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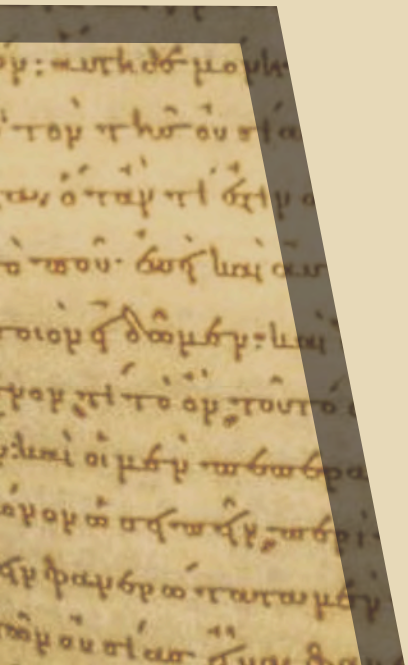

# ristotelica

## Early Modern Adaptations and Transformations of Aristotelian Natural Philosophy: Terminology, Key Concepts, and Case Studies

Edited by Simone Guidi and Enrico Pasini

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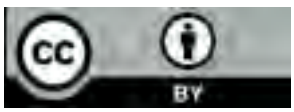

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# *ARISTOTELICA*

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Submissions, which can be very short or long (there is no word limit), and written in any of the main European languages, must meet the highest scholarly standards and be based on sound methodology. They should contribute significantly to the field by asking innovative questions and reaching well-argued and ground-breaking conclusions.

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# Early Modern Adaptations and Transformations of Aristotelian Natural Philosophy: Terminology, Key Concepts, and Case Studies

## INTRODUCTION

by Simone Guidi and Enrico Pasini

### Abstract

In the development of early modern science, Aristotelian-scholastic natural philosophy provided crucial tools for understanding epistemology, logic, and cosmology, including key insights on quantification and mathematics, qualities, force, matter, atomism and corpuscularianism, the material continuum, and infinity. The new natural philosophy drew on philosophical instruments developed by medieval and post-medieval thinkers, often used to conceive of novelties. The technical and scientific vocabulary that condensed around Aristotelianism and its hybridizations with other traditions served as a fundamental vehicle for science in the transition from the late Middle Ages to the early phase of the Scientific Revolution. This special issue of *Aristotelica* integrates these two aspects by investigating the development and reconceptualization of Aristotelian notions in early modern natural philosophy and emphasizing the role of terminology and its historical shifts. Without claiming to be exhaustive, and by spotlighting a number of relevant case studies from various periods of the Renaissance and early modern natural thought, we attempt to chart some of these overlaps in concepts and vocabulary, focusing particularly on the significant time period from the fourteenth to the seventeenth century.

### Keywords

Early Modern Science, Aristotelian-scholastic Natural Philosophy, History of Learned Terminology, Trasformations of Scientific Terminology

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"Nihil tam arduum quam vel nova novis rebus imponere
nomina, quaedam vero obsoleta in usum revocare"
(Gerolamo Cardano, *Artis arithmeticae tractatus de integris*)

## *1. An Aristotelian Heritage*

For over a century, historians of science and philosophy have been exploring the significance of Aristotelian-scholastic natural philosophy in the development of early modern science, and its ongoing, albeit discreet, influence on the onset of modern science. As shown already by the pioneering works of Pierre Duhem,[1] later consolidated by those of Anneliese Meier,[2] William A. Wallace,[3] Edward Grant,[4] and many recent others, Aristotelianism continued to provide early modern Western culture with a crucial set of tools spanning epistemology, logic,[5] and cosmology,[6] including key insights on quantification[7] and mathematics,[8] qualities,[9] force,[10] matter, atomism and corpuscularianism,[11] the material continuum,[12] and infinity.[13]

Although characterized by a general reaction to fundamental aspects of Aristotelian-scholastic philosophy, the new sciences never achieved the level

[1] Duhem (1913-1959).
[2] Meier (1949-1958).
[3] Wallace (1981, 1984).
[4] Grant (1994, 1996, 2010).
[5] See, in particular, Randall (1961), Schmitt (1969), Edwards (1983), Bruyère (1984), Mikkeli (1997a, 1997b), Oldrini (1997), Papuli (1983), Di Liscia, Kessler and Methuen (1997), Sgarbi (2013, 2017, 2023).
[6] See especially Grant (1994).
[7] See, in particular, Meier (1949-1958), Sylla (1971-1972, 1973), Di Liscia (1993b), Roudaut (2021, 2022), Di Liscia and Sylla (2022).
[8] See, just by way of example, Murdoch (1967), Roux (2010).
[9] See especially Pasnau (2011).
[10] See, in particular, Wallace (1978, 1981), Di Liscia (1992, 1993a, 2001), Hesse (2005), Sarnowsky (2007).
[11] See especially Des Chene (1994) pp. 81-167 and (1998), Specht (1987, 1997), Hattab (2009, 2017), Robert (2010, 2012, 2017, 2024), Schmaltz (2019, 2020), Åkerlund (2019), Guidi (2020) pp. 231-60. See also some of the papers in Jullien (2015), and the essays in the important Lüthy and Nicoli (2022), and Polloni and Roudaut (2024).
[12] Limiting the matter to medieval and early modern Aristotelianism see, in particular, Murdoch (1957, 1964, 1982, 2009), Ceylerette (2015), Sherry (2018) and Guidi (2022).
[13] See, for instance, Murdoch and Synan (1966), Murdoch (1982), Murdoch and Thijssen (2001), and Uckelman (2015). See also Celeyrette (2011) for the non-scholastic environment.

of unity of Aristotelian natural philosophy. Hence, the new natural philosophy could not help but implicitly draw on the set of philosophical instruments developed by the medieval and post-medieval worlds, often conceiving their very novelties through them. In the words of Daniel Garber, "the diversity of alternative anti-Aristotelian programs that blossomed in the late sixteenth and early seventeenth centuries never completely sorted itself out in a single alternative to the Aristotelian program, nothing that could be called the new science".[14] In turn, the interest of some scholastics – mainly Jesuits[15] – in the new sciences brought, in a way, the process full circle.

Furthermore, as Tullio Gregory aptly noted, "if linguistic signs are a privileged vehicle of ideas, the study of lexica and their transformations" is a fundamental portal into "the study of culture and languages in their dynamic historical reality".[16] Precisely for this reason, when examining the underlying influence of Aristotelian-scholastic philosophy on the advent of the new sciences, particular attention should be directed towards a specific linguistic development. It is an established fact that the technical and scientific vocabulary that, over the centuries, condensed around Aristotelianism and its hybridizations with other traditions – Galenism, Neo-Platonism, Arab philosophy, to name but a few – served as a fundamental scientific vehicle in the passage from the late Middle Ages to the early phase of the Scientific Revolution.

The present special issue of *Aristotelica*[17] simultaneously integrates these two aspects and historiographical perspectives. While investigating the development and reconceptualization of Aristotelian notions in early modern natural philosophy, this collection of papers emphasizes, in particular, the role of terminology and its historical shifts. Without claiming completeness – but in the hope of fostering new research in this combined field of studies – we examined a number of relevant case studies from different

[14] Garber (2016) p. 142.
[15] See, in particular, Feingold (2002, 2003), Gorman (2020).
[16] Gregory (2006) p. ix (our translation).
[17] The preparation of this issue was facilitated by a preliminary series of online seminars, which were organized in collaboration with *Aristotelica* by the Institute for European Intellectual Lexicon and History of Ideas of the Italian National Research Council (CNR-ILIESI). The seminars were held from October 2023 to February 2024 under the title "Early Modern Transformations and Adaptations of the Aristotelian Scientific Vocabulary". The ILIESI, based in Rome, has provided ongoing support to *Aristotelica* since its inception.

moments of the Renaissance and early modern natural thought. Through these studies, we attempted to tentatively chart some of these overlaps in concepts and vocabulary, focusing particularly on the significant time period from the fourteenth to the seventeenth century.

A conceptual cornerstone of this enterprise is that, as a tradition eminently constructed through dialectical reasoning and the pursuit of proper definitions, Aristotelianism conceptually evolved over the centuries in the form of a philosophical vocabulary. While remaining steady in its main nomenclature, this vocabulary constantly underwent remarkable shifts in meaning. Consequently, Aristotelianism, more than any other tradition in the Western world, contributed significantly to the construction of the overall philosophical, technical, and conceptual language – especially after its textual rediscovery in the twelfth century and its translation into Latin. Thus, it is not surprising that generations of natural philosophers, physicians, and practitioners educated in European schools grew up literally shaping their mentality through the stable yet dynamic set of terms provided by Aristotle and his countless commentators, fluently speaking the language of Aristotelianism in the vast majority of the sciences.

It is important to note that the Aristotelian conceptual vocabulary did not limit its 'infrastructural' role to facilitating linear conceptual exchanges between natural philosophers. More importantly, it blended in the new science, acting as a vehicle for labelling and conceptualizing the transition from the old to the new view of nature. As a reshaped image of the natural world emerged from the anti-Aristotelian pillars of the new science (pointed out so aptly by Peter Dear),[18] the traditional language of Aristotelian-scholastic natural philosophy overlapped with the new emerging knowledge – in many cases, it was indispensable for calling new and unexpected things by a familiar name. Furthermore, the evolution of Aristotelian terminology accompanied the well-known phase of migration and resemanticization of intellectual vocabulary that characterized the transition from medieval and post-medieval to early modern philosophy, punctuated by terminological contaminations between Aristotelianism and other philosophical and technical traditions – including attempts to adapt non-Aristotelian notions into an

[18] Dear (1988) p. 1.

Aristotelian lexicon – as well as by genuine terminological novelties that arose in the previously mentioned process of translation of Aristotelian natural philosophy both from Greek and Arabic sources into Latin, and from the translation, diffraction, and multiplication of that intellectual vocabulary from the Latin renditions into the European vernacular languages.[19]

Thus, we chose to define the broad timespan of this investigation as the period from the fourteenth to the seventeenth century, but to concentrate specifically on the sixteenth and seventeenth centuries. As is well known, it was especially at this time that Aristotelian natural philosophy began to undergo some of its more significant conceptual alterations. These adjustments were due to several intertwining factors that combined and somehow collapsed at the onset of the emergence of modern science, revealing the birth of a new philosophical mentality; to mention just a few of these factors: the eclecticism of the Nominalist schools, the introduction of new textual practices, the rediscovery of alternative ancient sources, and – most notably – the rise of competing, anti- or non-Aristotelian trends in logic[20] and in natural philosophy.[21]

In the course of the seventeenth century, this process accelerated and eventually culminated, with the definitive replacement of Aristotelian-scholastic vocabulary by that of the new scientific domains. Nonetheless, until at least the late sixteenth century, this transformation was far from complete, and historians of science and philosophy have to acknowledge the structural overlap of two systems of thought – or even two cultures – so often brought together by the reference to a shared conceptual vocabulary.

### *2. Terms, Key Concepts, and Case Studies*

As said, the present issue addresses this chaotic and generative phase in which the coexistence of transformation, contamination, and persistence of old and new concepts revolves around specific terms and expressions. It begins with a clear case offered by Giacomo Rughetti's paper, which follows the migration of a key Aristotelian notion from one meaning to another by means of

[19] This aspect is emphasized, in particular, by Lines (2013, 2015) and Sgarbi (2017).
[20] See, e.g., Robinet (1996), Roux (2012), Burton (2024); and, from a different perspective, Maclean (2001) and Sgarbi (2022).
[21] See, in particular, Garber (2022).

translations, adaptations, and transformations. Rughetti studies, in particular, the impact on the *Figuratio* by Giordano Bruno (1548-1600) of the translation of ἕξις as *forma* by Michael Scot in his Arabic-Latin version of Aristotle's *Physica*. Rughetti, moving from the meaning of ἕξις in Aristotle and in the Arabic version of the *Physics* – to which he adds a thorough examination of the lexical choices of sixteenth-century editions of *Physics* in Latin translation – manages to show that Bruno's choice of the *translatio Scoti* marks his connection to a long conceptual tradition of philosophers who understood form as a quality of matter. It is not by accident that, besides Bruno, this notion remained crucial in the sixteenth- and seventeenth-century Aristotelian-scholastic understanding of qualities;[22] and, from there, it became involved in the debates about the hylomorphic model – a crucial moment for the development of the early modern scientific mentality.

By contrast, at the beginning of the seventeenth century, conceptions of matter were still one of the main points of divergence between scholastic philosophers and the *novatores*. However, as a large body of literature has argued,[23] the scholastic understanding of *materia* was already diverging from both the original Aristotelian sense of ὕλη and the medieval sense of *materia*, and was evolving into something different. Erik Åkerlund addresses here a specific case of this conceptual and terminological re-adaptation, that of the Jesuit Pedro Hurtado de Mendoza and his understanding of *materia*, closely connected to those of his contemporary fellow Jesuits Francisco Suárez and Rodrigo Arriaga (Hurtado's pupil). After reconstructing Hurtado's view of the ontological status of prime matter, his rejection of the Aristotelian tenet that prime matter is pure potency, as well as his distinction between a 'physical' and a 'metaphysical' sense of the term *materia*, Åkerlund discusses Hurtado's conception of the matter-form relation. Participating in the general Jesuit tendency to treat matter and form as independent entities, Hurtado maintains that their being could be sustained, at least by God's power, and

[22] The conceptual association between ἕξις/*dispositio* and *forma* is present in scholastics contemporary with Bruno in discussions on the category of *qualitas*, based on Aristotle's own mention of it in *Cat*. 8. It can be found, for example, in Fonseca's commentary on the *Metaphysics* (vol. 2, V, q. 14, c. 14, qq. 1-2), as well as in Suárez's *Disputationes* (42, s. 2, n. 1-ff.).
[23] See again Des Chene (1994) pp. 81-167 and (1998), Specht (1987, 1997), Guidi (2020) pp. 231-60.

they could thus exist separately. At the same time, he subscribes to the view that matter can subsist apart from categorial quantity, while still retaining the same place and capacity to change place. Interestingly, Åkerlund also dwells on the important problem of the different kinds of matter and on Hurtado's speculations about a purely theoretical distinction was still relevant for early modern cosmological debates.[24]

However, to address these themes properly – much like the figure in Flammarion's renowned engraving, who thrusts his head through the firmament – the simple terminological horizon must ultimately be transcended. Indeed, the study of terminology must be associated with a close analysis of the transformations of the scientific theories which they terminologically support. This is particularly evident in the important case of heat, discussed in Sylvain Roudaut's contribution, which provides an insightful survey devoted to the *long durée* of a debate culminating in the late sixteenth century. It is well known that, by the late Middle Ages, the concept of 'heat' was firmly entrenched in the Aristotelian worldview and the domain of natural philosophy, where it merged particularly with Galenic medicine. Along with its opposite, 'cold', as well as with 'wet' and 'dry', the concept of heat was part of the system of universal qualities that explained natural processes and transformations, and which was the basis of both Aristotelian physics and life science. At a later stage, the concept of heat shifted towards being understood as motion, and so as a process. Over time, this shift would also mobilize such notions as mechanization, reaction and resistance, intensive variation, degree, and, of course, those of accident, nature, and species. Roudaut focuses on *contrarium positivum* (in opposition to *privativum*) to analyze how the notion of 'positive contrariety' between heat and cold was progressively dismantled in the late Middle Ages and Renaissance, leading to mechanistic and empirical approaches that eventually resulted in modern thermodynamics.

