly that soul is the efficient cause in the generation process of living things, the living things' soul operates as the efficient cause of their generation, taking into account that he considers the vital heat as the embodiment of the soul[268]. Therefore, the role of the soul as an efficient cause in the generation and development of living things is considered to determinate their forms. More specifically, each living thing is endowed with a nature which is causally responsible for its development, and in the stage of a living thing's development, which is from embryo, infant, child,

[267] For detailed discussions, see chapter 2.5.1.

[268] According to Aristotle, the offspring is endowed with its form from a male parent, through the vital heat it had received during the concoction in the male's body, informing the matter provided by the female (the menstruation). The male semen informs a similar situation of female substance: the offspring are males who are very similar to the male parent. Therefore, the condition under which this happens is that the semen carries enough vital heat to fully grasp the relatively cold female matter: the greatest vital heat thus generates in the matter the most perfect form, that of the father. And since the vital heat functions as the embodiment of the soul, the soul is the efficient cause in the generation in living things. For detailed discussion, see chapter 3.5. See also Code (1999) on soul as an efficient cause in Aristotle's embryology.

adult, and so on, soul enables matter to constitute their nature; otherwise, the living things could not live and develop. As we have seen, the most typical example of role of the soul as an efficient cause is in vital heat's role in the formative process by which semen acts on menstruation (*GA* IV.3, 767b17–21; 768a21–27). According to Aristotle, the offspring is endowed with its form from a male parent, through the vital heat it received during the concoction in the male's body, informing the matter provided by the female (the menstrual fluid). The male semen informs a similar situation of female substance: the offspring are males who are very similar to the male parent. The condition under which this happens is that the semen carries enough vital heat to fully grasp the relatively cold female matter: the greatest vital heat thus generates in the matter the most perfect form, that of the father. Therefore, the vital heat, which is considered as the embodiment of the soul, performs as an efficient cause in the formative process of living things. Moreover, Aristotle clearly supposes the coincidence of final cause and efficient cause with respect to the soul in the generation of animals[269]. The soul is considered to be the efficient cause in the procedure of the generation of animals because it is the whole soul or some part of it that constitutes the nature of a living thing. And the soul is also the final cause because it is the presence of the soul that enables matter to organize a living thing and makes living things become alive. Hence, the soul is an efficient cause in the process of generation and development of living things, in order to make a living thing as it is. Furthermore, the soul is a final cause in the production process of living things, for the nature of living things is determined by the soul. In this sense, it can be concluded that the continuous efficient causal chains are directed toward the final cause with respect to the soul. And it is also clear that the first mover and the soul can be seen both as final cause and efficient cause.

Accordingly, the unmoved first mover unifies the universe as a final cause, and also constitutes the starting point of all the continuous efficient causal chains in the universe; while the soul operates as the efficient cause in the generation of living things, and also performs the function of final cause in this process, since the soul determines the nature of living things.

[269] See *PA* I.1, 641a25–31. See also Johnson (2005, 254–255), who indicates that Aristotle combines the efficient cause and final cause in his argument of the soul, and this combination of causes is interesting for the causes are different but with respect to the soul they are combined.

4.3 The Role of Efficient Causation in Complementing the Teleological Framework of the Final Cause

While final causation is central to Aristotle's teleological framework, its explanatory power is limited to the why of the nature of the universe and natural phenomena. This limitation makes clear the importance of efficient causation within Aristotle's explanatory framework to realize the coherence of his system.

The relationship between efficient and final causation is best understood as one of distinction and complementarity. Final causation provides the overarching purpose that unifies the cosmos, through which all entities and processes are directed toward the good. It ensures that the natural world operates with a sense of order and purpose, offering a teleological rationale for its existence. Efficient causation, on the other hand, supplies the dynamic mechanisms necessary to actualize the purposes outlined by final causation. Efficient explanation shows how motion and change propagate across time and space, thereby ensuring that the cosmos functions as a coherent and interconnected whole.

Efficient causation achieves this coherence by establishing continuous causal chains that link all entities and phenomena across the cosmos. These chains, originating from the first mover, extend through both the inanimate and animate realms, creating a network of interconnections that underpins the universe's coherence. Thus, efficient causation is not merely a supplementary mechanism but a vital explanatory principle that complements the teleological orientation of final causation.[270]

Aristotle's cosmological framework exemplifies this interconnection. The first

[270] Byrne (2018, 98–100) comments that an efficient cause must be adequate to produce the beneficial effect by means of its own causal powers before it can be understood to be directed to that end, for every efficient cause can be made to produce a good result in the right context. Although I agree with his view that the efficient cause is sufficient to produce these effects by its own power, I tend to disagree with his view that every efficient cause can be made to produce a good result in the right context. Aristotle uses the term 'beneficial' to explain final, not efficient cause. In my interpretation, Aristotle utilizes the efficient cause to explain chains of interaction in terms of physical coherence, which is different from the function of his final cause.

mover, as the ultimate final cause, serves as the object of desire that motivates all motion in the universe. It does so without itself being moved, thereby establishing the overarching teleological order of the cosmos. Simultaneously, as first mover it functions as the origin of efficient causal chains that sustain the continuity of motion. It causes the movement of the outermost celestial sphere, which transmits motion to adjacent heavenly bodies. These cascading interactions create a network of efficient causal chains that connect the celestial and sublunary worlds, ensuring the physical coherence of the cosmos.

In the sublunary realm, efficient causation governs the motion of the four terrestrial elements—earth, water, air, and fire. This motion ultimately derives from vital heat, which is generated by the Sun. According to Aristotle, the Sun itself is composed of aether, the fifth element, and is eternally moved by the First Unmoved Mover. As the primary celestial body influencing the sublunary world, the Sun's motion initiates the natural transformations and cyclical processes governing terrestrial phenomena. These elements interact to form cohesive causal chains that bridge the celestial and terrestrial realms, maintaining the interdependence of the cosmos. Meteorological phenomena, such as evaporation, condensation, and precipitation, also depend on the motion of the Sun and other heavenly bodies. These motions drive weather patterns in the sublunary world, creating efficient causal chains that connect celestial and terrestrial activities. By elucidating these processes, efficient causation ensures the coherence of the inanimate world within Aristotle's teleological framework.

The animate world further illustrates the complementarity of efficient and final causation. Aristotle attributes the generation and sustenance of life to the efficient causation of vital heat, which is produced by the Sun and serves as the formative principle of living beings. In animals, vital heat is distributed throughout the body via blood vessels, with pneuma acting as the medium that transports and sustains it. Pneuma, a substance generated through the interaction of vital heat and blood, carries vital heat to all parts of the body, ensuring the organism's functioning and coherence (*GA* II.6, 742a9–20). In reproduction, pneuma in semen transmits the generative power necessary for fertility (*GA* II.3, 736b30ff). These processes demonstrate how continuous efficient causal chains link biological phenomena to the broader causal framework of the cosmos.

Efficient causation ensures the continuity and coherence of the universe by linking disparate phenomena through continuous causal chains. These chains

sustain motion and change while integrating the physical and biological realms into a unified system. By addressing the mechanisms through which processes unfold, efficient causation serves the teleological framework of final causation in providing a comprehensive account of Aristotle's cosmos.

Final causation directs natural processes toward their ultimate purpose or good. Efficient causation, however, ensures that these purposes are realized by instigating the dynamic processes that connect and sustain the universe across time and space. This relation between final and efficient causation underscores the unity of Aristotle's explanatory framework. While final causation provides the teleological rationale for the universe's order, efficient causation ensures its dynamic continuity by linking disparate phenomena through continuous causal chains, also in those cases where teleological causation is less apparent or seems to be lacking. These chains integrate the celestial and sublunary realms, as well as the inanimate and animate worlds, into a cohesive system. By addressing both purpose and process, Aristotle's philosophy avoids reductionism, offering a holistic account of the natural world.

By establishing continuous causal chains, efficient causation bridges the inanimate and animate realms, realizing the unity and order of Aristotle's cosmos. By integrating efficient causation into the teleological framework of final causation, Aristotle achieves a comprehensive understanding of the natural world, balancing purpose and process in a harmonious whole.

In conclusion, the relation between final and efficient causation is foundational to Aristotle's unified explanation of the universe. Final causation draws natural processes toward their ultimate purposes, while efficient causation actualizes these purposes through dynamic mechanisms. Together, they form a complementary system that ensures the continuity and coherence of the cosmos, integrating the celestial and terrestrial, the inanimate and animate, into a unified whole. By demonstrating the interplay between purpose and process, Aristotle's philosophy provides a comprehensive framework that balances teleological aims with the physical realities of motion and change, establishing the unity and intelligibility of his universe.

4.4 The Commensurability and Non-competition between Final and Efficient Causation

Because efficient and final causation operate at distinct explanatory levels—one addressing the mechanics of change and the other addressing its purpose—they do not compete but rather complement each other. Efficient causation provides the means by which ends are achieved, while final causation offers the rationale that underlies those means. Together, they ensure the intelligibility of the phenomena they explain.

The commensurability of efficient and final causation lies in their mutual reinforcement. Final causes orient efficient causes, ensuring that their activity is directed toward specific ends. Conversely, efficient causes actualize these ends, serving as the mechanisms through which final causes are realized. For example, the heart's efficient activity of circulating blood makes sense only in light of its final cause, which is the sustenance of life. Neither form of causation can function independently: efficient causation is purposive because of its being oriented toward the final cause, while the final cause is actualized through efficient causation.

In Aristotle's cosmology, this interconnectedness becomes especially clear. The Unmoved Mover, as the ultimate final cause, provides the purpose for all motion in the universe. At the same time, efficient causes—such as the movements of celestial spheres—sustain the continuity of motion by actualizing the principles set forth by the final cause. This relationship demonstrates how efficient causation, while mechanistic in its operation, is fundamentally aligned with the teleological structure of the cosmos. Far from competing with final causation, efficient causation ensures the continuity and coherence of the universe by fulfilling its teleological aims.

Although efficient and final causation are always integrated, their explanatory emphasis shifts depending on the context. In phenomena where the teleological orientation is evident—such as biological processes—the final cause provides the overarching framework, while efficient causation operates as the mechanism that realizes the purpose. For instance, the process of blood circulation can be

explained by the heart's efficient activity, but this activity is only fully intelligible when understood as directed toward the final goal of sustaining life.

Conversely, in fields like meteorology or the motion of inanimate elements, efficient causation often plays a more prominent role. Processes such as rainfall, evaporation, or the movement of fire and earth can be explained mechanistically through efficient causes, even when their final causes are less apparent. However, this does not mean that efficient causation operates independently of final causation: it rather actualizes the teleological framework by ensuring the continuity of natural processes, even in cases where the overarching purpose is difficult to discern. This adaptability highlights the commensurability of these causes, as efficient causation reinforces the broader teleological framework without replacing or undermining it.

Efficient causation is indispensable for maintaining the continuity and coherence of Aristotle's universe. It provides the means by which motion and change occur, ensuring the actualization of potentialities across time and space. However, its role is always embedded within the purposive structure established by final causation. Final causation supplies the telos or purpose that directs natural processes, while efficient causation actualizes these purposes through specific mechanisms that may be operative also where teleological causation is less apparent or seems to be lacking. Together, they form a unified explanatory system that preserves the intelligibility and order of the cosmos.