Alongside theoretical frameworks, such as hylomorphism, that were bitterly contested but, at the same time, managed to transfer almost *en bloc* to specific areas of modern thought, the formation of particular key terms and ideas of early modern science was greatly influenced by, and often reliant on, complex stratifications of the Aristotelian and non-Aristotelian heritage,

[24] See especially Grant (1994) pp. 244-70.

unified by language. This is evident in disciplines and fields as diverse as astronomy,[25] medicine and physiology,[26] meteorology, causation theory, and, as previously mentioned, quantification. In all these, Aristotelian vocabulary, blended with technical terminology, indifferently lends a permanent tinge to the early modern vocabulary of continuity, time, movement,[27] corpuscles, atoms, natural qualities, etc. For instance, the persistent role of Aristotle's causal principle of motion is made particularly evident by Christoph Sander's analysis of the theoretical accounts of magnetic attraction. In his paper on Aristotelian presuppositions in the explanation of magnetic movements, Sander examines a wide network of authors, mainly Jesuits. He shows how notions associated with such terms as *trahit* and *propellit* (attraction and action), *conatus* and *sua sponte* (coition and concourse), are all relocated when the accent is shifted to teleological explanations, to reciprocal action, and to the causal roles of magnets and metals. Such a case may give us the opportunity to note how these shifts reveal a persistent survival of Aristotelian natural philosophy through terminology.

In such processes, a variety of transformations are at stake, especially when a change in the mutual relation between terms proves to be as relevant as that in the terms themselves. For instance, when new *syncategoremata* (e.g., adjectives) modify the concepts underlying the same term, or when a term is modified due to a change in the surrounding constellation of accessory vocabulary. However, equally, we often encounter a shift in the concept associated with a core term, or a set of such terms. Yuan Tao's contribution examines such a case of a 'prevalent' term in a specific domain of natural theories: the concept of 'auditory *species*' and its central role in theories of sound and hearing. This is primarily a scholastic development, grounded in

[25] The detection and discussion of sunspots, e.g., directly adds new content to *maculae*, but also indirectly shifts the concepts and contents associated with observation, the separation of supralunar and sublunar, emanation, and even puts pressure on current ideas about the formation of comets.

[26] This is apparent in the domain of the theories of life, which experience fluctuations in terms and expressions such as *potentia*, *capacitas resistendi*, *facultas*, as well as in the semantic conditions associated with change and motion, or continuous processes in general.

[27] As we can see in the constellation around *impetus* and projectiles, which includes motion, mover, motor; the triad of contact, medium, and vacuum; the well-known opposition of natural and violent; *vis* and *virtus*, *vis impressa* and *impressio*; *gravitas*, *fatigabilitas*, *inclinatio*.

relatively obscure statements made by Aristotle in *De anima*, but it reveals how interpretations of Aristotle's position were characterized by creativity and were prone to the constant introduction of new terminological tools, conceptual additions, and adaptations. In her article, Tao examines, in particular, the views of two important Aristotelian authorities in the sixteenth and seventeenth centuries, the Coimbra Jesuits and Rodrigo Arriaga, mentioned above, compared with those of the German physician Christoph Günther Schelhammer. From this comparison, it clearly emerges that, while the prevailing technical terminology and the fundamental account of sound transportation to the senses remained stable, the actual conceptual reference underwent significant transformation over time. The latter depends, indeed, on different positions on the problems of the gradation of materiality, the mode of interaction between the material and the immaterial, and the nature of air motion that contributes to sound generation and propagation.

Adopting a broader historical and cultural perspective, Omodeo's contribution grapples with Aristotelian notions of the eternity of the world as its starting point, examining their relationship to materialism in Renaissance cosmological thought. Omodeo focuses on the reception of Averroes by Giordano Bruno – whose cosmology simultaneously integrates Aristotelian and Averroist notions of eternal matter with Neoplatonic and Cusanian motifs – arguing that Bruno's work constitutes a radicalization of Averroistic ideas. These include the notion of the productive potentiality of matter (that would eventually attract the attention of Ernst Bloch in his interpretation of the 'Aristotelian Left') and the denial of creation *ex nihilo*. Remarkably, Bruno reshapes these notions, bringing together the concepts of necessity, infinity, and vitality in that of an eternal, animated universe.

The final contribution by Enrico Pasini remains within the realm of cosmological debates, centering on the vocabulary of infinity and the way Aristotelian terminology was stretched to fit new conceptual frameworks. While infinity represents one of the crucial new concepts of the early modern understanding of the world, the Aristotelian stance towards this notion had always been ambiguous, for reasons connected to theology, creation, and natural philosophy. Scholastic philosophy generally rejected real infinities in the created world, while recognizing potential infinities in the continuum,

in line with Aristotle's views. Pasini's contribution concerns two emblematic examples in which Aristotelian vocabulary is used for new aims – a sixteenth-century literary celebrity (Béroald de Verville) and a seventeenth-century mathematician and philosopher (Leibniz) – showing how the resemantization of infinity is doubly at stake in these two different contexts. On the one hand, in Verville's Platonizing understanding of matter and form in relation to divine infinite power; on the other hand, in Leibniz's recovery of the notion of substantial form (in a way, however, that ultimately undermines its Aristotelian foundation). In both cases, a clear dependence on Aristotelian-scholastic concepts and terminology emerges, even when moving away from or distorting the original framework.

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GIACOMO RUGHETTI

# FORM AS A QUALITY OF MATTER
## The Translation of ἕξις in Michael Scot's Version of Aristotle's *Physics* and its Influence on Giordano Bruno's *Figuratio Aristotelici Physici auditus*

**Abstract**

In this article, I analyse the influence of the translation of ἕξις as '*forma*' in Michael Scot's Arabic-Latin version of Aristotle's *Physics* on a passage of Giordano Bruno's *Figuratio Aristotelici Physici auditus*. I take my cues from a passage where Bruno uses the term '*formae*' to refer to Aristotle's expression ἕξεις καὶ διαθέσεις (*Phys*. II 1.193a25-26). I then examine all the 16th-century editions of the *Physics* Latin translations to trace the use of '*formae*' as a translation of this Aristotelian passage. I focus on the 1562 Giunta edition of Aristotle's *opera omnia* with Averroes' commentary, which includes the Arabic translation attributed to Michael Scot, the only one to translate ἕξις as '*forma*'. All occurrences of the translation of ἕξις in the Latin and Arabic translations are also documented. Finally, after a brief accounting of the meaning of ἕξις in Aristotle and in the Arabic version of the *Physics*, I discuss Bruno Nardi's interpretation of Albert the Great's *inchoatio formae*, to show how Bruno's use of the *translatio Scoti* places him in the tradition of ancient and medieval philosophers who have read the form as a quality of the matter.

**Keywords**

Aristotle's *Physics*, *Hexis* (Aristotelian Concept), Form (Early Modern Use), Giordano Bruno, Michael Scot

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## I

Giordano Bruno's *Figuratio Aristotelici Physici auditus* is a compendium of Aristotle's *Physics*, composed of six books and preceded by the application of the *ars memoriae* to the text itself.[1] It was published in Paris in early 1586, likely with didactic intent. Felice Tocco, along with Girolamo Vitelli, edited the unique modern edition.[2] Tocco described it as "un succoso compendio della fisica aristotelica [...] fatto con molta cura" (Tocco 1889, p. 104). Although this text is not among the most studied of Bruno's works, it is crucial to understanding the relationship between Bruno's thought and the tradition of the Aristotelian natural philosophy. Bruno's modifications to Aristotle's *Physics* are indeed frequent, with extensive references to the commentaries of Averroes, Philoponus, and Thomas Aquinas.[3] Among these, the edition of the Aristotelian text with Averroes' commentary is particularly relevant, as the *Figuratio* directly refers to the division of the text according to the comments of the Cordoban philosopher.[4] Furthermore, Charles B. Schmitt (1979), Charles H. Lohr (2000) and Charles Burnett (2013) have highlighted the relevance, for Renaissance Aristotelianism, of the Giunta edition of Aristotle's *opera omnia* with Averroes' commentary.[5] Here, I will

[1] Book VI is titled as "liber quintus" (p. 1, Bruno 1889, p. 202). In light of this, Felice Tocco states the existence of only five books (Tocco 1889, p. 104), despite the presence of a new chapter numbering system and the ornamental motif accompanying the first page of each book. He relies only on one copy (Turin) in his edition of the text (Bruno 1889, p. iv) and does not refer to the particularity of Book VI. This book holds, in fact, a unique status. Five copies of the *editio princeps* have been identified so far. They are kept in the Biblioteca Nazionale Centrale in Rome, the Biblioteca Nazionale Universitaria in Turin, the Bibliothèque Nationale in Paris, the Bodleian Libraries in Oxford, and the Smithsonian Libraries in Washington. In the Parisian and Oxford copies, Book VI precedes Books I-V, while the Roman copy contains only the introductory section and Book VI.

[2] The Tocco-Vitelli edition is included in Volume I, Part IV, of the *Opera Latine Conscripta* (Bruno 1889).

[3] Tocco (1889) p. 104 n. 1, had already pointed to Philoponus as a source for the Nolano, while Spruit (2000) pp. 351-2, mentions Averroes and Thomas as certain sources.

[4] The reference is meant to guide the reader in the only case in which the *Figuratio* does not follow the order of the *Physics* text. In Book VI, Ch. III we read: "Respondet parti 8 libri a tex. 54 ad 78" (p. 7*v*, Bruno 1889, p. 212), while in Ch. IV it states: "Respondet part 8 libri a tex. 34 ad 54 indeque usque in finem" (p. 10*r*, Bruno 1889, p. 216).

[5] The edition was published three times during the 16th century (1550-1552, 1562-1564 and 1574-1575). The *Physics* always occupies the whole Volume IV.

focus on a passage from the *Figuratio* linked to the translation of Aristotle's *Physics*, published many times during the sixteenth century, always together with Averroes' commentary.

Before examining the case study of this article, I will provide additional information about the *Figuratio* and its context, to outline the value of Bruno's interpretation of the Aristotelian text. As I have already mentioned, the work was printed in the early months of 1586, during Bruno's second stay in Paris. In fact, Bruno had previously spent about two years in the French capital, between 1581 and early 1583, before leaving Paris to travel to London with the French ambassador Michel de Castelnau. During that time, he delivered lectures at the Collège Royal.[6] This first stay was certainly very productive for Bruno, who published three works related to the *ars memoriae* in 1582: *De umbris idearum*, dedicated to the King of France Henry III, who was impressed by his mnemonic art, *Cantus Circaeus* and *De compendiosa architectura*.[7] Then, in London, Bruno published three more mnemotechnic works in 1583,[8] followed by the six vernacular dialogues between 1584 and 1585.[9] However, when he came back to Paris, the political tensions generated by the Wars of Religion affected the already unstable balance at the French court.[10] This, together with the polemic with the mathematician Fabrizio Mordente,[11] worked to Bruno's disadvantage, preventing him from

[6] The Collège Royal was founded in 1530 by Francis I. The *lecteurs royaux* were active in this institution. According to Bruno's own trial testimony, he was assigned to deliver a "lettione ordinaria" in Toulouse, while in Paris he could only read "quella estraordinaria" (Firpo 1993, p. 161). Therefore, it must be noted that the Nolan was not formally appointed as a *lecteur royal*, even though he delivered lectures at this prestigious institution.

[7] On Bruno's first stay in Paris see Spampanato (1921) I, pp. 307-29; Ricci (2000) pp. 142-83; *Giordano Bruno 1548-1600. Mostra storico documentaria* (2000) pp. 85-96 and Ciliberto (2020) pp. 173-208.

[8] *Ars reminiscendi*, *Explicatio triginta sigillorum* and *Sigillus sigillorum*.

[9] On Bruno's years in England see Spampanato (1921) I, pp. 329-86; Yates (1939) pp. 227-42 and (1964) pp. 205-56; Aquilecchia (1963) pp. 3-13 and (1995) pp. 21-42; Ciliberto (1986) pp. 91-153 and (2020) pp. 209-427; Ciliberto and Mann (1997); *Giordano Bruno 1548-1600. Mostra storico documentaria* (2000) pp. 97-124.

[10] On this topic see Ricci (2000) pp. 373-6.

[11] On this controversy, see the articles by Camerota (2024) and Canone (2024) in the catalogue of the recent exhibition organised at the National Central Library of Rome. Ricci (2000) pp. 380-90, stresses how the 'Mordente affair' is directly linked to the political-religious dynamics of power at the court of Henry III.

regaining his lecturing position at the Collège Royal.[12] For this reason, it is likely that the publication of a compendium of Aristotle's *Physics* with the *ars memoriae*[13] – a choice that follows Bruno's intellectual output between Paris and London – was an attempt to obtain again a teaching role.[14] As Bruno states in the dedication of the work (Bruno 1889, pp. 133-5), the *Figuratio* is the result of a precise comparison with the text of the Stagirite. However, it does not strictly follow it. Bruno, in fact, significantly modifies the text, also by using the commentaries already mentioned. These modifications often bring to light crucial themes of the Nolano's thought. The *Figuratio* is divided in six books, organized into chapters and articles. The first four books follow the order of the Aristotelian books, while *Figuratio*'s fifth book covers *Physics* books five and six, and *Figuratio*'s sixth book covers the Aristotelian books seven and eight.[15]

## II

The case study of this article addresses *Phys.* II 1.193a9-28. I will briefly summarise the Aristotelian passage and then analyse how Latin translations have influenced Bruno's interpretation. As is typical of Aristotle, he introduces a new topic by presenting the views of the earlier philosophers. In this case, to define 'nature', he begins with the opinion of those who consider it to be a synonym of matter, conceived as the "first component" present in the

[12] In the second interrogation in Venice, Bruno says that "tornando il detto Ambasciator in Francia alla Corte, l'accompagnai a Paris; dove stetti un altro anno, trattenendomi con quelli signori ch'io conoscevo, a spese però mie la maggior parte del tempo" (Firpo 1993, pp. 159-64). This suggests that Bruno was not once again appointed as an extraordinary reader.
[13] For an extensive analysis of this section, see the article by Matteoli (2015).
[14] In support of this hypothesis is another direct testimony of Bruno's second stay in Paris: the *journal* of Guillaume Cotin, librarian of the Abbey of Saint-Victor. This is the only source to give direct news of the *Figuratio*. In the *journal*, in fact, Cotin notes on 27 December 1585, that Bruno told him that he was working on three works, including "la philosophie entière d'Aristote rédigée à peu de figures, et la quelle il enseignera en demy an" (Spampanato 1921, II, p. 655). On Bruno's second stay in Paris see, in addition to the already mentioned articles by Camerota (2024) and Canone (2024), Spampanato (1921) I, pp. 387-410; Aquilecchia (1957); Auvray (1900); Yates (1951); Perfetti (1992); Canone (2007); *Giordano Bruno 1548-1600. Mostra storico documentaria* (2000) pp. 125-36 and Ciliberto (2020) pp. 429-65.
[15] In addition to the number of books, Felice Tocco also misinterpreted the concordances with Aristotle's text (Tocco 1889, p. 104).

natural being, "which is intrinsically unshaped" (Reeve 2018, p. 21). According to Antiphon, evidence for this view is the fact that a rotting wooden bed generates a sprout, rather than another bed. Similarly, everything that remains identical to itself, despite being in contact with something else, constitutes the nature and substance of a being. For this reason, some say that the nature of beings consists of one or more elements, and they identify them with the "substance of all things, everything else being ἕξεις καὶ διαθέσεις" (*ibid*.). [16] The elements constituting the nature-substance are eternal, whereas *hexeis* and *diatheseis* are generated and decay endlessly. With reference to this passage from the *Physics*, Bruno writes in the *Figuratio* (Bruno 1889, p. 155):

> Materiam quidem esse naturam est manifestum, tum ex hoc quod primum informe subiectum maxime natura existimatur, ut ex lecto putrescente declarat Antiphon, et ex auro quod in aquam, et ligno quod in terram vertitur, alii; tum etiam ex antiquorum communi sententia, qui sane totam rei substantiam atque naturam (utpote unum perpetuo manens, supra quo infinitae formae variantur) materiam esse crediderunt, quos quidem per pueros patrem a matre non distinguentes figurare possumus.[17]