This interconnection is critical to the central theme of this thesis, which explores the role of efficient causation in Aristotle's philosophy. While efficient causation is often associated with mechanistic explanations, it cannot be fully understood without acknowledging its alignment with final causation. By operating within a teleological framework, efficient causation not only explains the mechanics of change but also ensures the coherence of Aristotle's universe. The commensurability of efficient and final causation demonstrates that Aristotle's causal system is not fragmented or competitive but a holistic approach to understanding the natural world's continuity and purposiveness.

Therefore, for the grounding of unity, unity in Aristotle's cosmos arises from the harmonious relation between efficient and final causation: efficient causal chains connect disparate phenomena across space and time, ensuring the coherence of the cosmos as a unified whole (spatial and temporal continuity); while final causation ensures that all processes and entities are directed toward the

good, grounding the cosmos's purpose and intelligibility (teleological integrity). Efficient causation thus guarantees the dynamic coherence of the cosmos, while final causation provides its teleological coherence. Together, they uphold the cosmos as both a continuous and purposeful reality. And the relation between efficient and final causation in Aristotle's philosophy demonstrates their commensurability and distinct contributions to explaining the unity of the cosmos. Final causation provides the teleological grounding, while efficient causation ensures dynamic continuity, also in cases where teleological explanations may appear insufficient. This relation avoids explanatory competition, instead forming an integrated framework that explains the cosmos as a unified, continuous, and intelligible whole.

Conclusion

Aristotle's philosophy provides a deeply interconnected causal framework that seeks to explain the cosmos as a coherent, unified system. This thesis has examined the roles of efficient and final causation within this framework, demonstrating their interdependence and their complementary contributions to Aristotle's understanding of the natural world. By investigating the interaction of these causal principles across diverse domains—cosmology, meteorology, the motions of elements, and biology—this study has sought to address a fundamental question: How does Aristotle reconcile the teleological primacy of the final cause with the operational significance of efficient causation to achieve a unified explanation of the cosmos? This study demonstrates that the operation of efficient causation is indispensable in guaranteeing the spatial and temporal continuity of the cosmos. This continuity ensures that the universe remains an integrated and unified whole, preserving its intelligibility and coherence within Aristotle's broader metaphysical and natural framework.

The primacy of the final cause as the ultimate explanatory principle in Aristotle's teleological framework is indisputable. The final cause, epitomized by the Unmoved Mover, serves as the ultimate end or purpose that governs the order and coherence of the universe. This notion of teleology underscores the inherent goodness and purposiveness of natural phenomena, reflecting Aristotle's belief that all aspects of the cosmos are directed toward the realization of the good. However, as this thesis has argued, the explanatory scope of final causation is not without limitations. Certain phenomena, particularly those in meteorology and the behavior of inanimate elements, resist direct alignment with the teleological framework, raising questions about the adequacy of final causation as a universal explanatory principle.

In addressing these challenges, this thesis has highlighted the role of efficient causation as an indispensable explanatory principle within Aristotle's system. Efficient causes, steering the mechanisms and processes of matter heading for form, thereby ensure the spatial and temporal continuity in the universe. Thus efficient causation also bridges gaps where teleological explanations may be less apparent, offering a mechanistic grounding for phenomena that might otherwise seem disconnected from the broader teleological order.

Through an analysis of Aristotle's texts, particularly *Meteor* I.9, IV.11, IV.12, and *PA* I.1 and II. 8–9, this study has demonstrated how efficient causation complements final causation by initiating processes and interactions between natural phenomena. For example, in meteorological processes, efficient causes such as the Sun's heat play a pivotal role in the generation and corruption of terrestrial phenomena. These processes, while mechanistically driven, remain consistent with the overarching teleological framework by contributing to the sustenance and order of the cosmos. Similarly, in biological contexts, efficient causation underpins the developmental and functional processes of living beings, operating in alignment with the teleological purposes defined by the final cause.

A key contribution of this thesis lies in its exploration of the relationship between final and efficient causation, which Aristotle does not explicitly articulate but which emerges implicitly across his works. This relationship is characterized by complementarity rather than competition. While the final cause provides the ultimate "why" of phenomena, efficient causation addresses the "how", offering a processual account of the mechanisms through which teleological purposes are realized. This interplay ensures that Aristotle's explanatory framework remains both comprehensive and adaptable, capable of addressing the diversity and complexity of natural phenomena.

This thesis has argued that efficient causation, albeit ontologically posterior, operates in harmony with final causation, ensuring the coherence and continuity of the cosmos. This dual-focus approach enriches Aristotle's teleological framework, allowing it integrate phenomena that seem to fall outside the explanatory scope of final causation.

In Section 1.1, I have shown that Aristotle's discussion in *Physics* II.7 refines his causal framework by demonstrating that while final causation remains the highest explanatory principle in nature, it does not singularly account for all natural occurrences. By distinguishing between essential and accidental causes, Aristotle acknowledges the role of contingency within an otherwise purposively ordered universe. His hierarchical model of explanation accommodates different levels of causal interaction: while the cosmos as a whole is teleologically oriented toward the good, individual natural processes often require an interplay of efficient, material, and formal causes to be adequately explained. In cases of chance and spontaneity, efficient causation takes precedence, ensuring the continuity of causal chains even when purposiveness is not immediately apparent.

Rather than undermining teleology, this model reinforces its coherence by situating contingency within a structured explanatory framework. Thus, Aristotle preserves the intelligibility of nature without reducing it to a rigid teleological determinism, demonstrating that natural philosophy must account for both order and variation within its causal schema.

In Section 1.2, I have established the importance of clarifying Aristotle's final causation to ensure a nuanced understanding of its scope and application. This chapter has laid the groundwork for subsequent analyses by identifying the central role of final causation in Aristotle's system and the necessity of efficient causation to realize the diversity of ends in the different regions of nature.