This text diverges from Aristotle's in many aspects,[18] but here I focus only on the definition of matter identified by the ancients with substance and nature as "unum perpetuo manens, supra quo infinitae formae variantur" (Bruno 1889, p. 155). In Aristotle's text, instead, it is stated that ἕξεις καὶ διαθέσεις of the matter "come to be or pass away an unlimited number of times" (Reeve 2018, p. 21). It is therefore evident that Bruno has replaced ἕξεις καὶ διαθέσεις with the term '*formae*'. The words ἕξεις and διαθέσεις are attested in the reference editions of the Greek text – Bekker (193a25-26) and Ross (1936) – without significant variants in the manuscripts. To

[16] I have replaced the English translation with the key terms for this study: ἕξεις and διαθέσεις (*Phys*. 193a25-26). Reeve translates ἕξεις as 'states' and διαθέσεις as 'dispositions'.
[17] Felice Tocco and Girolamo Vitelli decided to retain the expression "figurasse possumus", as it appears in the *editio princeps*. Cecilia Sideri suggested modifying the expression to "figurare possumus".
[18] In addition to last sentence, which is found in Book I of the Aristotelian text (184b12-14), it should be noted that Aristotle says the opposite of what Bruno mentions regarding gold and wood. In the *Physics* (193a17-21), in fact, it is stated that neither gold changes when in contact with water nor wood when in contact with earth.

better understand what might have influenced Bruno's interpretation, it is necessary to analyse the Aristotelian text as edited in the commentaries that Bruno extensively used to write the *Figuratio*. I refer, as mentioned, to the sixteenth-century editions of the commentaries by Philoponus, Averroes and Thomas Aquinas. Then, I examine the Giunta edition of Aristotle's *opera omnia* with Averroes' commentary, published in Venice in 1562, along with the 1570 '*Piana*' edition of Thomas Aquinas' commentary, printed in Rome by the heirs of Antonio Blado and Giovanno Osmarino Gigliotto.[19] In fact, both texts are identified by Charles B. Schmitt (1979, pp. 125-6) as reference editions for the sixteenth-century Aristotelian studies. It is well known that, in the Latin tradition of the *Physics*, the medieval translations from Greek by James of Venice and William of Moerbeke compose the *vulgata*. These translations are referred to as '*antiqua translatio*' or '*vetus translatio*' in the sixteenth-century editions (Cranz 1971, p. 113). Both the editions with Averroes' and Thomas' commentaries include two versions of the Aristotelian text: alongside the *vulgata* in William of Moerbeke's translation, the Giunta edition has the translation from Arabic, commonly attributed to Michael Scot (*translatio Scoti*), while the *editio Piana* presents James of Venice's version with the more recent translation by John Argyropoulos. Philoponus' commentary was edited in the sixteenth century with two different translations of the Aristotelian text, one by Guilielmus Dorotheus and the other by Johannes Baptista Rasarius. Here, I refer to Rasarius' translation – printed more frequently than Dorotheus' version – in the 1581 edition published in Venice by the heirs of Girolamo Scotto. This edition, in fact, is the closest to the publication of the *Figuratio* (Cranz 1971, p. 157; Lohr 2024, pp. 72-3). I transcribe from these sixteenth-century editions the passage corresponding to *Phys.* 193a23-28, that ends with the terms ἕξεις καὶ διαθέσεις:[20]

[19] The *Physics* was published in Volume II of the *opera omnia* commissioned by Pius V, alongside the *De caelo* and *De generatione et corruptione*. The publisher Giulio Bolani degli Accolti also contributed to the printing of the work, hence some copies feature the inscription "apud Iulium Accoltum" (Cioni 1969).

[20] In the transcription I expand the abbreviations and change the 'u' into 'v'.

Aristotle (1562) p. 51*r*E, *vulgata*:
quod enim aliquis ipsorum existimavit huiusmodi, sive unum, sive plura, hoc, et tot dicit esse omnem substantiam, alia autem omnia passiones istorum, et habitus et dispositiones.

Aristotle (1562) p. 51*r*F, *translatio Scoti*:
illud enim, quod existimavit unusquisque eorum esse huiusmodi, sive unum, sive plura, illud, vel illa posuerunt totam substantiam, et quod alia sunt passiones accidentes istis, et dispositiones, et formae.

Aristotle (1570), p. 16*r*, *vulgata*:
quot enim aliquis acceperit ipsorum huiusmodi, sive unum, sive multa hoc, et tanta dicit esse omnem substantiam: alia autem omnia passiones istorum et habitus, et dispositiones.

Aristotle (1570), p. 16*r*, Argyropoulos:
quod enim quisque tale esse putavit, sive unum, sive plura, id totque universam substantiam esse dicit. Cetera vero cuncta affectus horum habitus, ac dispositiones.

Aristotle (1581) p. 66, Rasarius:
Quod enim quisque putavit tale esse sive unum, sive plura, id totque universam substantiam esse dixit: caetera vero alia affectiones, habitus ac dispositiones horum.

In the following table I summarise the comparison of the texts, with the reference only to the translation of the Aristotelian expression ἕξεις καὶ διαθέσεις:

| Aristotle (1562) p. 51*r*E, *vulgata* | Aristotle (1562) p. 51*r*F, *translatio Scoti* | Aristotle (1570) p. 16*r*, *vulgata* | Aristotle (1570) p. 16*r*, Argyropoulos | Aristotle (1581) p. 66, Rasarius |
|---|---|---|---|---|
| habitus et dispositiones | dispositiones, et formae | habitus, et dispositiones | habitus, ac dispositiones | habitus ac dispositiones |

The translation "dispositiones et formae" is found only in the *translatio Scoti* of the Giuntine, while the other texts state "habitus et dispositiones". Therefore, it seems that, in the *Figuratio*, Bruno received the term '*formae*' from the *translatio Scoti*. To identify any other translation of this specific Aristotelian passage as '*formae*', I examine the other Latin translations of the *Physics* published up to the date of the printing of the *Figuratio*.

## III

To trace both the translations and sixteenth-century editions of Aristotle's text, I referred to the recently published catalogue of Latin editions of Aristotle, edited by Christoph Lüthy and Davide Cellamare (Lohr 2024). This work carries on Charles Loh's research, which was built on the revision by Charles B. Schmitt, published in 1984, of the *Bibliography of Aristotle Editions, 1501-1600* edited by F. Edward Cranz (1971). Fifteen different translations of the *Physics* are known to have been published up to 1586, the year the *Figuratio* was printed. I list the translators below, including in the footnotes the editions consulted and, where applicable, the references to the catalogues:

1. James of Venice (12th C.): "habitus et dispositiones".[21]
2. Michaele Scot (12th-13th C.): "dispositiones et formae".[22]
3. William of Moerbeke (13th C.): "habitus et dispositiones".[23]
4. John Argyropoulos (15th C.): "habitus ac dispositiones".[24]
5. Guillaume Briçonnet (15th-16th C.): "habitus/ et dispositiones".[25]
6. Augustinus Niphus (15th-16th C.): "habitus, et dispositiones".[26]
7. Guillelmus Dorotheus (16th C.): "habitus ac dispositiones".[27]
8. Nicolaus Grochius (16th C.): "habitus et affectiones".[28]
9. Gentian Hervetus (16th C.): "habitus, et affectiones".[29]
10. Lucillo Filalteo Maggi (16th C.): "habitusque, et dispositiones".[30]

[21] Aristotle (1570) p. 16*r* (Lohr 2024, 7.1).
[22] Aristotle (1562) p. 51*r*E (Cranz 1971, 108.193; Lohr 2024, 7.7).
[23] Aristotle (1562) p. 51*r*F (Cranz 1971, 108.193; Lohr 2024, 7.5).
[24] Aristotle (1570) p. 16*r* (Lohr 2024, 7.3). There is another version of this translation, attested in a single printed copy, which I have not been able to examine (Cranz 1971, 108.074; Lohr 2024, 7.4).
[25] Aristotle (1518) p. 13*v*. This is a revision of the *vulgata* (Cranz 1971, 107.850; Lohr 2024, 7.9).
[26] Aristotle (1549) p. 62*v*N (Cranz 1971, 108.173; Lohr 2024, 7.8).
[27] Aristotle (1546) p. 49*v*. The text contains only Books I-IV with the commentary of Philoponus (Cranz 1971, 108.291; Lohr 2024, 7.14).
[28] Aristotle (1552b) p. 27. This is a revision of Périon's translation (Cranz 1971, 108.241; Lohr 2024, 7.13).
[29] Aristotle (1551a) p. 45*r* (Lohr 2024, 7.12).
[30] Aristotle (1566) p. 125 (Lohr 2024, 7.18).

11. Joachim Périon (16th C.): "habitus et affectiones".[31]
12. Johannes Baptista Rasarius (16th C.): "habitus ac dispositiones".[32]
13. Francisco Vallés (16th C.): "habitus, et dispositiones".[33]
14. Francesco Vimercati (16th C.): "habitus et dispositiones".[34]
15. Anonymous: Lohr (2024) 7.17, refers to a single edition of the anonymous translation – absent in Cranz (1971) – printed in Paris in 1562, which I have not been able to consult.

In addition, the online *Vernacular Aristotelianism in Renaissance Italy Database* (VARI 2012), edited by David Lines and Eugenio Rufini, points to a vernacular translation by Antonio Brucioli, published in Venice in 1551,[35] which states "habiti, et disposizioni" (Aristotle 1551b, p. 26). I summarise the results of the investigation below:

| | |
|---|---|
| 1. habitus et/ac dispositiones: | 10 translations: James of Venice, William of Moerbeke, John Argyropoulos, Guillaume Briçonnet, Augustinus Niphus, Guillelmus Dorotheus, Lucillo Filalteo Maggi, Johannes Baptista Rasarius, Francisco Vallés, Francesco Vimercati. |
| 2. habitus et affectiones: | 3 translations: Gentian Hervetus, Joachim Périon, Nicolaus Grochius. |
| 3. dispositiones et formae: | 1 translation: Michael Scot. |

The expression '*habitus et dispositiones*', with the variant '*ac*' replacing '*et*' in the translations by Argyropoulos, Dorotheus, and Rasarius, is the most attested translation, also found in the *vulgata*. The translations by Nicolaus Grochius, Gentian Hervetus, and Joachim Périon feature the variant

[31] Aristotle (1550b) p. 14*r* (Cranz 1971, 108.187; Lohr 2024, 7.10).
[32] Aristotle (1558) p. 72. The text contains only Books I-IV with the commentary of Philoponus (Cranz 1971, 108.361; Lohr 2024, 7.15).
[33] Aristotle (1562b) p. 57 (Lohr 2024, 7.16).
[34] Aristotle (1550c) p. 101 (Lohr 2024, 7.11). This volume also includes the Greek text, and at p. 100, we read ἕξεις, καὶ διαθέσεις, as in both the Bekker and Ross editions (1936) 193a25-26.
[35] See also Cranz (1971) 108.224.

'*affectiones*' in place of '*dispositiones*'. Only the translation attributed to Michael Scot includes '*formae*', used by Bruno in the *Figuratio* to address the Aristotelian passage. By cross-referencing the catalogues of Cranz (1971) and Lohr (2024), thirteen editions of *translatio Scoti* can be identified, from 1501 to 1584.[36] Among these, I have been able to consult, in addition to the three Giunta editions of Aristotle's *opera omnia* with Averroes' commentary already mentioned (Aristotle 1550a, 1562a, 1574), the following editions:

1. Aristotle (1520) p. 41*v*: "habitus et dispositiones"/"dispositiones et forme".[37]
2. Aristotle (1529) p. 41*v*: "habitus et dispositiones"/"dispositiones et forme".[38]
3. Aristotle (1560) p. 40*v*E: "habitus, et dispositiones"/"dispositiones, et formae".[39]

Although in only three out of ten copies, the other editions confirm the Giuntine's version. I analyse below all occurrences of '*habitus*' in the *vulgata*, with reference to its equivalent in Michael Scot's translation. For this purpose, I keep referring to Volume IV of the 1562 Giunta edition, for both translations. The textual research was conducted by cross-referencing the online resources *Aristoteles Latinus Database* (ALD 2023) and *Digital Averroes Research Environment* (DARE 2010). The former enables searches within the Greek-to-Latin translations by James of Venice and William of Moerbeke, while the latter allows searches within the *vulgata*, the *translatio Scoti* and Averroes' long commentary, in the incunable printed in Padua around 1472-1475 (Aristotle 2011):

| | Book | Bekker/Ross | *Vulgata* | *Translatio Scoti* |
|---|---|---|---|---|
| 1 | I | 188a7: ἕξεις | p. 25*v*I: habitus | p. 25*v*K: formae |
| 2 | I | 193a25: ἕξεις | p. 51*r*E: habitus | p. 51*r*F: formae |
| 3 | II | 195a9: εὐεξίας | p. 60*r*E: Boni habitus / bonae habitudinis | p. 60*v*G: Bonae consistentiae corporis |
| 4 | IV | 209b27: ἕξις | p. 127*v*K: habitus | p. 127*v*L: forma |

[36] Cranz (1971) p. 155, lists fourteen editions, but the one printed in Venice in 1516 contains only Augustinus Niphus' version (107.838).
[37] *Ibid*., 107.866.
[38] *Ibid*., 107.906.
[39] *Ibid*., 108.423.

| | | | | |
|---|---|---|---|---|
| 5 | IV | 210b26: ἕξις | p. 132*v*G: sicut habitus | p. 132*v*H: secundum formam |
| 6 | IV | 223a19: ἕξις | p. 201*r*F: habitus | p. 201*v*G: forma |
| 7 | V | 228a8: ἕξεις | p. 229*v*M: habitus | p. 230*r*A: formae |
| 8 | V | 228a14: ἕξεις | p. 230*r*F: habitus | p. 230*v*G: formae |
| 9 | V | 228a15: ἕξις | p. 230*r*F: habitus | p. 230*v*G: forma |
| 10 | VII | 245b22: τοῖς σχήμασι καὶ ταῖς μορφαῖς καὶ ταῖς ἕξεσι | p. 318*r*D: In figuris, et formis, et habitus | p. 318*r*F: In figuris, et formis, et vestiti |
| 11 | VII | 246a29-30: ἕξεσιν | p. 319*v*K: in habitibus | p. 319*v*L: in formis |
| 12 | VII | 246a30: ἕξεις | p. 319*v*K: habitus | p. 319*v*L: formae |
| 13 | VII | 246b27: περὶ τὰς ἕξεις | p. 319*v*L: circa habitus | p. 320*r*A: in formis |

There are a further thirteen occurrences in the two versions of the *vulgata* text in the *Aristoteles Latinus* edition and in the *vulgata* of the Paduan incunabulum transcribed in DARE (2010). However, in this case these texts differ from the version of the *vulgata* in the Giunta edition. In fact, the occurrences of '*habitum*' in both *Aristoteles Latinus* and DARE always correspond, in the Giunta edition, to '*contiguus*'.[40] The Greek text edited by Ross also does not feature ἕξις in any of these occurrences. It is likely that the editors of the Giunta edition revised and emended those previous versions of the *vulgata*.[41]

The analysis has shown that all occurrences of '*habitus*' in the *vulgata* in the Giunta edition correspond to the Greek ἕξις. Also, excluding the translation of εὐεξίας, eleven out of twelve instances are rendered as '*forma*' in Michael Scot's translation. The only exception occurs in the passage where, in the Greek text, ἕξις follows μορφή in the phrase τοῖς σχήμασι καὶ ταῖς μορφαῖς καὶ ταῖς ἕξεσι. This passage poses no difficulty for translators from Greek. However, in the *translatio Scoti*, '*forma*' is replaced with '*vestiti*'. It is therefore evident that we are dealing with a systematic approach: the Arabic equivalent of the Greek ἕξις is translated into Latin as '*forma*'. Evidence for this lies in the absence of '*habitus*' in Michael Scot's translation and the substitution of '*forma*' with '*vestiti*' in the only case where ἕξις directly

[40] And mostly to the verbs '*sequor*' and '*succedo*' in Michael Scot's translation, as also founded in DARE.

[41] In fact, the volume's introduction states: "Aristotelis de Physico auditu libri Octo, ex optimis codicibus castigati" (Aristotle 1562a, p. [1]*v*).

follows μορφή in the Greek text. As previously mentioned, this translation is attributed to Michael Scot and was conducted from Arabic. All the other translations printed in the sixteenth century, starting with James of Venice's *vulgata*, were made from the Greek.[42] This distinction is crucial for this research. The variant '*formae*', indeed, can only result from the double translation of the Greek ἕξεις into Arabic and then from Arabic into Latin.

## IV

Before analysing the Arabic text, it is useful to briefly outline the history of this translation, to highlight its significant role within Aristotle's *Physics* tradition. I first examine the sixteenth-century editions, for information about the translation. As I have already mentioned, I have analysed six editions from the thirteen listed in Cranz (1971) and Lohr (2024): the three Giuntine (Aristotle 1550a, 1562, 1574), the editions printed in Lyon in 1520 and 1529 and, finally, the one printed in Venice by Comin da Trino di Monferrato in 1520. None of these editions contain specific references to the *translatio Scoti*, not even the Giunta editions, despite the extensive information given about the criteria for the edition of the texts. In the preface to the first volume of the first edition, Marco degli Oddi mentions only the revision of the Aristotelian text by Giovanni Battista Bagolino, with no distinction between the two versions.[43] In Cranz (1971) p. 155, this translation is described as a "translation associated with the commentary of Averroes," while in Lohr (2024, p. 70, 7.7), it is referred to as anonymous. However, in the introduction to the critical edition of James of Venice's translation of the *Physics*, Fernard Bossier and Jozef Brams (1990) p. liv n. 84, clarify that this translation is the one commonly attributed to Michael Scot. The Scotsman was already identified by De Vaux as a possible translator of the *Physics*, the certain translator of the *De Caelo*, and most likely the translator of Averroes' long commentary

[42] From the manuscripts, before the printing of the Aldine edition of Aristotle's works, at the end of the fifteenth century.

[43] "Ob id Physicorum liber in Quarto volumine locum obtinuit, qui quidem de principiis naturalium rerum agit: vbi contextus in primis Aristotelis castigatus fuit a Bagolino nostro, et Averrois commentaria magna, quae in hanc conscriptis tractationem, ab iis, quos supra recensuimus, doctoribus emendata sunt" (Aristotle 1552a, p. 9).

(1933, p. 219; Glasner 2009, p. 12 n. 16). Although the attribution remains uncertain, it is nonetheless possible to link this translation with Averroes' commentary. In fact, the *translatio Scoti* is always linked with it, both in manuscripts and printed editions. Furthermore, De Vaux (1933, p. 221) was the first to suggest Theodore of Antioch as the translator of Averroes' *Proemium* to the long commentary on the *Physics*. According to De Vaux, the translation of the *Physics* could also have been made by Theodore, or by both him and Michael Scot. The two, in fact, were together in the service of Frederick II, during the last years of Scot's life, before his death in 1235. Theodore would then succeed him as court philosopher.[44] In addition, according to De Vaux (1933, p. 224), the translation was not part of the Aristotelian works introduced in Paris around 1230. Since the translation is preserved in a manuscript from the Bibliothèque Nationale in Paris dated 1243,[45] it can be dated to the first three decades of the 13th century. Thus, the *translatio Scoti* can be placed in the milieu of Frederick II's court. Indeed, Theodore succeeded Scot as court philosopher, and the two are the translators, respectively, of Averroes' *Proemium* and, almost certainly, his long commentary on Aristotle's *Physics*, to which the *translatio Scoti* is always associated.

The *translatio Scoti* is not the only *Physics* translation from Arabic. There are, in fact, two others: the first, by Gerard of Cremona, dated between his arrival in Toledo in 1144 and his death in 1187, which presents only the Aristotelian text, without commentary; the second, anonymous, is preserved in only three manuscripts, one of which contains only Book VII and sections of Book VIII with Averroes' commentary, while the others contain only Book VII with the commentary of the Cordoban philosopher (Arnzen 2021, p. ccv).[46] Rüdiger Arnzen (*ibid*., p. ccvi) highlights how the

[44] On Michael Scot at the court of Frederick II, see Burnett (1994) and (1999) and Pick (1998).

[45] Paris, B. N. lat. 15453 (Bossier and Brams 1990, p. lv n. 84).

[46] Arnzen (2021) pp. ccv-ccix, formulates the hypothesis that this translation was meant to fill gaps in the *translatio Scoti*. He had, in fact, already demonstrated the earlier date of the anonymous translation, based on the influences of the *translatio Scoti* on it. However, Arnzen adds that it cannot be excluded that it consists of excerpts of a new and complete translation. Moreover, Schmieja (2007) pp. 85-135, highlights that this translation is truly

three translations differ significantly from each other. The text of Gerard of Cremona follows the Arabic closely, while the other two translations are more focused on the fluency of the Latin text. Nevertheless, Arnzen (*ibid*., p. ccix) adds that the technical terminology is translated mostly the same. Here, my analysis focuses on the *translatio Scoti*, as it is the only one to have been published during the sixteenth century. Bossier and Brams (1990, pp. lv-lvi) note that this translation had a greater fortune, and influenced authors such as Robert Grosseteste, Adam of Buckfield, and Albert the Great. Moreover, they observe that a chain of scholastic glosses appeared at the University of Oxford, including excerpts from an '*alia translatio*', which refer to this translation and Averroes' commentary.[47] Finally, the authors point to the influence of Scot's translation on the later tradition of the translation by James of Venice, dating from around 1235-1240 (Bossier and Brams 1990, p. lix).

After having briefly outlined the historical and cultural context of the *translatio Scoti*, I examine the Arabic text. Among the three Arabic translations of the Greek text, the *translatio Scoti* was based on that of Isḥāq Ibn Ḥunayn. This translation, carried out between the 9th and 10th centuries, has been preserved almost intact in the manuscript Leiden Or. 583, dated October 5, 1130. The manuscript is the result of roughly a century of teaching activity on Aristotle's *Physics*. In fact, Isḥāq Ibn Ḥunayn's translation was adopted as the canonical text in the school of Yaḥyā ibn 'Adi, and countless scholars from the Baghdad school worked on this manuscript over the centuries.[48] Arnzen (2021) p. xciv, stresses that their goal was not to preserve the translation but to modify the text in order to understand, adapt, and incorporate Aristotle's thought into the philosophy and cosmology of their school. All three Arabic translations are accompanied by a commentary. In the case of the manuscript tradition of Leiden Or. 583, these include the commentaries of Alexander and Themistius, alongside those of the Arab

independent and not merely a revision of the *translatio Scoti*. Finally, Schmieja also suggests Hermannus Alemannus as a possible translator.

[47] The authors clarify that from the study of the existing copies, it emerges that this is neither the result of multiple scholars working independently, nor the copying of glosses from one manuscript to another. Instead, they suggest that this is the work of several scholars who progressively formed the core of the Oxford exegesis of the text (Bossier and Brams 1990, p. lv).

[48] The manuscript was last copied by Abū al-Ḥakam († 1135) (Peters 1968, p. 31).

commentators of the school of Yaḥyā ibn ʻAdi (Peters 1968, p. 31). Additionally, it is relevant to underline that Averroes worked on a different manuscript tradition of the translation, as did the Latin translators.[49] The manuscript text was edited in two volumes in 1964-65 by Abdurrahman Badawī. For the textual research, I have used the online resource *Glossarium Græco-Arabicum. A Lexicon of the Medieval Arabic Translations from the Greek* (GGA 2011), but my gratitude goes to Tommaso Alpina, who provided me with invaluable information on the Arabic terms. He has also integrated the missing occurrences in GGA (2011). I therefore proceed to list the correspondences between the passages I have examined in the Giuntine and the text of Isḥāq Ibn Ḥunayn's translation in the edition by Badawī:

| | | Bekker/Ross | *Vulgata* | *Translatio Scoti* | Badawī |
|---|---|---|---|---|---|
| 1 | I | 188a7: ἕξεις | p. 25*v*I: habitus | p. 25*v*K: formae | al-hay'āt |
| 2 | I | 193a25: ἕξεις | p. 51*r*E: habitus | p. 51*r*F: formae | malakāt |
| 3 | II | 195a9: εὐεξίας | p. 60*r*E: Boni habitus / bonae habitudinis | p. 60*v*G: Bonae consistentiae corporis | ḫiṣb al-badan |
| 4 | IV | 209b27: ἕξις | p. 127*v*K: habitus | p. 127*v*L: forma | hay'a |
| 5 | IV | 210b26: ἕξις | p. 132*v*G: sicut habitus | p. 132*v*H: secundum formam | l-hayʾa |
| 6 | IV | 223a19: ἕξις | p. 201*r*F: habitus | p. 201*v*G: forma | hay'a |
| 7 | V | 228a8: ἕξεις | p. 229*v*M: habitus | p. 230*r*A: formae | al-hay'āt |
| 8 | V | 228a14: ἕξεις | p. 230*r*F: habitus | p. 230*v*G: formae | hay'āt |
| 9 | V | 228a15: ἕξις | p. 230*r*F: habitus | p. 230*v*G: forma | hay'a |
| 10 | VII | 245b22: τοῖς σχήμασι καὶ ταῖς μορφαῖς καὶ ταῖς ἕξεσι | p. 318*r*D: In figuris, et formis, et habitus | p. 318*r*F: In figuris, et formis, et vestiti | al-aškāl wa-l-ṣuwar wa-l-hayʾāt |
| 11 | VII | 246a29-30: ἕξεσιν | p. 319*v*K: in habitibus | p. 319*v*L: in formis | al-hayʾāt |
| 12 | VII | 246a30: ἕξεις | p. 319*v*K: habitus | p. 319*v*L: formae | |
| 13 | VII | 246b27: περὶ τὰς ἕξεις | p. 319*v*L: circa habitus | p. 320*r*A: in formis | |

[49] See Arnzen's *stemma codicum* (2021) p. ccxxx.

The translation of Isḥāq Ibn Ḥunayn attests to the two words commonly used to translate ἕξις, namely *malaka* (ملكة) and *hay'a* (هيئة) (Naaman 2017, p. 4).[50] The former refers to a personality trait, a disposition, and, in this sense, a *habitus*. The latter denotes form as external configuration or appearance.[51] It is therefore evident that the Latin translator has translated not only the Arabic *hay'a* as '*forma*', but also *malaka*, while, since James of Venice, the Latin translators have used '*habitus*' to refer to the Greek ἕξις.

## V

The analysis of all the translations of the *Physics* highlighted that the *translatio Scoti* is the only one to refer to the Aristotelian phrase ἕξεις καὶ διαθέσεις as 'dispositiones, et formae'. Moreover, it has been shown that in this version, through the Arabic, there is a systematic translation of ἕξις as '*forma*'. On the contrary, in the translations from Greek, the term is always translated as '*habitus*', since the version by James of Venice. Additionally, it has been noted that the passage from *Phys.* 193a9-28 is reported by Giordano Bruno in the *Figuratio* following precisely the *translatio Scoti*. In fact, Bruno writes that matter is "unum perpetuo manens, supra quo infinitae formae variantur" (Bruno 1889, p. 155). By adopting the term found only in the Arabic translation, Bruno does not modify the meaning of the Aristotelian passage. Indeed, both translations in the Giuntine edition state that, for the ancients, nature is the "primum non formatum per se" (Aristotle 1562a, fol. 50*v*I, 50*v*K-L). It is therefore the Aristotelian text itself that refers, in all its editions, to the fact that ancient thinkers conceived the form as ἕξις or διάθεσις of the matter. Indeed, all the Latin editions – except for Scot's translation – indicate that for the ancients, everything other than matter is described as *passiones*, *habitus*, and

[50] Along with *malaka* and *hay'a*, Naaman lists *qunya* (acquired disposition), *ḥāl* (state), and *ḥāl lāzima* (inseparable state) as alternatives to convey the sense of ἕξις.

[51] Naaman (2017) p. 6, explains that Al-Fārābī uses the term *malaka* to refer to consolidated dispositions that are difficult to lose, while *ḥāl* refers to dispositions that are easy to lose. According to Al-Fārābī, who was trained in Baghdad – where, as previously noted, the translation of the *Physics* by Isḥāq Ibn Ḥunayn circulated – it is a mistake to use *hay'a* as a synonym for *malaka*, since *hay'a* can also indicate a transitory disposition, much like the term *ḥāl*. From this perspective, *hay'a* should translate διάθεσις instead, and only *malaka* should refer to ἕξις.

*dispositiones* of the matter. This necessarily includes the form, which is explicitly mentioned by Averroes (Aristotle 1562, pp. 50*r*M-52*r*A), Thomas Aquinas (Aristotle 1570, p. 16*r*), and Philoponus (Aristotle 1581, pp. 64-6). After all, ἕξις and διάθεσις belong to the category of quality, along with πάθος (*Cat*. 8.9a28-10a9) and σχῆμα or μορφή (*Cat*. 8.10a11-26), the latter two conceived as figure and external form. It is therefore likely that, in this passage, Aristotle refers to the category of quality, suggesting that, in the view of the ancients, the form – understood as figure or external appearance – is a πάθος, an ἕξις, and a διάθεσις of the matter. In short, they conceived the form as a quality of the matter-nature-substance. Thus, while in following Scot's translation Bruno does not modify the meaning of the Aristotelian text, the expression "unum perpetuo manens, supra quo infinitae formae variantur" clearly evokes his own theory of the relationship between matter and form. In doing so, he links up with the tradition of those who have interpreted the form as a quality of matter-nature-substance, thereby assimilating it to the other components of the category of quality, including ἕξις.

To discuss this parallel between ἕξις and form as a quality of the matter, it is useful to briefly outline the meaning of ἕξις and διάθεσις in Aristotle's work. In *Cat*. 8.8b29-9a1, the Stagirite defines them as two genres of the category of quality, differing in that the ἕξις is more stable and enduring – such as knowledge and virtue – while the διάθεσις is easily removable and changes quickly – such as hotness and chill, sickness and health. As qualities rather than substances, ἕξεις do not belong to the essence of a being, even though, unlike διάθεσεις, they are characterised by stability and permanence (Ackrill 1963, p. 24). Furthermore, Pierre Rodrigo (2004) emphasises that ἕξις relates to πρᾶξις, θεωρία, and ποίησις, implying a dynamic process as a tension toward fulfilment, conceived as ἐνέργεια. As a habitual, stable, and enduring state, ἕξις has always an evaluative aspect, meaning either perfection or, conversely, decadence. Hence, in ethics, the virtue is an ἕξις as a perfection in accordance with the nature of the being (κατὰ φύσιν): to be virtuous means to have a stable disposition to function well, with a strong and healthy body and a good quality of character. Although it is a quality and not a substance, ἕξις constitutes the natural perfection of a substance, the stable condition

of its proper functioning, i.e. its perfection (Morel 1997; Chiaradonna and Farina 2020).