Section 1.2.1 has analyzed Aristotle's notion of the final cause, with particular attention to its role as both a principle of orientation and an explanatory framework. Through an examination of key passages from *Phys* and *PA*, I have demonstrated how the final cause—expressed as "that for the sake of which"—provides teleological explanations for both natural and artificial phenomena. This section has shown how the final cause unifies processes and structures by attributing purposiveness to natural phenomena, particularly in biological contexts. The final cause explains the orientation and functionality of living beings, illustrating how their parts work together to achieve their natural ends.

Section 1.2.2 has explored the implications of the principle "nature does nothing in vain," which encapsulates Aristotle's teleological worldview. This principle underscores the intrinsic purposefulness of natural phenomena and reinforces the primacy of the final cause. However, this section also addressed the limitations of final causation in certain contexts, such as meteorological events or the behavior of inanimate elements, where teleological explanations may be less immediately apparent. This discussion has set the stage for the subsequent analysis of how efficient causation complements the final cause in Aristotle's system.

In Section 1.3, I have provided an in-depth examination of Aristotle's concept of efficient causation, focusing on its role as the source of motion and change. By analyzing examples from *Metaphysics* and *Physics*, I have shown how efficient causation provides the mechanisms through which potentiality is actualized, linking disparate phenomena through continuous causal chains. This section emphasized the dynamic nature of efficient causation, which operates across various domains to ensure the continuity and coherence of processes within the cosmos.

This chapter has established the foundation for understanding how final and efficient causation, as two complementary explanatory principles, sustain the intelligibility of Aristotle's goal-directed cosmos. While efficient causes account for the mechanisms of change, final causes provide the explanatory framework that makes these processes intelligible by revealing their orientation toward an end. Rather than acting as co-equal forces, final and efficient causes function as two aspects of the same explanatory structure—one answering "why" and the other answering "how." By articulating the distinct roles of these two causes and their interdependence, I have demonstrated that Aristotle's causal framework is not fragmented but integrated, addressing both the purposive and mechanistic dimensions of natural phenomena. While the final cause provides the *why* of natural processes, the efficient cause ensures the *how*, linking diverse phenomena through continuous chains of causation.

In chapter 2, I have examined limitations of final causation in Aristotle's explanation of natural phenomena. This investigation has highlighted the challenges of applying final causation universally across different domains of Aristotle's natural philosophy.

In Section 2.1, I analyzed the role of final causation in Aristotle's cosmology, focusing on its application in *Meta Lambda*. Aristotle conceptualizes the final cause as a teleological principle that unifies the cosmos by directing all motion and processes toward an ultimate purpose. However, while the final cause provides a broad teleological framework, its explanatory reach in cosmology appears to be not without limitations, particularly in addressing the dynamic interconnections among celestial bodies.

Section 2.1.1 has demonstrated that Aristotle's *Meta Lambda* presents the final cause as the foundational principle of the cosmos. By focusing on the Unmoved Mover as the ultimate final cause, Aristotle provides a teleological framework where all motions and processes in the universe are directed toward an ultimate purpose. My analysis of *Lambda* 5–10 has shown that the final cause, epitomized by the Unmoved Mover, functions as a unifying principle not only for celestial motions but also for the hierarchical ordering of all entities within the universe. However, while the Unmoved Mover operates as an overarching teleological principle, the orientation towards its ends requires the initiation and control of processes in the different regions of the cosmos.

Section 2.1.2 has addressed the limitations of final causation in Aristotle's

cosmology, particularly as discussed in *DC*. While final causation functions as an explanatory principle for the natural motions of celestial bodies, its role appears constrained when providing a comprehensive account of their continuous, unchanging movement. Aristotle's framework suggests that mathematical calculations and geometric principles serve as primary tools for explaining celestial motions, while final causation is appealed to where direct observation and computation fall short. Here the Unmoved Mover functions as a final cause, evoking celestial motion as an object of desire. The permanence of celestial motion thus highlights the role of efficient causation as a complementary factor, ensuring cosmic continuity where final causation alone proves insufficient. This sets the stage for exploring efficient causation's role in sustaining Aristotle's unified explanation of the universe.

In Section 2.2, I explored the limitations of final causation in explaining the motion of elements. While Aristotle uses the notion of final causation to describe the natural tendencies of elements—that is, their movement toward their determinate places—the processes through which the natural world is realized are initiated by efficient causation. This section also demonstrated that the explanatory scope of final causation is constrained when addressing the interactions between sublunary and celestial elements, particularly in terms of the continuous transformations and interdependencies observed in the natural world.

Section 2.2.1 has analyzed the limitations of final causation in explaining the motion of sublunary elements. While Aristotle's teleological framework attributes purpose and order to the natural tendencies of the four sublunary elements—earth, water, air, and fire—final causation struggles to account for the dynamic interactions and transformations among these elements. By examining Aristotle's discussions in *Physics* and *Meteorology* I have demonstrated that while final causation offers insights into the end-directed nature of elemental motions, it fails to provide a comprehensive account of the mechanisms underlying these processes. This limitation points to the necessity of efficient causation in explaining the continuous and interconnected transformations that sustain the natural order in the sublunary world.

Section 2.2.2 extended the analysis to the role of final causation in explaining the motion of the celestial element, aether. Aristotle posits aether as the eternal and unchanging substance that constitutes the heavenly spheres, moving in perfect circular motion. However, the application of final causation to aether is

constrained by its unique nature. While the Unmoved Mover serves as the final cause for the motion of the heavens, the explanatory gap lies in detailing how the interactions between aether and the sublunary elements are sustained. My examination has shown that the continuous motion of aether requires efficient causation to account for its interaction with the sublunary elements, particularly in generating heat and influencing meteorological and terrestrial phenomena.

In Section 2.3, I have examined the limitations of final causation in Aristotle's explanation of meteorology. While Aristotle's teleological framework imparts purpose to natural phenomena, its application to meteorological events proves problematic. Meteorological phenomena, such as rainfall, evaporation, and condensation, are primarily explained through material and efficient causes, the role of the final cause being either minimal or entirely absent. This analysis highlights the challenges of integrating phenomena that are seemingly devoid of intrinsic purpose or end into a teleological framework. Through the investigation of Aristotle's *Meteorology* and related treatises, I have argued that the explanation of meteorological events relies heavily on the interplay between celestial motions and the sublunary elements. Aristotle attributes these phenomena to the motion and influence of the heavenly bodies, which act as efficient causes, transferring motion and energy to the sublunary realm. While Aristotle occasionally uses teleological language—such as when discussing rainfall in *Phys* II.8—this does not establish a consistent application of the final cause in meteorological explanations. The analysis in this chapter has further demonstrated that efficient causation plays a critical role in bridging the explanatory gap left by final causation in this domain. For example, the heat generated by the Sun, as an efficient cause, drives the cycles of evaporation and precipitation that sustain meteorological processes. These efficient causal chains connect the celestial and sublunary realms, providing a coherent explanation of how these regions interact dynamically.

In Section 2.4, I turned to Aristotle's biological works, where final causation finds its most effective application. The soul, as the organizing principle of living beings, operates as a final cause, directing the development and functioning of biological entities. However, even in this domain, there are exceptional cases—such as certain processes within reproduction and growth—that resist explanation in terms of final causation.

Section 2.4.1 has shown that Aristotle identifies the soul as the final cause in

his biological framework, emphasizing its role as the organizing principle of living beings. The soul not only provides purpose and direction to biological processes but also serves as the unifying factor that connects the diverse aspects of life. Through an analysis of Aristotle's discussions in *DA* and *PA*, I demonstrated that the soul functions as the ultimate explanatory principle in the biological domain, guiding the growth, reproduction, and activities of living beings. This section established the foundational role of final causation in Aristotle's biology.

Section 2.4.2 explored how the soul, as a final cause, contributes to the unified explanation of living beings and their functions in Aristotle's biology. The analysis focused on the ways in which the soul integrates various faculties and parts of living organisms into a cohesive whole. By examining Aristotle's detailed descriptions of anatomical structures and physiological functions, I argued that the soul ensures the harmonious operation of these components in service of the organism's ultimate purpose: survival and reproduction. This section highlighted Aristotle's successful application of final causation to explain the unity underlying the variety of the natural world.

Section 2.4.3 addressed the limitations of final causation in Aristotle's biological framework. While the soul provides a robust explanatory model for many aspects of life, certain phenomena—such as spontaneous generation and reproductive anomalies—pose challenges to teleological explanations. Some reproductive anomalies, including cases of sterility or malformation, do not easily fit within Aristotle's universal tendency towards the good, as they seem to deviate from nature's goal of producing fully functional and flourishing organisms. My analysis showed that in these cases, Aristotle relies on material and efficient causation to supplement the gaps in the explanatory power of the final cause.

This chapter has demonstrated that while final causation is integral to Aristotle's teleological framework, there are exceptions to its explanatory capacity. The analysis revealed that final causation excels in providing purpose and direction but faces limitations in addressing the mechanisms and dynamics underlying certain natural phenomena.

By exposing the constraints of final causation in cosmology, the motion of elements, meteorology, and biology, this chapter has laid the groundwork for the subsequent investigation into the role of efficient causation. The continuity and coherence of Aristotle's universe cannot be accounted for by final causation as such. Instead, efficient causation, with its focus on the how of motion and change,

constitutes a necessary component of Aristotle's unified explanatory framework. Together, these causes offer a holistic understanding of the cosmos, balancing teleological purpose with dynamic processes working on matter to be actualized in form. This conclusion prepares the way for the analysis in Chapter 3, which will explore the role of efficient causation in ensuring the continuity and coherence of the universe, thereby addressing the gaps identified in the explanatory power of final causation.

In Chapter 3, I have established that efficient causation is indispensable for sustaining the continuity and coherence of Aristotle's cosmos. Across the fields of cosmology, the motion of elements, meteorology, and biology, efficient causation complements final causation by addressing the mechanisms through which motion and change occur.

In Section 3.1, I examined the role of efficient causation in Aristotle's cosmology, focusing on the Unmoved Mover as the primary efficient cause. Through an analysis of *Phys* VIII, I demonstrated how the Unmoved Mover initiates motion without itself being moved, serving as the starting point for continuous efficient causal chains that unify the celestial realm. This investigation revealed that efficient causation ensures the coherence and continuity of celestial motions, providing a dynamic mechanism that complements the teleological order established by the final cause.

Section 3.1.1 has examined the role of the Unmoved Mover as an efficient cause within Aristotle's *Physics*. This analysis demonstrated that the Unmoved Mover serves as the primary source of motion, initiating all movements in the universe without itself being moved. By doing so, the Unmoved Mover provides a foundational basis for continuous efficient causal chains that ensure the interconnectedness of all physical processes in the cosmos. Aristotle's argument in *Phys* VIII emphasizes the necessity of an unmoved, eternal, and actual cause to sustain the coherence of the universe, highlighting the indispensable role of efficient causation in achieving a unified explanation of celestial and terrestrial phenomena.

Section 3.1.2 expanded this investigation to explore the continuous efficient causal chains that originate from the Unmoved Mover and extend through the heavenly bodies. These chains demonstrate the cascading interactions that transmit motion from the outermost celestial sphere to neighboring spheres, eventually influencing the sublunary world. This section illustrated how these

efficient causal chains operate seamlessly, creating a cohesive and interconnected system across different regions of the cosmos. The orderly transmission of motion from the Unmoved Mover through the celestial spheres not only sustains physical processes but also reinforces the unity of Aristotle's cosmological framework.