In the meaning outlined above, the concept of ἕξις relates to Bruno Nardi's (1936) interpretation of Albertus Magnus's theory of *inchoatio formae*, which Nardi directly connects to Giordano Bruno's thought. The Italian scholar identifies the first use of the expression to refer to Robert Grosseteste's doctrine, according to which light is the primary form that put into act all matter (Nardi 1936, p. 75). In Scholasticism, the term is used to indicate Augustine's theory of *rationes seminales*, according to which form already exists, albeit incompletely, within the active power of matter (*ibid*., p. 76).[52] Similarly, Bonaventure interprets the power of matter not as a passive capacity but as an active power that, in actualising itself, becomes form, "in quell modo che il bocciolo schiudendosi diventa la rosa" (*ibid*., p. 79). This culminates in Albertus Magnus's view that the virtue of the heavens impresses into the pure and indeterminate power of the prime matter the *principia formalia et effectiva*, that enable the matter to send forth all particular forms from within itself. These *principia* are created alongside matter, distinct from it, and all forms originate from them. Albertus refers to this process as *potentia activa indita materiae*, arising from a primordial, indeterminate, and imperfect form that, striving towards its perfection, determines itself, and evolves into the infinite forms of nature, more or less perfect, depending on their distance from the heavens (*ibid*., p. 82). The conception of form as a tension towards the fulfilment of the *principia formalia et effectiva* inherent in the matter overturns the Aristotelian position – adopted, among others, by Thomas Aquinas – according to which the matter is pure power, awaiting to receive from the outside act and order from the form (*ibid*., p. 84). For Albertus, by contrast, the matter must already contain something of the form – an *inchoatio formae* – enabling it to move towards the fulfilment and perfection of forms. The Dominican, indeed, marks a distinction

[52] Michele Ciliberto highlights the influence of Augustine's thought on Bruno's work, through Teofilo da Vairano. He was Bruno's teacher in Naples, and had a great impact on him, particularly "nella critica della materia come pura potenzialità, e nel riconoscimento ad essa di una dimensione positiva, di una certa dimensione 'attuale'" (Ciliberto 1986, pp. 56-8). On Teofilo da Vairano, see Carella (1995) and (2012), Scapparone (2014) and Carannante (2019).

between two conceptions of the power of the matter: *potentia indifferentemente ad esse et non esse* and *potentia formalis* as *aptitudo ad actum*. In this latter sense, the matter contains a beginning of the forms, which strive towards their perfection and fulfilment within the matter itself (*ibid.*, p. 88). In Nardi's interpretation of Albertus Magnus's *inchoatio formae*, the form represents, for the Dominican, the perfection of something inherent in the matter, in accordance with the nature of the being. This interpretation of the form is similar to the Aristotelian conception of ἕξις. In this sense, ἕξις and form converge, both representing the fulfilment of a nature inherent in matter itself, as its perfection.

The use of the term '*forma*' by Bruno in the *Figuratio*, as found in the *translatio Scoti*, is placed within the tradition of the *inchoatio formae* and the overturning of the Aristotelian relationship between matter and form. It is Bruno himself who refers to this expression in the *De vinculis* (Bruno 2000, p. 516):

> Profundius vero philosophantes intelligunt quod nos alibi declaravimus, ut materia ipsa inchoationem habeat omnium formarum in sinu suo – ita ut ex eo omnia promat et emittat –, non puram illam exclusionem – ita ut quasi omnia peregrina concipiat ab externo. Extra quippe materiae gremium nulla forma est, sed in eo tum omnes latent, et ex eo tum omnes educuntur.

Barbara Amato (2010, p. 63) stresses the importance, for Bruno, of the meaning of the indeterminacy of the matter. Whereas for Aristotle the matter is indeterminate in the sense that it lacks forms, for Bruno it is so because it contains all forms within itself. Matter is the only substance of physical things and is more worthy of being called 'nature' than form, since form without matter has no subsistence (Bruno 2009, p. 54). In the parallel between nature and artistic production, Bruno speaks of an "arte della materia", capable of eliciting forms "per modi di separazione, di parto, di efflusione, come intesero i Pitagorici, comprese Anassagora e Democrito" (Bruno 2007, p. 719). For the Nolano, the matter is a "cosa divina", as it "esplica lo che tiene implicato" and is "ottima parente, genitrice e madre di cose naturali: anzi, la natura tutta in sustanza" (*ibid.*, p. 720), just as the ancient philosophers, mentioned by Aristotle in *Phys.* 193a9-28, believed. Moreover, immediately before the passages from the *De la causa* cited above, Bruno (*ibid.*, p. 719) directly refers to the *Physics* passage that I have analysed in this paper:

Et io dico, che l'essere espresso, sensibile et esplicato, non è principal raggione dell'attualità, ma è una cosa consequente et effetto di quella: sì come il principal essere del legno e ragione di sua attualità non consiste ne l'esser letto, scanno, trabe, idolo et ogni cosa di legno formata.

It is finally in his commentary on Aristotle's *Physics* that Bruno clearly reveals what in the *Figuratio* was only implicit (Bruno, forthcoming, p. 84):

Natura dupliciter dicitur: uno pacto significat materiam, alio pacto significat formam. Primo modo iuxta antiquorum opinionem maxime natura materia dicebatur, siquidem materia videtur esse quod semper manet et perseverat idem, ut argumentabatur Antiphon ex similitudine lecti infossi, qui si putrescens germinet, non producet lectum alterum, sed lignum; unde totam substantiam rerum existimabat esse materiam. Ita et hi et alii multi, quorum hi quidem terram, illi vero aerem, alii vero aliud naturam existimabant, omnem vero formam ad passionem, dispositionem et habitum referebant. Stat ergo commune nobis et ipsis naturam uno modo dici materiam.[53]

Here, Bruno mentions all the terms present in the Latin text of the *Physics* – '*passionem*', '*dispositionem*', and '*habitum*' – and not only, as in the *Figuratio*, the term '*formae*' found in the *translatio Scoti*. However, it is the addition of "stat ergo commune nobis et ipsis naturam uno modo dici materiam" that makes explicit what was implicit in the *Figuratio*. The use of the term '*formae*' from the *translatio Scoti* in the passage of the *Figuratio* reveals how the overturning of the Aristotelian conception of the relationship between form and matter means for Bruno placing the '*nolana filosofia*' into the tradition of those who conceived the form as a quality of the matter-nature-substance.

[53] This work contains Bruno's commentary on the first five books of the *Physics*, on the *De generatione et corruptione*, and on Book IV of the *Meteorologica*. It was published at the end of the nineteenth century in Volume III of the *Opera Latine conscripta*, edited by Felice Tocco and Girolamo Vitelli, under the title *Libri Physicorum Aristotelis Explanati*. Ilenia Russo edited a new critical edition of the text, with an Italian translation (Bruno, forthcoming).

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# PEDRO HURTADO DE MENDOZA (1578-1641) ON MATTER

**Abstract**

This paper examines a specific instance of conceptual and terminological reconfiguration in early modern scholastic Aristotelianism: the case of the Jesuit Pedro Hurtado de Mendoza and his account of *materia*, tightly interwoven with the positions of fellow Jesuits Francisco Suárez and Rodrigo Arriaga. After reconstructing Hurtado's position on the ontological status of prime matter, his rejection of the Aristotelian claim that it is pure potency, and his distinction between "physical" and "metaphysical" meanings of *materia*, we turn to Hurtado's treatment of the matter-form relation. Hurtado maintains that matter and form's being could, at least through divine power, be sustained separately. He likewise holds that matter can subsist without categorial quantity while preserving location and the capacity for local motion. We also address the problem of distinct kinds of matter and highlight Hurtado's speculations concerning the possible existence of a hypothetical form of matter, a purely theoretical distinction that nonetheless remained relevant within early modern cosmological debates.

**Keywords**

Aristotelian Tradition, Matter, Form, Pure Potency, Pedro Hurtado de Mendoza

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## *1. Introduction*

The *Cursus Philosophicus* was the dominant format for philosophical textbooks in the Aristotelian Scholastic tradition in the 17th and 18th centuries. Arguably the first work in this format was *Universa philosophia*, written by the now much-neglected Spanish Jesuit Pedro Hurtado de Mendoza (1578-1641). First published in 1615 under the title *Disputationes a summulis ad metaphysicam*, it came out in different versions until reaching its final form in its 1624 edition, printed in Lyon.[1] This work was to have a huge impact on the later textbook tradition in philosophy.[2]

Pedro Hurtado de Mendoza was born in 1578 in the Basque town of Balmaseda, approximately 20 miles southwest of Bilbao.[3] He was of a noble lineage and had relatives at the court of the Spanish kings. Hurtado de Mendoza entered the Jesuit order in 1595 and continued to study in Salamanca, among other places. Having been ordained as a priest in 1607, he went on to teach philosophy in Pamplona and in Valladolid. From 1618, he taught theology in Salamanca, interspersed by different trips and special assignments given by the Provincial from time to time.

Although he also published in theology, it was for the *Universa philosophia* that he was to become most famous. As noted above, this work proceeded through a number of different editions before reaching its final form.

At the time that Hurtado de Mendoza became active as a teacher, the Jesuits had undergone what Jacob Schmutz has called a "provincialization."[4]

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[1] For the editorial history, see Novotný (forthcoming) and especially Schmutz (forthcoming). It is the 1624 edition that will be used in this article.

[2] There were earlier works spanning the whole of philosophy, for example Eustachius a Santo Paulo's *Summa philosophiae* from 1609, known among other things from René Descartes's references to it. (See Perler 2015.) More famous than Hurtado de Mendoza's work is also his confrère Francisco Suárez's (1548-1617) *Disputationes metaphysicae* from 1597. As the title gives at hand, though, this work only spans metaphysics. As will be seen, Suárez exerted a huge influence on Hurtado de Mendoza. Suárez's work is sometimes said to be the first complete work on metaphysics in the Latin West that was not a commentary on Aristotle's *Metaphysics*. There were some immediate precedents also to Suárez, though. See Lohr (1988) pp. 610-3.

[3] For the biographical and bibliographical data, see Novotný (forthcoming) and Schmutz (forthcoming).

[4] Schmutz (forthcoming).

In the generation before him, with the most famous example being Francisco Suárez, the Jesuit teachers in the colleges on the Spanish peninsula had often visited and taught at different colleges across Europe. Hurtado de Mendoza, however, was to remain teaching on the Spanish peninsula for his entire career, and for 20 years in Salamanca, at that.

There were exceptions to this 'provincialization,' of course, in later generations. Hurtado de Mendoza's student Rodrigo de Arriaga (1592-1667) was to leave for Prague in the mid-1620s, and many other students left similarly to take teaching positions in different parts of Europe and, indeed, in other parts of the world as well. The main trend is still clear, however: It was more common for Jesuits to remain and continue teaching in one province for their entire active lives than it had been before, but their students, as well as their written works, could still carry their teachings around the world.

Something else that is noteworthy in Hurtado de Mendoza's works, and the *Universa philosophia*, is that a specifically Jesuit philosophical tradition was taking form. He still refers to much of the philosophical tradition when treating a question. But his Jesuit predecessors in general, and "P. Suárez" in particular, play a major role as interlocutors. In Rodrigo de Arriaga's *Cursus Philosophicus*, from 1632, this trend is even stronger in his referring to Suárez and Hurtado de Mendoza to lay the groundwork in addressing many questions. Other such reference figures among the Jesuits of earlier generations were Pedro da Fonseca (1528-1599), Luis Molina (1535-1600) and Gabriel Vásquez (~1550-1604). In the analysis presented here, Hurtado de Mendoza is related both 'backwards,' primarily to Suárez, and 'forwards,' primarily to Arriaga, in order to present a kind of 'micro history' of certain conceptual changes: 'micro' in terms of both the scope of the comparisons presented and the very limited material upon which these comparisons have been made.[5] The focus, however, is placed on Hurtado de Mendoza's thinking itself.

The aim of this article is to present at least some main features of Hurtado de Mendoza's views on matter in general and prime matter in particular. Section 2 addresses the metaphysical status of prime matter, regarding its

[5] Hurtado de Mendoza's *Universa philosophia* from 1624 will be related, then, to Suárez's *Disputationes metaphysicae* from 1597 and to Arriaga's *Cursus Philosophicus* from 1632. (See bibliography.)

existence, essence and subsistence. Section 3 presents Hurtado de Mendoza's rejection of the labelling of prime matter as "pure potentiality" (*pura potentia*). In this section, Hurtado de Mendoza's distinction between a "physical" and a "metaphysical" sense of "matter" is discussed. The relation of matter to form, and especially the question of whether God could uphold matter without form, is the topic of section 4. This more general discussion of the status of matter leads then to the question of prime matter's relation to quantity, which is treated in section 5. In section 6, finally, some fascinating speculations by Hurtado de Mendoza regarding the possibility of types of matter other than the matter constitutive of our material world are presented.

## *2. The Existence and Actuality of (Prime) Matter*

Regarding the question of prime matter in general, Hurtado de Mendoza largely follows Suárez in emphasizing the reality of matter and stating that it has this reality separately from form.[6] It can be argued that this view is closely connected to the rejection of anything more than a merely rational or conceptual distinction between essence and existence; for if matter has its own essence, its own character so to speak, and if essence is not truly distinct from existence, then it seemingly follows that matter also has its own existence.

This is also the way in which Hurtado de Mendoza lays out the argument when treating the reality of prime matter:

> If we speak metaphysically, we call *essence* the first concept that we form of whichever being. But if we speak physically, a thing's *essence* is the substantial parts united amongst themselves, as the essence of a human is the body united with the rational soul. The *existence* is the formal ground (*ratio*) by which each single thing is constituted outside its causes, in actuality, and the ground (*ratio*) by which things are constituted in the nature (*ratio*) of beings in an unqualified sense (because, as I will prove in the Metaphysics section, disputation VIII, section I, that that which does not exist is not a being in an unqualified sense).

[6] For Suárez, see Åkerlund (2015) and (2019). Novak (forthcoming) takes Hurtado de Mendoza to hold a basically 'Suárezian' view of prime matter, though with some modifications. Suárez understands prime matter, in line with the broad Aristotelian tradition, as "the first subject of changes, or of forms" (*DM* 13.1.4; 25:396b: "primo subjecto mutationum, vel formarum"). Hurtado de Mendoza refers to this passage when he presents what he himself understands by the concept of "prime matter" (in *UPh* Physica, disp. II, sectio I, § 1; 167b).

From the light of this reason alone, one seems to be able to infer that actual essence is neither really, nor from the nature of the things, distinguished from actual existence. For the present controversy, though, a real or modal distinction is to be supposed between essence and existence. For if one rejects this distinction, there is nothing left for the locus of this question. But on the distinction between essence and existence, whose proper place is in the section on Metaphysics, disputation VIII, I will not say a word at present.[7]

As can be seen, Hurtado de Mendoza's argumentation here incorporates a complex dialectic. At its core, the question is whether matter has its own proper existence, that is, apart from the existence of form. Hurtado de Mendoza begins by making a distinction as to how 'essence' is used in metaphysics and in physics, respectively. In physics, 'essence' refers to the entire thing, the union or composite of matter and form, with the human being's body and rational soul as prime examples.[8] However, in metaphysics, the essence

[7] *UPh* Physica, disp. II, sectio VI, § 54; 173b: "*Essentia* dicitur primus conceptus, quem efformamus de quovis ente, si metaphysice loquamur; si vero physice, *essentia* rei est partes substantiales inter se unitæ, ut hominis essentia est corpus unitum animo rationali. *Existentia* est ratio formalis, per quam unaquæque res constituitur extra suas causas in actu, et ratio, per quam res constituuntur in ratione entis simpliciter (quia quod non existit, non esse simpliciter ens probabo disput. 8 met. sect. 1) unde ipso rationis lumine videtur inferri, essentiam actualem non distingui realiter, neque ex natura rei ab existentia actuali. Ad præsentem tamen controversiam supponenda est distinctio realis, aut modalis inter essentiam et existentiam. Nam ea distinctione rejecta, nullus superest huic controversia locus, de distinctione autem essentiæ ab existentiæ nec verbum quidem in præsenti faciam, cujus sedes propria est in metaphysica, disput. 8." As indicated at the end of the quotation, that essence and existence are merely rationally distinct in created things is treated in *UPh* Metaphysica, disp. VIII, especially sectio IV, §§ 38-80; fol. 833b-39b. All translations are my own, unless otherwise stated.