In Section 3.2, I explored the role of efficient causation in the motion of elements, highlighting the interaction between the celestial element, aether, and the four sublunary elements—earth, water, air, and fire. This analysis underscored the necessity of efficient causation in explaining the movement and interaction of the elements, demonstrating how the heat and motion generated by celestial bodies serve as efficient causes for terrestrial transformations. By connecting celestial and sublunary processes, efficient causation sustains the coherence of the natural world.

Section 3.2.1 examined the interactions between the celestial element (aether) and the four sublunary elements in Aristotle's framework, focusing on the continuity of efficient causal chains. Despite criticisms that aether creates a disconnection between the celestial and sublunary realms, my analysis demonstrated that Aristotle explicitly describes interactions between these realms, particularly through the role of the circular motion of aether. This motion generates heat, which influences the sublunary elements and establishes efficient causal chains that connect the two regions. Through this analysis, I argued that efficient causation bridges the celestial and sublunary spheres, unifying them into a coherent system.

Section 3.2.2 turned to the sublunary realm itself, exploring the efficient causal chains among the four sublunary elements: earth, water, air, and fire. Aristotle's *De Generatione et Corruptione* provided the foundation for understanding how these elements interact in processes of mutual transformation and compound formation. I demonstrated that efficient causation accounts for the dynamic processes through which these elements interact, ensuring the continuity and coherence of the sublunary world. By emphasizing the role of efficient causal chains, this section highlighted how Aristotle's framework integrates the interactions of the sublunary elements into a unified explanatory model.

In Section 3.3, I turned to Aristotle's *Meteorology*, examining how efficient causation accounts for meteorological phenomena. The Sun's heat, as an efficient cause, drives processes such as evaporation, condensation, and precipitation, creating causal chains that link celestial motions with terrestrial weather patterns.

This section emphasized the importance of efficient causation in bridging the explanatory gap between the celestial and sublunary realms, ensuring a unified understanding of meteorological phenomena.

Section 3.3.1 examined the Sun's role as an efficient cause in Aristotle's meteorology, focusing on its contributions to the processes of generation and corruption in the sublunary world. Through the heat it produces, the Sun drives essential transformations such as evaporation, condensation, and precipitation. These processes illustrate how efficient causation bridges celestial and terrestrial phenomena, creating continuous causal chains that sustain the coherence of the sublunary realm. This section highlighted the Sun's pivotal role in maintaining the dynamic continuity of natural processes within Aristotle's framework.

Section 3.3.2 expanded the discussion to explore the continuous efficient causal chains linking the celestial world and the sublunary world in meteorology. By analyzing Aristotle's description of meteorological phenomena, I demonstrated how the motions of the heavenly bodies generate causal chains that directly influence the sublunary elements. This analysis reinforced the view that efficient causation ensures the interconnection and unity of the cosmos by providing mechanistic explanations for natural phenomena that somehow make up for the limitations of final causation in this field.

In Section 3.4, I investigated the role of efficient causation in Aristotle's biology, focusing on the vital heat produced by the Sun. By examining the efficient causal chains from the celestial to the sublunary realms, I demonstrated how efficient causation operates as a unifying principle in Aristotle's biological framework.

Section 3.4.1 analyzed the role of efficient causation in the continuous causal chains linking the celestial world to the generation of living beings in the sublunary realm. This section focused on Aristotle's description of vital heat produced by the Sun, which acts as an efficient cause in the reproduction and sustenance of life. By examining passages where Aristotle posits the Sun as an efficient cause, I demonstrated how celestial influences, such as heat and motion, initiate and sustain life on Earth. This analysis reinforced the idea that efficient causation bridges the celestial and sublunary realms, creating a coherent and interconnected biological framework.

In Section 3.4.2 I expanded on this theme by investigating the role of vital heat within living organisms. Vital heat, as transported by pneuma, ensures the proper

functioning of biological processes, and facilitates reproduction. This section demonstrated how efficient causation operates at a micro level, from the transmission of vital heat through the blood vessels to its generative function in reproduction. By elucidating these mechanisms, I showed that efficient causation ensures the coherence of biological processes, supporting the teleological aims of life and reproduction.

This chapter has also shown how Aristotle's interconnection of efficient causation into his explanatory framework resolves challenges posed by the limitations of final causation. Efficient causation does not compete with final causation but instead complements it, offering a comprehensive understanding of the cosmos that balances purpose and process. The findings of this chapter pave the way for Chapter 4, where the interplay between final and efficient causation will be examined in greater depth. By exploring their commensurability and non-competition, the next chapter will highlight how these two forms of causation collectively contribute to Aristotle's unified explanation of the universe, reinforcing the coherence of his philosophical system.

In Chapter 4, I have explored the intricate relationship between final and efficient causation in Aristotle's philosophy, with the aim of understanding how their interplay establishes a unified explanation of the universe. The chapter was structured into four key sections to address different dimensions of this relationship comprehensively.

In Section 4.1, I investigated the relation between final and efficient causation in Aristotle's *Meteorology* and *De Partibus Animalium*. Through an analysis of *Meteor* I.9, IV.11, IV.12, and *PA* I.1 and *Phys* II.9, I demonstrated how Aristotle's final and efficient causes operate in tandem to account for the mechanisms and purposes of natural phenomena. The analysis revealed that while final causation provides the overarching teleological rationale, efficient causation initiates the various processes through which these aims are realized. This complementarity ensures a cohesive explanatory framework that spans various domains of nature.