[8] Cf. here Suárez and the 'metaphysical form,' the form of the whole, which is the same as the essence or the nature of a thing. See *DM* 15.11.3; 25:558a: "It must, therefore, be said that the properly metaphysical form which is the form of the whole is nothing else than the whole essence of a substantial thing which we also call the entire nature of a thing. It is not called a form because it specially exercises the proper causality of a form, but because by itself it constitutes the thing essentially. I explain and prove each of these claims. For in a human being, for example, this form of the whole is said to be humanity which, since it consists of matter and the form of a human being, expresses the whole essence of a human being." (English translation from Suárez 2000, p. 178. "Dicendum est ergo primo formam proprie metaphysicam, quae est forma totius, nihil aliud esse quam totam rei substantialis essentiam, quam etiam integram naturam rei appellamus, quae non dicitur forma eo quod specialiter exerceat propriam causalitatem formae, sed quia rem essentialiter constituit per seipsam. Declaro et probo singula; nam in homine, verbi gratia, haec

is the "first concept" we form of something. Notice, however, that as Hurtado de Mendoza is treating *matter* here, it is rather within the *metaphysical* realm that he could presumably be understood to be moving, as matter itself is not a composite of matter and form.

Having defined existence as that by which each thing is constituted in actuality, Hurtado de Mendoza acknowledges the closeness of his present treatment to metaphysics and points out – with a reference precisely to the Metaphysics part of the work – that only by the above definitions can one understand that essence and existence are merely rationally distinct in things. However, because this would end the consideration of the question of whether matter has its own proper existence – presumably on account of its having its own essence or nature, and this being more or less obvious – Hurtado de Mendoza *for the sake of argument* assumes that there *is* a real[9] or modal distinction between essence and existence.[10] Here, Hurtado de Mendoza is employing a kind of hypothetical reasoning that his student Rodrigo de Arriaga would take even further.

Even with this hypothesis, though, Hurtado de Mendoza can show that matter has its own existence, independently of form. It also follows from matter having its own existence that matter has its own *subsistence*, at least partially, as substantial form also has its own partial subsistence. Hurtado de Mendoza writes:

> Matter and form are therefore independent. Further, [they are] absolutely [independent], according to my opinion. Because subsistence is the substantial complement of a nature in its relation to itself. But matter and form are natures. They therefore have this complement. Therefore partial, because it is prior to the union. For subsistence is [relation] to itself, but union [is relation] to another.[11]

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forma totius dicitur esse humanitas, quae cum ex materia et forma hominis constet, totam essentiam hominis dicit [...]").

[9] A distinction "from the nature of things" (*ex natura rei*) is the same as a real distinction, according to Hurtado de Mendoza. See *UPh* Metaphysica, disp. VI, sectio III, § 55; fol. 794a-b.

[10] Hurtado de Mendoza devotes the whole disputation VI of the Metaphysics part of *Universa philosophia* to the different kinds of distinctions. See *UPh* Metaphysica, disp. VI; foll. 786b-817b.

[11] *UPh* Physica, disp. II, sect. VII, § 103; fol. 179a-b: "[M]ateria et anima ita sunt independentes: absolute item in mea sententia; quia subsistentia est complementum substantiale

Matter and form, then, have their own independent subsistence. However, they are directed toward each other, so to speak, and toward the union, so this subsistence can only be said to be partial.

It is a distinguishing feature that matter and form are treated in a highly parallel fashion in many contexts.[12] Here is but one further example, in Hurtado de Mendoza answering to an objection regarding the reality of matter:

> Third, because if [matter] had act, it would therefore have substantial and complete being in an unqualified sense. The consequence does not follow, for the separate soul – indeed, any substantial form whatsoever – has its own existence and, if you like, subsistence, but none of these is a complete substance in an unqualified sense.[13]

Once again, the subsistence of matter as the subsistence of form is stressed. In addition, the case of the separate soul is taken as an example that can be transferred to other substantial forms, as well as to matter.[14]

### *3. The Rejection of Prime Matter as 'pura potentia'*

As can be seen, matter thus has its own, although partial, existence and subsistence according to Hurtado de Mendoza. What does he do, then, with the traditional understanding of prime matter as "pure potency" (*pura potentia*)?

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naturæ in ordine ad se; sed materia et forma sunt naturæ; ergo habent illud complementum: ergo partiale: quia est prius unione: subsistentia enim est ad se, unio autem ad aliud."

[12] Though this must only be taken as a weak hypothesis here, this seems to be a development or trend from Suárez, through Hurtado de Mendoza, and to Arriaga. To substantiate this claim would demand a more thorough treatment of the former and the latter together with Hurtado de Mendoza than is possible in this article. See, though, for comparison, e.g., Åkerlund (2015) and (2019) for Suárez, and Åkerlund (2024) for Arriaga.

[13] *UPh* Physica, disp. II, sectio VI, § 59; 174a: "Tertio, quia si habet actum, ergo habet simpliciter substantiale esse, et completum. Nulla est consequentia, animus enim separatus, immo et quævis forma substantialis propriam habet existentiam, et, si placet, subsistentiam, cum tamen nulla ex illis sit substantia simpliciter completa."

[14] Though not referring to the *separate* soul, it is noteworthy that Suárez takes the human soul as the primary example when arguing for the existence of substantial forms. See *DM* 15.1.6; 25:499a: "The first argument for the existence of substantial forms is that a human being consists of a substantial form as an intrinsic cause; therefore, all other natural things also do." (Translation from Suárez 2000, p. 20. "Primo igitur ratio sit, nam homo constat forma substantiali, ut intrinseca causa; ergo et res omnes naturales.")

Following in the footsteps of Suárez, Hurtado de Mendoza does not reject this understanding wholesale. He rather makes a distinction, as does Suárez,[15] between a *physical* and a *metaphysical* understanding of this label, accepting in the *physical* sense but denying that matter would be pure potency in a *metaphysical* sense.[16] In a physical sense, matter is "every being [that is] formally extended, for example including prime matter, quantity and other similar [beings]."[17] This is also what he has in mind when treating 'matter' in the Physics section of the work. Taken in a metaphysical sense, however, 'matter' seems to come close to the meaning of 'potentiality.' As he writes, in God there is no matter, "not only physically, but also metaphysically."[18] In angels, however, although there is no physical matter composed with form in them, there is still a metaphysical composition as to matter:

> An angel, however, although it abstracts according to its being from all physical matter (also intellectual), does not abstract from metaphysical matter. Because in an angel, there is real composition of nature and suppositum, of intellect and understanding, of will and love, of substance and accident.[19]

This is, in a sense, a more general way of using the term 'matter,' in line with the Aristotelian-Scholastic tradition.[20]

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[15] Cf., e.g., *DM* 13.5.9; 25:416b: "It should therefore be said, first, that prime matter is not called pure potency with respect to every act metaphyiscally, that is, because it does not include any metaphysical act. For this could not be true." ("Dicendum est ergo primo materiam non vocari puram potentiam respectu omnis actus metaphysici, id est, quia nullum actum metaphysicum includat; hoc enim verum esse non potest.")

[16] *UPh* Physica, disp. II, sect. VI, § 56; fol. 173b: "[E]st enim pura potentia physice, id est, comparata ad actos physicos tantum habet rationem potentiae receptivae illorum; cui potentiae non repugnat, sed potius est necessarius actus entitativus et metaphysicus."

[17] *UPh* Metaphysica, disp. I, sectio VI, § 162; 718b: "Materiam physica voco omne ens formaliter extensum: verbi gratia, includens materiam primam, quantitatem aut quid simile: [...]."

[18] *UPh* Metaphysica, disp. I, sectio VI, § 162; 719a: "Deus abstrahit secundum esse a materia non solum physica, sed etiam metaphysica: [...]."

[19] *UPh* Metaphysica, disp. I, sectio VI, § 162; 719a: "Angelus autem, quamvis abstrahitur secundum esse ab omni materia physica etiam intellectuali, non tamen a metaphysica. Quia in eo est realiter compositio ex natura et supposito, ex intellectu et intellectione, ex voluntate et amore, ex substantia et accidenti: [...]."

[20] We will not explore this metaphysical sense of 'matter' further here, more than when the strictly physical sense of 'matter' has to be explicated. As to the brief treatment above, though, compare, for example, how Thomas Aquinas explicates the three ways in which substances have essences in *De ente et essentia*, chapter V (essence here standing as

Returning now to the physical understanding of 'matter,' and the labelling of prime matter as *pura potentia*, Hurtado de Mendoza seems to be even more dismissive of this label than Suárez. He writes that as it is "commonly taken," to call matter pure potency is "neither satisfactory, nor true," as it must at least have "entitative and existential" actuality.[21]

As stated above, one reason that matter must be real is that it constitutes the entire composite, together with form. But the reality of matter can also be shown from the fact that we need it to account for the very generation of substantial form in material things (excluding the case of the human soul).[22] As a point supporting the concept that matter has its own existence, Hurtado de Mendoza writes the following:

> The conclusion is proved, second, because the essence of prime matter is a true material cause of the material form. Therefore, matter cannot exist through form. The consequence is proven because a true and proper cause is by nature prior to its effect. The effect is contained eminently in the cause beforehand, but existence is foreknown in the cause beforehand, because no real cause causes – and neither does it proximately have the power to cause – before it pre-exists. Therefore, before the existence of the material form is known, the existing prime matter must be foreknown. But it cannot exist in this by form,

potentiality in relation to the actuality of being), also involving (physical) 'matter' into this treatment: "There are in fact three ways in which substances have essence. There is a reality, God, whose essence is his very being. [...] Essence is found in a second way in created intellectual substances. Their being is other than their essence, though their essence is without matter. [...] In a third way essence is found in substances composed of matter and form. In these, too, being is received and limited, because they have being from another. Their nature or quiddity, moreover, is received in designated matter." (Translation from Aquinas 1968, pp. 60, 62, 65: "Invenitur enim triplex modus habendi essentiam in substantiis. Aliquid enim est, sicut Deus, cuius essentia est ipsummet suum esse; [...] Secundo modo invenitur essentia in substantiis creatis intellectualibus, in quibus est aliud esse quam essentia earum, quamvis essentia sit sine materia. [...] Tertio modo invenitur essentia in substantiis compositis ex materia et forma, in quibus et esse est receptum et finitum, propter hoc quod ab alio esse habent, et iterum natura vel quiditas earum est recepta in materia signata." Aquinas 1976, fol. 378a-9a).

[21] *UPh* Physica, disp. II, sect. II, § 24; fol. 169b: "Communiter vero materia prima appellatur a Thomistis *pura potentia*, quod ita fuse sumptum, nec placet, nec est verum; quia materia prima actu existens habet ut minimum actum entitativum, et existendi, [...] ergo materia prima non est pura potentia universaliter sumpta."

[22] More on the relation between these 'acts' of matter below.

because then (or: at that stage) the existing form is not yet known. Therefore, prime matter cannot exist by form.[23]

Because matter is a true (material) cause of a (material) form, it would be circular reasoning to state that matter in *its* turn would be an effect of form, and dependent on it for its existence. Matter thus has a reality of its own, independently from form, and can therefore also be a true material cause of a material form.

### *4. The Relation of Matter to Form*

As can be seen, matter is therefore relatively independent from form according to Hurtado de Mendoza. So, what is the relation between matter and form *positively* stated?

First, according to Hurtado de Mendoza, the relation from matter to form is *transcendental*. Hurtado de Mendoza follows Suárez in his basic understanding of a *transcendental* as opposed to a *categorical* (or 'predicamental') relation, with these two being the only kinds of real relations.[24] In both cases, the foundation (*fundamentum*) of the relation must be real. In the case of a categorical relation, the terminus of the relation also must be real. In the case of a transcendental relation, however, the terminus does *not* need to be real. In this case, with a relation *from* matter *to* form, Hurtado de Mendoza understands it so that the status of the relation has to do with the fact that matter is not related to any one *particular* substantial form. It only has a "general" openness to receiving form:

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[23] *UPh* Physica, disp. II, sect. VI, § 73; fol. 175b: "Secundo probatur conclusio, quia essentia materiæ primæ est vera causa materialis formæ materialis, ergo materia non potest existere per formam. Probatur consequentia, quia causa vera, et propria est natura prior suo effectu, quem in illo priori continet eminenter, sed in illo priori præintelligitur existens, quia nulla causa realis causat, neque est proxime potens ad causandum, antequam præexistat; ergo, antequam intelligatur existentia formæ materialis, præintelligitur materia prima existens, sed in illo priori non potest existere per formam, quia tunc nondum intelligitur forma existens, ergo materia prima non potest existere per formam."

[24] Hurtado de Mendoza treats the relation between transcendental and categorical relations in *UPh* Metaphysica, disp. XV, sectio VIII, §§ 86-95; foll. 911b-12b. He there primarily, and explicitly, follows Suárez's treatment in *DM* 47. For Suárez's division of real relations into transcendental and categorical, see *DM* 47.3.10; 26:797b.

A transcendental relation consists in a dependence that one thing has on another, without which it cannot be, at least in being possible, as a vital act without a vital power, and this without act, at least a possible act. But matter cannot be without forms being possible; the relation to these is therefore said [to be] transcendental.[25]

Here, form depends on matter, but not the other way around (at least not in this context).[26]

As to the relation of matter and form, one could further ask: Could matter and form exist independently of each other?

Now, naturally, matter comes with form, and prime matter also has "an innate desire for substantial forms."[27] However, by God's power, matter could exist on its own, without form.

As stated above, Hurtado de Mendoza ascribes to matter its own subsistence and existence. Hence, it is nearly a given that he believes that God could uphold matter without form. However, in his argumentation, he wishes to show that *even if* matter had its existence through form, God could still determine some other means to uphold matter without form:

For even if the existence [of matter] came forth from form, why could it not come forth from something else?[28]

Once again, as in other cases mentioned above, Hurtado de Mendoza makes it more difficult for himself in a way when showing that matter can be

[25] *UPh* Physica, disp. II, sect. II, § 20; fol. 169b: "[R]elatio transcendentalis consistit in dependentia, quam habet una res ab alia, sine quam salte in esse possibili, esse non potest, ut actus vitalis sine potentia vitali, et hæc sine actu, saltem possibili, sed materia esse non potest, nisi esse possibiles formæ, ergo ad illas dicit relationem transcendentalem."

[26] There is, as far as can be ascertained, no separate treatment of Hurtado de Mendoza's treatment of relations. Arriaga on relation has been treated in Penner (2012). The specific question of the union between matter and form will not be treated here. For some recent treatments, see Anfray (2019), Schmaltz (2020) and Leinsle (forthcoming). Basically, according to Hurtado de Mendoza, the union consists of two 'modes,' one of matter ('materialization') and one of the substantial form ('information'). (See especially Leinsle forthcoming.)

[27] *UPh* Physica, disp. II, sect. III, § 32; fol. 170b: "appetitum innatum ad formas substantiales."

[28] *UPh* Physica, disp. II, sect. IX, § 144; fol. 183b: "Licet enim ex natura rei existentia proveniat a forma, cur non poterit aliunde provenire?"

upheld by God's power, and he argues that this can be shown even if a separate existence is ascribed to matter, as he himself contends.