Section 4.1.1 examined the relation between final and efficient causation as presented in Aristotle's *Meteorology*. This section focused on natural phenomena such as meteorological events and the formation of minerals, where efficient causation predominantly explains the observable mechanisms, while final causation remains present but implicit. Through the analysis of processes like rainfall, evaporation, and mineral formation, I demonstrated that while efficient

causation provides a mechanistic account of these phenomena, Aristotle's teleological framework subtly persists, linking these processes to broader cosmic purposes. However, I also highlighted the limits of teleology in this domain, especially when natural events like excessive rainfall challenge the sustenance of life.

Section 4.1.2 turned to Aristotle's *De Partibus Animalium*, where final causation assumes a central role in explaining the purposive structures and processes of living organisms, complemented by efficient causes. Here, I analyzed how final causation provides the teleological framework for understanding the function and organization of biological entities, while efficient causation explains the processes through which these purposes are realized.

In Section 4.2, I examined the fundamental role of final causation in Aristotle's unified explanation of the cosmos. Two critical aspects were explored: first, the primacy of final causation as the primary and essential explanatory principle, and second, the way continuous efficient causal chains are directed toward the final cause. This analysis underscored the centrality of the final cause in providing the ultimate purpose toward which all processes in the universe converge, while highlighting its interconnection with efficient causation in maintaining the cosmos's intelligibility and order.

Section 4.2.1 explored Aristotle's view that final causation is the primary and foundational explanatory principle in his philosophy. This section highlighted how the final cause serves as the ultimate rationale for natural processes, establishing their purpose or goal. Through analysis of Aristotle's texts, such as *PA* I.1 and *Phys* II.9, I demonstrated that the final cause is prioritized over efficient causation due to its essential role in defining the end toward which all processes are directed. This priority of the final cause underscores its centrality in Aristotle's teleological framework, forming the cornerstone of his unified explanation of the universe.

Section 4.2.2 examined how efficient causation is directed toward the final cause within Aristotle's explanatory system. By analyzing examples from his biological and cosmological treatises, I demonstrated that continuous efficient causal chains consistently aim at realizing the purposes defined by the final cause. These chains provide the dynamic mechanisms that actualize the teleological ends, ensuring the coherence of Aristotle's universe. This analysis reinforced the complementarity between final and efficient causation, with efficient causes

functioning as instruments to fulfill the purposes outlined by the final cause.

Section 4.3 focused on the role of efficient causation in complementing the teleological framework of the final cause. By bridging gaps in explanation left by final causation, efficient causation sustains the interconnectedness of celestial and sublunary phenomena, reinforcing the unity of Aristotle's cosmos.

In Section 4.4, I explored the commensurability and non-competition between final and efficient causation. The discussion revealed that these two causes are distinct yet mutually reinforcing, operating at different explanatory levels. While final causation provides the ultimate purpose, efficient causation explains the means by which this purpose is achieved. Their interplay exemplifies a harmonious interconnection of teleology and mechanistic approaches, avoiding explanatory conflicts while preserving the coherence of Aristotle's philosophical system.

Hereby we have demonstrated that the relationship between final and efficient causation is pivotal to Aristotle's unified explanation of the universe. Final causation offers the teleological framework that directs natural processes toward their ultimate purposes, while efficient causation ensures their realization by addressing the mechanisms of motion and change. Together, they form a complementary system that integrates purpose and process, ensuring the intelligibility and coherence of Aristotle's cosmos.

By highlighting the vital role of efficient causation within this framework, this thesis provides a new perspective on Aristotle's natural philosophy, reaffirming its relevance to contemporary discussions of causality, unity, and the philosophy of nature.

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Summary

This dissertation investigates the relationship between final causation and efficient causation in Aristotle's philosophy, with particular emphasis on the role of efficient causation in ensuring the spatial and temporal continuity of the cosmos within a teleological framework. While Aristotle famously assigns primacy to the final cause—"that for the sake of which"—as the ultimate explanatory principle, he also acknowledges that not all natural phenomena lend themselves to straightforward teleological explanation. The study argues that efficient causation, often treated as subordinate to final causation, plays a crucial and complementary role in sustaining the coherence of his cosmological, physical, and biological systems.

The inquiry is prompted by a philosophical and textual puzzle already recognized by Theophrastus: if final causation is primary, why is it absent or only indirectly applied in many of Aristotle's explanations, particularly in meteorology, the motion of inanimate elements, and certain irregular biological phenomena? This apparent boundary of final causation raises the problem of whether Aristotle's teleology can offer a genuinely unified account of the universe. The research responds by showing that efficient causal chains—linking otherwise disparate domains of the cosmos—are essential for Aristotle's vision of the world as a continuous and intelligible whole.

The dissertation begins with a conceptual clarification of Aristotle's definitions of final and efficient causes and their place within his broader theory of the four causes. The final cause is characterized both as a motivating principle (the ultimate end or good, exemplified by the Unmoved Mover) and as an explanatory framework for revealing the purposefulness of natural processes. Efficient cause, by contrast, is "that from which the origin of motion or change comes," highlighting its role as the directional and originating source of activity. While Aristotle consistently presents final causation as primary, his causal theory is hierarchical and context-sensitive, allowing efficient causation to predominate in certain explanatory contexts without undermining teleological primacy.

The study then examines the explanatory limits of final causation across four major domains of Aristotle's natural philosophy: cosmology, the motion of elements, meteorology, and biology. While Metaphysics Λ presents the cosmos as

teleologically ordered under the Unmoved Mover, this model encounters difficulties in accounting for phenomena that lack manifest purposiveness. In cosmology, celestial spheres are described in teleological terms, yet their effects on the sublunary realm often operate through physical interactions best explained by efficient causation. In the study of elemental motion, the orientation of elements toward their natural places can be construed teleologically, but irregular or intermediate motions demand mechanistic explanation. In meteorology, events such as rainfall can be interpreted teleologically only in specific contexts; otherwise, their explanation depends on chains of physical processes. In biology, final causation achieves its most robust expression in the organization and function of living beings, yet anomalies in reproduction and other irregularities reveal limits to its explanatory scope.