Suárez also argues that matter can be upheld by God's absolute power, just as form can. However, Suárez's argumentation is more straightforward, making references precisely to the proper, although partial, existence and subsistence of matter:

> [J]ust as matter has its own incomplete essential entity, so also it has its own incomplete existential entity. For the existence of a substance is composed in the same way as the essence of the substance, and thus, without any contradiction or repugnance, God can conserve matter without form just as He conserves form without matter. For, although the proper receptacle, so to speak, of the complete and entire existence is the complete nature or substantial supposite, a part of the nature, or a partial nature, nevertheless, is capable of a partial existence which is proportionate with it and which it can, by divine power, subsist alone as a part, just as quantity exists as separate in its proportionate existence by divine power.[29]

To be a bit speculative, here it is as though this basic point has already been satisfactorily argued for Hurtado de Mendoza; now he desires to show that God could uphold matter *even if* the basic points regarding the existence and subsistence of matter were *ex hypothesi* granted to the opposite side.

Later, in Arriaga, this question would take an interesting and quite unexpected turn. In line with his Jesuit predecessors, Arriaga also affirms that matter can exist without substantial form:

> We have denied all *a priori* dependence of prime matter on form. Now, however, I also deny an essential *a posteriori* dependence. For I judge that prime matter can exist without such a substantial form, at least miraculously.[30]

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[29] *DM* 15.9.5; 25:533b: "[M]ateria, sicut habet suam partialem entitatem essentiae, ita et existentiae; existentia enim substantiae ita composita est sicut essentia substantiae, et ideo sine ulla implicatione vel repugnantia potest Deus sicut formam sine materia, ita et materiam sine forma conservare. Quia, licet proprium susceptivum (ut ita loquamur) completae et integrae existentiae sit completa natura vel substantiale suppositum, tamen pars naturae seu natura partialis capax est partialis existentiae sibi proportionatae, in qua potest per divinam potentiam partialiter sola subsistere, sicut quantitas in sua proportionata existentia per divinam potentiam separata existat." (Translation from Suárez 2000, p. 118.)

[30] Arriaga (1632), "Physica", disputatio II, sectio VI, subsectio II, § 98; 261a: "Dependentiam omnem a priori a forma negavimus materiæ primæ; nunc autem eidem nego dependentiam essentialem a posteriori: arbitror enim, saltem miraculose eam posse existere sina ulla forma substantiali."

In this statement, he essentially follows Suárez and Hurtado de Mendoza. Now, however, comes a twist:

> I have said *substantial*, since matter cannot exist without some modal form, namely without some ubication and duration (in case these are distinguished).[31]

So, matter can be without *substantial* form. However, matter *must* have a 'where' and a 'when,' so to speak, with these being designated "modal forms."[32] Arriaga sometimes also enumerates quantity in this list.

Seen from this perspective, Hurtado de Mendoza, with his complex dialectic, stands on a line upon which a clear development on the small scale occurs: between Suárez's more 'simple' affirmation that God could uphold matter without form and Arriaga's affirmation of the same position but with the addition that matter must still come with *some* (modal) forms.

### *5. Matter and Quantity*

The above arguments bring us to Hurtado de Mendoza's understanding of how matter is related to *quantity*.

First, quantity comes from matter as from its "root," and matter is the "material cause" of quantity. Hurtado de Mendoza writes further that quantity is "contained in the power of matter."[33]

Could we, then, have matter *without* quantity? Hurtado de Mendoza affirms this unequivocally. Just as quantity can be without matter,[34] all the more so can matter be without quantity, with the even more 'robust' ontological status of matter as an independent entity. In this context, Hurtado

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[31] Arriaga (1632), "Physica", disputatio II, sectio VI, subsectio II, § 98; 261b: "Dixi *substantiali*, quia sine aliqua forma modali, nempe sine aliqua ubicatione vel duratione (casu quo distinguatur) nequit existere materia."

[32] For more on Arriaga on these issues, see Åkerlund (2024) especially pp. 340-1, from where also the above translations of Arriaga are taken.

[33] *UPh* Metaphysica, disp. IV, sect. V, § 94; fol. 757b: "Nam materia prima præhabet quantitatem, estque illius radix, et fundamentum in genere causæ materialis: sed hoc est quantitatem contineri in potentia materiæ: […]."

[34] This would be a standard position that Hurtado de Mendoza could refer to, as this is the case in transubstantiation in the Eucharist. For the Medieval background, with views into the 17th century, see Pasnua (2011) ch. 10, pp. 179-99.

de Mendoza also makes an interesting distinction between extension on the one hand and impenetrability on the other:[35]

> You ask, first, *whether prime matter could be conserved without quantity*. Many reject this, but I don't know on what grounds. For if prime matter were conserved without quantity, it wouldn't from that follow two contradictory predicates. You say that matter will be extended and not extended: extended, indeed, because it has parts, but not extended, because it would lack extension. This is an equivocation [I say]. Because it would not be impenetrably extended, for this is the proper effect of quantity. It would be extended, however, as if essentially. For all material things have this extension, that is, composition from parts. It is shown secondly, for quantity depends more on matter than matter on quantity, as is obvious in itself. But quantity can be without matter, by [the] absolute power [of God]. Therefore, matter [can be] without quantity.[36]

Thus, impenetrability is an effect of quantity, but not extension. Extension is merely the property of having a "composition of parts" of material things. Matter without quantity, then, would still have extension, although this material thing would be penetrable.[37]

The question of the nature of matter without quantity raises many consequent questions for Hurtado de Mendoza, the answers to which are interesting in relation to comprehending his general understanding of matter. First, there is the question of whether matter without quantity would reduce to a "point." For someone contending that extension comes with, or at least

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[35] For a background on views regarding the relation between extension and impenetrability, see Pasnau (2011) ch. 15, pp. 300-22.

[36] *UPh* Metaphysica, disp. XII, sectio VI, § 47; 890a: "Rogas primo. *Utrum materiæ prima possit divinitus sine quantitate conservari?* Negant nonnulli, nescio quo fundamento: nam si materia prima conservetur sine quantitate, non inde sequuntur duo prædicata contradictoria. Dices, materiam fore extensa, et non extensam; extensam quidem, quia habet partes: non extensam, quia careret extensione. Hæc est æquivocatio; quia non esset extensa impenetrabiliter, hic enim effectus est proprius quantitatis: esset autem extensa quasi essentialiter; omnis enim res materialis habet hanc extensionem, id est compositionem ex partibus. Secundo probatur; quia magis dependet quantitas a materia, quam materia a quantitate, ut per se patet: sed quantitas de potentia absoluta potest esse sine materia: ergo materia sine quantitate."

[37] Arriaga would later hold an interesting variant of Hurtado de Mendoza's view. Arriaga thinks that quantity is identical to matter, and therefore even calls quantity a "substance." However, he still speculates at length regarding what matter without quantity *would* be like, and in this comes to quite similar views as Hurtado de Mendoza. See Arriaga (1632), "Metaphysica", disputatio V, sectio I, subsectio III, §§ 21-6; 879b-80b. See also Åkerlund (2024) pp. 342-3.

is dependent on, quantity, this seems to be the case.[38] However, because Hurtado de Mendoza does *not* connect extension to quantity, this conclusion does not follow. Although the fine points of his own answer remain somewhat unclear,[39] he seems to maintain that matter would "retain its prior place, unless it would be moved from without," and "remain in the prior space" by the "preceding ubication."[40]

Could such matter without quantity then be moved? It would not be possible that it could be moved in the normal way, namely that something else that is material 'pushes' it because two bodies cannot possibly occupy the same space (as impenetrability is dependent on quantity). However, because matter without quantity has a place, this place could also be changed, and hence matter without quantity *could* also be moved; that is, its place could be changed. This is also the case with respect to the power of angels. As angels are immaterial, their way of moving matter – insofar as this is within their ability – is not by way of "impetus" and moving in a bodily way (that is, because two impenetrable bodies cannot take up the same space), but rather by a mere 'act of will.' This other way of moving matter would in no way be impeded by the removal of quantity from matter.[41]

Finally, what would happen to a falling body – say, water falling though air – if it lost its quantity in the air? Hurtado de Mendoza's answer is that it would keep falling, as this falling occurs on account of the heaviness (*gravitas*) of the falling body, which is not removed by the removal of quantity.[42] Quantity, and impenetrability, are only needed in order for a body to receive motion (*motus*) from another body, which would not be the case here. Indeed, the

[38] Hurtado de Mendoza refers to the Jesuit Antonius Rubius (1548-1615) for this view.
[39] A deeper understanding of Hurtado de Mendoza's position here would require a further exploration of the relation between terms such as 'point' (*punctum*), 'place' (*locus*), 'space' (*spatium*), and 'ubication' (*ubicatio*) in his philosophy.
[40] *UPh* Metaphysica, disp. XII, sectio VI, § 48; 890a: "[…] posset remanere in priori spatio per ubicationem precedentem: imo retineret priorem locum nisi ab extrinseco moveretur; […]."
[41] *UPh* Metaphysica, disp. XII, sectio VI, § 48; 890a: "Angelus autem non movet impetu, quo ipse feratur in locum: neque propter incompossibilitatem ipsius cum alio corpore in eodem loco, sed movet per voluntatem. Quaproter ut corpus moveat, non eget resistentia in eodem corporeut egent cætera corpora."
[42] Once again, a full exploration of this position of Hurtado de Mendoza's would require a fuller treatment of his natural philosophy than is possible here.

falling body of water would move even more easily through the air, as it would not have the resistance that comes from its quantity and impenetrability![43]

### *6. Excursus: The Possibility of Another Kind of Matter*

Before bringing this brief overview of Hurtado de Mendoza's understanding of matter to a close, it might be interesting to also mention his speculations regarding a kind of matter other than the matter we know.

These speculations come in the context of Hurtado de Mendoza's treating the question of whether all the matter of sub-lunary creatures is of the same kind, as well as the consideration of the relation between matter in sub-lunary and supra-lunary substances. It is precisely with regard to corruptible – that is, sub-lunary – material substances that he asks whether there could be another kind of matter in these entities:

> I say, second, that by the absolute power of God, there can be other matter of corruptible things, of a kind distinct from ours. It is proven, for there are other possible primary qualities that are mutually contrary, from which arise other secondary qualities, which dispose for other forms independent from our qualities. But the matter of such forms differs from ours.[44]

We have here quite a speculative discussion regarding other kinds of primary and secondary qualities distinct from those we know.[45] Those other kinds of qualities would require another kind of matter than the kind that we have in the material world that we inhabit. Hurtado de Mendoza also refers once

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[43] *UPh* Metaphysica, disp. XII, sectio VI, § 49; 890a: "Confirmatur tunc corpus posse moveri: demus aquam in aëre existentem, quantitate spoliari, tunc ea aqua motu gravium descendere infra aërem: ergo se posset movere. Probatur antecedens; quia gravitas est principium corpus impellens infra aërem: ergo dum corpus retinet gravitatem, ea impelletur. Neque vero impedietur motus; quia quantitas neque est virtus activa, nec passiva illius, neque requiritur extensio nisi ad recipiendum motum ab alio corpore. Imo facilius gravitate moveretur aqua; quia non haberet resistentiam: […]."

[44] *UPh* Physica, disp. II, sect. V, § 52; fol. 173a: "Dico secundo, de potentia absoluta Dei potest esse alia materia rerum corruptibilium, distincta specie a nostra. Probatur, quia sunt possibiles aliæ primæ qualitates inte se contrariæ, ex quibus oriuntur aliæ secundæ qualitates, quæ disponant ad formas alias independentes a nostris qualitatibus, sed materia talium formarum specie differret a nostra, […]."

[45] Once again, a fuller explication of the quote above would require a more extensive treatment of Hurtado de Mendoza's understanding of qualities.

again to the fact that it does not involve any contradiction as a reason for why God could create this other kind of matter:

> Second, that which does not imply a contradiction should not be denied of God. But there does not seem to be any repugnance in such matter. It should therefore not be denied of God that He could make such matter".[46]

The question remains, though, whether this kind of matter could even be more perfect than 'our' kind of matter. In answering this question, Hurtado de Mendoza speculates not only about another kind of matter but also about embodied creatures with an immaterial soul – as we have – that are more perfect than we are:

> You ask whether this [other kind of matter] would be more perfect than our [kind] or not. I answer that it is possible that it is much more perfect, and also much more imperfect, because of those qualities; some might be more perfect than our qualities, some others more imperfect. But if the matter would not have the capacity for [receiving] a spiritual form, there is no doubt that ours would be more perfect than this; if, however, it would have the capacity for [receiving] another form more perfect than the soul, there is no doubt that this would be more perfect than ours.[47]

Thus, Hurtado de Mendoza speculates regarding embodied creatures with 'spiritual' forms – as we have – who are superior to us. This is, I believe, a strong testament to the speculative power of this thinker.

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[46] *UPh* Physica, disp. II, sect. V, § 52; fol. 173a: "Secondu, quod non implicat contradictionem, non est denegandum Deo; sed nulla apparet repugnantia talis materiæ, ergo non est denegandum Deo illam facere posse."

[47] *UPh* Physica, disp. II, sect. V, § 53; fol. 173a: "Rogas utrum esset perfectior hac nostra vel non? Respondeo esse possibiles multas perfectiores, et imperfectiores multas, quia qualitates illæ possunt esse, aliæ quidem perfectiores nostris qualitatibus, aliæ vero imperfectiores. Si autem nulla materia esset capax formæ spiritualis, non dubium, quin hæc nostra sit illis perfectior; si autem esset capax alterius formæ perfectiores animo, non dubium quin sit perfectior, quam hæc nostra."

## *7. Conclusion*

Pedro Hurtado de Mendoza, standing in a tradition of Jesuit thinkers and instigating the tradition of the school-book format of *Cursus Philosophicus*, unequivocally affirms the separate, although partial, essence, existence and subsistence of prime matter, often incorporating a highly complex dialectic when arguing for this position (section 2). In line with this basic understanding of the status of prime matter, he basically rejects the designation of prime matter as "pure potency" (*pura potentia*). In this context, he also makes a distinction between a "physical" and a "metaphysical" sense of the term "matter" (section 3). As for the relation of matter and form, although matter has an "innate desire" for form, Hurtado de Mendoza affirms that matter and form could be upheld and exist separately, by the power of God. Once again, Hurtado de Mendoza employs a complex dialectic, arguing from a position in which he hypothetically accepts the premises of his opponents. Further, regarding the question of matter as existing without form, Hurtado de Mendoza maintains an interesting position as a 'middle figure' between Suárez and Arriaga (section 4).

As for matter's relation to quantity (section 5), matter can exist without quantity, just as quantity can exist – all the more so – without matter. Matter would not lose extension without quantity, but it would be penetrable. Matter would retain its place, also without quantity, and it could also be moved, although not in the 'regular' way but rather, for example, through an act of will by an angel. Indeed, a body moving through the air would even be able to move more easily if it lost its quantity.

Finally, and as an *excursus* (section 6), although all matter around us is ultimately of the same kind, one could without contradiction imagine other kinds of matter for corruptible things. This would be matter that receives other kinds of forms. Whether one would count this other kind of matter as more or less noble than the one to which we have access would depend on the kinds of forms it could receive. The type of argumentation exhibited in this context is a powerful testament to the speculative power of Pedro Hurtado de Mendoza.

## Abbreviations

*DM* = Suárez, F. (1861 [1597]) *Disputationes metaphysicae*, in *Opera omnia*, vols. 25-26. Paris: Vivès.

*UPh* = Hurtado de Mendoza, P. (1624) *Universa Philosophia*. Lyons: Louis Prost, héritiers Rouillé.