The analysis proceeds to show how efficient causation functions to bridge these explanatory gaps. In Aristotle's account of the cosmos, continuous chains of efficient causes extend from the Unmoved Mover to the heavenly bodies, and from celestial motions to changes in the sublunary realm. In the domain of elements, efficient causation links the motion of aether to the four sublunary elements and governs their mutual interactions. In meteorology, the Sun operates as an efficient cause of generation and corruption, transmitting celestial influence through physical processes. In biology, vital heat—mediated by celestial bodies—functions as an efficient cause for reproduction and development. These examples demonstrate that efficient causation serves as the mechanism through which the teleological order of the cosmos is actualized.

The interplay between final and efficient causation is ultimately shown to be both commensurable and non-competitive. Final causation explains why natural processes occur, by reference to ultimate ends; efficient causation explains how they occur, by tracing the chains of motion and change that realize those ends. Their interaction produces a unified explanation of the cosmos: final causes provide teleological direction, while efficient causes ensure operational continuity. In Aristotle's natural philosophy, unity is thus multi-dimensional—comprising teleological coherence, causal continuity, and the integration of diverse phenomena into an intelligible whole.

The contribution of this dissertation lies in three main areas. First, it delineates the boundaries of final causation across Aristotle's natural treatises, showing that its explanatory primacy does not entail universality of application. Second, it

offers a comprehensive account of efficient causation as a principle of cosmic unity, rather than merely a subordinate cause. Third, it reframes the relationship between final and efficient causes as a complementary partnership essential to Aristotle's vision of the natural world.

Grounded in close readings of Aristotle's cosmological, physical, meteorological, and biological works, the study demonstrates that the coherence of Aristotle's universe depends on a dual structure: teleology provides the overarching rationale, while efficient causation maintains the interconnectedness and temporal continuity that make the cosmos a living, unified whole. By reconciling purposiveness with causal mechanisms, this account resolves interpretive challenges that have persisted since antiquity and offers a nuanced model of how Aristotle integrates different causal principles to explain the unity of nature.

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Curriculum Vitae

QUE Yuye was born in 1992 in Xinyang, China. From 2009 to 2013, she studied at the Institute of Philosophy, Nankai University, obtaining a Bachelor's degree in Philosophy from the Institute of Philosophy and a Bachelor's degree in History from the Institute of History. During her undergraduate studies, she focused on Sartre's existential philosophy and Hegel's philosophy. From 2013 to 2016, she pursued her Master's degree in Philosophy at the Institute of Philosophy, Beijing Normal University, with a research focus on Aristotle's natural philosophy. Since 2017, she has been a doctoral candidate at Leiden University, under the supervision of Prof. dr. D. L. Berger, Prof. dr. M. van Raalte, and Dr. C. Robbiano. Her doctoral research, supported by a scholarship from the China Scholarship Council, examines the relationship between final and efficient causation in Aristotle's philosophy, with particular attention to their role in sustaining the unity and continuity of the cosmos.

Propositions

1. Aristotle's causal framework, while prioritizing the final cause, defines the efficient cause as the origin of motion or change, setting the stage for understanding its distinct role in explaining the 'how' of natural processes within a teleological system.

2. The principle that "nature does nothing in vain" is regarded as articulating a regulative ideal within Aristotle's teleology. However, when applied to phenomena such as spontaneous generation, meteorological irregularities, or elemental motion, the explanatory reach of final causation appears to be contextually limited. Such cases indicate that a purely teleological framework does not uniformly account for all natural processes, thus inviting a more nuanced and domain-sensitive interpretation of Aristotle's causal theory.

3.Efficient causation plays a pivotal role in sustaining the spatial and temporal continuity of the cosmos. Through continuous causal chains—extending from the Unmoved Mover to celestial motions and sublunary effects such as vital heat—it ensures the coherence and continuity of the diverse domains of cosmology, meteorology, and biology, particularly where the teleological function of final causation becomes obscure or implicit.

4. In Aristotle's natural philosophy, final and efficient causes exemplify a commensurable and non-competitive relation. While the final cause retains explanatory primacy as the ultimate end toward which processes are directed, the efficient cause is necessary to affect the transition from potentiality to actuality, thereby ensuring both continuity and coherence in the cosmic order.

5. This dissertation challenges interpretations that overemphasize either final or efficient causation in Aristotle by demonstrating their necessary interconnection for a complete understanding of his natural philosophy and the continuity and coherence of his cosmos.

6. By highlighting the role of efficient causal chains in ensuring cosmic continuity, this study offers a new perspective on the unity of Aristotle's universe, bridging the perceived explanatory gap between the eternal celestial realm and the generable/corruptible sublunary realm.

7. The analysis clarifies that Aristotle's teleology is not uniformly applicable

across all natural domains, suggesting a more nuanced, context-dependent, and hierarchical model of explanation is required to fully grasp his system, rather than assuming a monolithic application of final causality.

8. Reinterpreting the function of efficient causation provides a more robust framework for understanding seemingly non-teleological or mechanistically driven phenomena (like meteorological events or elemental motion) within Aristotle's broader teleological cosmology, interconnecting them coherently rather than treating them as exceptions.

9. Aristotle's synthesis of teleological and mechanistic explanation offers an enduring conceptual model for current debates in philosophy of science and biology—particularly those concerning explanatory pluralism, functional explanation, and the reconciliation of purpose and process in complex systems.

10. The Aristotelian account of causation demonstrates that understanding natural and social systems often requires multi-layered explanations that integrate both instrumental mechanisms and normative ends. This insight remains vital for framing questions of coherence, continuity, and intelligibility in contemporary theoretical contexts.