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SYLVAIN ROUDAUT

# HEAT, COLDNESS, AND CONTRARIETY IN LATE SCHOLASTIC PHILOSOPHY

**Abstract**

While it is well known that heat played a dominant role in the development of modern science, the fact that its status had already begun to evolve drastically in earlier periods is much less recognized. Although not pertaining exclusively to the Aristotelian framework, by the late Middle Ages, heat was deeply embedded in the Aristotelian worldview, which dominated much of Western natural philosophy. In this framework, heat was classified as a fundamental quality, interacting with other elemental qualities in natural processes. In Aristotle's system, heat, along with cold, wet, and dry, was part of a theory of contrariety that explained change and transformation in the natural world: this is the aspect of Aristotle's theory of heat that is privileged in this paper. In the early modern period, unlike concepts such as 'substantial form', which were discredited by modern science, heat persisted but underwent a profound ontological shift. No longer a positive entity, it came to be understood as a process, specifically a form of motion, marking a decisive departure from medieval interpretations. This study traces the pre-history of this transition by analyzing how the notion of positive contrariety between heat and cold was progressively dismantled in the late Middle Ages and Renaissance. First, it examines the shift from a binary model of contrariety to a relative scale of thermal properties. Second, it discusses Cardano's critique of the Aristotelian view of cold as a positive contrary, which stimulated significant debate. Finally, it explores how redefinitions of resistance in the 16th century further undermined the traditional model, paving the way for mechanistic and empirical approaches that culminated in modern thermodynamics.

**Keywords**

Aristotelian Tradition, Heat (Historical Concepts), Aristotelian Theory of Contrariety (Heat and Cold), Girolamo Cardano, Prehistory of Thermodynamics

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## *1. Introduction*

While it is well known that heat played a dominant role in the development of modern science at the dawn of the 17th century, the fact that its status had already begun to evolve drastically in earlier periods is much less recognized. Although not pertaining exclusively to the Aristotelian framework, by the late Middle Ages, heat was deeply embedded in the Aristotelian worldview, which dominated much of Western natural philosophy. In this framework, heat was classified as a fundamental quality, interacting with other elemental qualities in natural processes. In the Aristotelian system, heat, along with cold, wet, and dry, was part of a theory of contrariety that explained change and transformation in the natural world.[1]

In the *Categories*, Aristotle had characterized contrariety as the second typical feature of qualities.[2] Not all qualities admit of contraries, as entities like shapes or figures, representing according to Aristotle the fourth species of qualities, do not have proper contraries. More precisely, a key aspect of Aristotle's theory is the distinction between two types of contrariety. The first is positive contrariety (*contrarium positivum* following the scholastic term of art). For Aristotle, contraries like heat and coldness were not simply opposites in the sense that one was the absence of the other. Rather, they were positive contraries, meaning that both heat and coldness were real beings that acted upon matter in opposed ways. This stands in contrast to privative contraries (*contrarium privativum*), where one member of the pair is

[1] See Anton (2001), Bogen (1992). Aristotle explicitly presents heat and cold as contraries in this passage: "as principles we have firstly that which is potentially perceptible body, secondly the contrarieties (I mean, e.g., heat and cold), and thirdly Fire, Water, and the like. For these bodies change into one another (they are not immutable as Empedocles and other thinkers assert, since alteration would then have been impossible), whereas the contrarieties do not change" (*Gen. corr*. II 1.329a32-b3; Aristotle 1984, p. 539). This aspect of Aristotle's theory of heat is privileged in this paper (it is not claimed to be the only relevant aspect: for example, see Freudenthal 1995 for 'vital heat' in Aristotle).

[2] Firstly, "things called paronymously because of these or called in some other way from them are Qualified"; secondly "There is contrariety in regard to qualification. For example, justice is contrary to injustice and whiteness to blackness, and so on; also things said to be qualified in virtue of them – the unjust to the just and the white to the black. But this is not so in all cases; for there is no contrary to red or yellow or such colours though they are qualifications" (Arist. *Cat.* 8.10b12-17; Aristotle 1984, p. 16).

defined by the absence of the other, such as darkness with respect to light. For Aristotle, who opposed alternative views defended by ancient philosophers on heat and cold,[3] these properties are positive powers that actively interact and oppose each other.

Aristotle's arguments for this position rested on several key points: a privation cannot act, but coldness does; a privation does not admit of degrees, but coldness can vary in intensity. These arguments supported Aristotle's broader metaphysical structure, in which positive contrariety explained the oppositions and affinities between the elements and the continuity of processes in nature. This notion was crucial to explaining the structural relations between the four classical elements (earth, water, air, and fire) and their corresponding qualities. It also justified the continuity of natural processes, such as heating and cooling, through the gradual replacement of one quality by its opposite within the same subject.

This distinction between two types of contraries was not without its challenges. Aristotle's use of contrariety to explain change was based on the idea that contraries naturally repel one another. Consequently, Aristotle's concept of contrariety implies that contraries, by definition, cannot be present in the same subject at the same time.[4] However, since change in the category of quality is, according to him, a continuous process, Aristotle seems compelled to admit that a certain continuity exists in the transition from one contrary to its opposite, as in every natural motion in the proper sense of the term. Although a quality is, in itself, something indivisible, its gradual reception during an alteration entails a divisibility according to the subject, which presupposes intermediate states between, for example, hot and cold.[5] To the eyes of a reader of Aristotle seeking to understand how such gradual change is possible, these intermediate states could suggest the

[3] See, e.g., Lloyd (1964).

[4] Arist. *Metaph.* Δ 10.1018a25-32: "We call contraries (1) those attributes that differ in genus, which cannot belong at the same time to the same subject, (2) the most different of the things in the same genus, (3) the most different of the attributes in the same receptive material, (4) the most different of the things that fall under the same capacity, (5) the things whose difference is greatest either absolutely or in genus or in species" (Aristotle 1984, p. 1608).

[5] Arist. *Ph.* VI 5.236a35-b18.

simultaneous presence of contraries in the same subject, at least for the duration of the change.

Under the dominance of Aristotelian concepts in natural philosophy, medieval thinkers inherited these paradoxes. However, during the early modern period, the concept of heat experienced a profound redefinition. Unlike other Aristotelian concepts, such as substantial form, heat was not erased from the new philosophical and scientific discourses but underwent a shift in its ontological status. Whereas in the Aristotelian framework it was considered a thing (a positive entity existing in nature), heat was reconceptualized as a process – specifically, a type of motion.[6] This marked a radical departure from the medieval understanding, influenced by the rise of mechanistic philosophy and the growing emphasis on empirical observation and mathematical modeling in natural philosophy.

This evolution was, however, the final phase of several stages of conceptual development depending on various factors. One such factor was the redefinition of coldness as the mere privation of heat. This historical departure from the medieval Aristotelian conception involved a complex interplay of metaphysical, empirical, and mathematical ideas that is still understudied.[7] Yet, the redefinition of heat not only reflected broader shifts in the ontology of natural properties but also laid the groundwork for the development of thermodynamics and the scientific study of heat in the centuries to come.

This study is devoted to trace the pre-history of the modern reconceptualization of heat, focusing on how heat and the notion of positive contrariety were disentangled in the late Middle Ages and Renaissance. To this end, this paper will proceed in three main sections. First, I will explain how the conception of heat prevailing in the late Middle Ages had already shifted away from the idea of pure contrariety between heat and coldness by implying the use of a relative scale rather than a binary opposition of these properties. Second, I will explore how one of the main arguments – the argument from action – supporting the Aristotelian definition of cold as a positive contrary was contested by Girolamo Cardano in the early 16th century, and

[6] On this, see Pasnau (2011) pp. 473-81.

[7] The modern transformations of heat have benefited from much more scholarly attention. A classic work on this topic is Fox (1971).

how this view sparked various reactions and debates among contemporary thinkers. Finally, I will show how the concept of resistance, when redefined in a specific way that gained prominence during the 16th century, helped move away from viewing heat and cold as positive contraries.

### *2. Late Medieval Views on Heat and their Ontological Implications*

Anticipating developments in early modern science, the problem of intensive variations – how to account for varying degrees of heat and cold – emerged as a central issue in late medieval natural philosophy.[8] This question was key to an important re-evaluation of contrariety, since the fact that qualities admit of degrees raised the problem of whether they are truly opposed to their contraries.

Medieval thinkers proposed different solutions to explain how properties like heat and coldness admit of degrees, with some emphasizing metaphysical interpretations and others proposing solutions that leaned more on empirical observation. The dominant theory that emerged during this period was the 'addition theory' of intensity, which interpreted qualitative properties like heat and cold through a quantitative model. According to this theory, the intensity of heat or cold could be conceived as an additive process, where increasing or decreasing degrees are understood as the addition or loss of intensive degrees (*gradus intensivus*) within one quality.

One of the competing theories against which the addition theory was developed can be labelled the 'admixture theory.' According to this view, varying degrees of intensity of a quality, like degrees of heat, are to be explained by different ratios of heat and coldness within the same subject. According to this view, the hotter a subject, the less its heat is mixed with coldness.

One of the few defenders of this view was Albert the Great (ca. 1206-1280), who allowed for the possibility of mixed contraries within the same subject to explain intermediate degrees like tepidity.[9] However, most medieval philosophers, following Aristotle's lead, agreed that contraries cannot coexist within the same subject, meaning that heat and cold should not be

[8] See Sylla (1973), and (1971-1972), Roudaut (2021) and the bibliography therein.
[9] Albert the Great (2013) tr. 5, c. 12, p. 128a.

able to exist simultaneously in the same body. But while the 'admixture theory' in its raw form was generally rejected in the Middle Ages, many medieval thinkers found some plausibility in the idea of mixture between opposing states to explain intensive variations.

For this reason, the axioms relating to heat and coldness as positive contraries came to change in the late 13th century. Although earlier thinkers like Henry of Ghent (1217-1293) might be considered as equally innovative on this point, one of the most influential contributions to this debate came from John Duns Scotus (ca. 1265-1308). Scotus accepted the 'addition theory' of intensive variations but he challenged the usual understanding of contrariety:

> From the instant of change, the motion of the attenuation of heat and the motion of the intensification of cold occur therefore simultaneously – neither of which involves anything that happens first or at some instant in which, by a sudden change, a degree of cold is introduced that is entirely incompossible with heat. At this first <instant>, heat no longer exists, and up until then, heat was present – so that heat has no last moment of its being, but had a last instant of being at rest; and cold has no first instant of its beginning to exist [*simpliciter sui esse*], though it has a first instant of being at rest (that is, what it receives through change, though this is not rest).[10]

Let us point out at the immediate consequence of this argument. Scotus proposed that when a hot object becomes less hot, there is no clear reason to prioritize either of the following propositions:

(a) The body becomes less hot.
(b) The body becomes colder.

According to Scotus, it is correct to describe the object as both losing a degree of heat and gaining a degree of coldness. This means that a body can simultaneously possess degrees of both heat and coldness. Scotus does not

[10] John Duns Scotus (1973) II, d. 2, p. 2, q. 5, p. 330, n. 396 [unless otherwise indicated, translations are mine]: "Currunt igitur simul, ab instanti mutationis, motus remissionis caloris et motus intensionis frigoris, – quorum neutrius est aliquid primo et in aliquo instanti in quo per mutationem subitam inducitur aliquis gradus frigoris omnino incompossibilis calori: in illo primo, calor non est, et usque ad illum calor fuit, – ita quod calor nullum ultimum sui esse habet, sed habuit ultimum in esse quieto; et frigus nullum primum habet simpliciter sui esse, licet habeat in esse quieto (scilicet quod accipit per mutationem, licet illud non sit quies)."

claim that gaining coldness and losing heat are the same process, but rather that they are necessarily correlated. While he maintains that heat and coldness are formal contraries that cannot be in the same subject, he accepts that, *at least during the time of qualitative change*, degrees of heat and cold are mixed in the same subject. Even though Scotus' position is not fully explicit on this point, we can conjecture that, according to him, heat and cold are incompossible in the same subject when perfectly actualized but that they are mixed during qualitative change.

Scotus' influential treatment of the problem of intensive variations opened the door to new discussions on the nature of contrariety and shaped subsequent debates on the nature of contraries in the early 14th century. In the wake of Scotus' ideas, several attempts to revise the concept of contrariety emerged, particularly concerning how to explain variations in intensive properties like heat and coldness. One of the most original contributions came from Walter Burley (ca. 1275-1344). Burley took the bold step of arguing that heat and coldness not only belong to the same genus (as acknowledged by Aristotle) but also to the same species. In his *Tractatus primus*,[11] composed in the late 1310s, Burley posited:

> Contrary forms, for instance hot and cold, black and white, belong to the same most specific species [*speciei specialissime*]. The first argument is the following: When two things are equally distant by a formal distance from the most perfect being in some species, then if one of them belongs to this species, so does the other.[12]

Burley's view was provocative. It implied that heat and cold, despite being contraries, belonged to a common continuous scale, and not to two distinct scales that would correspond to two different species. Interestingly, however, Burley did not abandon the term 'contraries' to designate heat and cold. Rather, his point was to reinterpret the conceptual framework of genera and species inherited from Aristotle. He sought to demonstrate that contrariety should be located *within* the level of species, and not only between two

[11] On this treatise, see De Rijk (1996).

[12] Walter Burley, *Tractatus primus*, f. 209vb: "Formae contrariae, videlicet calor et frigus, albedo et nigredo, sunt eiusdem speciei specialissimae. [...] Prima ratio talis est quandocumque aliqua duo aequaliter distant distantia formalia perfectissimo in aliqua speicie, si unum illorum diversorum sit in illa species reliquum etiam in illa specie."

species within a given genus. Based on considerations different from those of Scotus, his position led to dissociating the notion of contrariety from that of opposing species, viewing contrariety instead as a continuum of states belonging to the same scale.

By the early 14th century, a less radical but much more influential approach came from John Buridan (ca. 1300-1358), one of the main leading figures in the Parisian intellectual milieu. Buridan claimed that attenuated degrees of heat and coldness are not contraries in the same way that maximal degrees are. According to Buridan, only the extremes – such as maximal heat and maximal cold – are true contraries, while intermediate degrees represent a gradation rather than opposition.

As Buridan puts it, contrary forms are impossible in the same subject, but *contrary degrees* are not:

> I therefore state a third conclusion, that it is possible for some degrees of heat to exist simultaneously with some degrees of cold in the same subject. [...] The fourth conclusion is that it is impossible for any degrees of contrary forms to exist simultaneously in the same subject.[13]

This distinction between contrary forms and contrary degrees allowed Buridan and the proponents of this view to account for phenomena like tepidity, where neither pure heat nor pure coldness is present, without violating the principle that contraries cannot coexist in the same subject. This theory helped explain empirical phenomena observed in nature and became widely accepted within the academic circles of 14th-century Paris. One consequence of it was that it made contrariety a matter of quantity of degrees, and not a formal incompatibility between two opposite essences, as Buridan himself acknowledges:

[13] John Buridan (2016) III, q. 3, pp. 30-1: "Pono ergo tertiam conclusionem quod possibile est esse simul aliquos gradus caliditatis cum aliquibus gradibus frigiditatis in eodem subiecto. [...] Quarta conclusio est quod impossibile est aliquos gradus formarum contrariarum esse simul in eodem subiecto."

From what has been said follows the sixth conclusion, namely that the contrariety of forms is not based on the simple natures [*rationibus*] of the forms <themselves>, but on the quantity of their degrees.[14]

This view led to what I have labelled the 'new admixture theory,' which further refined the idea (already suggested by Scotus) that degrees of contrary qualities can exist simultaneously in the same subject.[15] According to the historian of science Pierre Duhem, this theory comes very close to considering coldness and heat as the same property but with opposite signs.[16]

This approach gained wide acceptance in the 14th century. Written at a slightly earlier period, from the late 1320s to the 1340s, the works of the so-called 'Oxford Calculators' implicitly relied on the same conception of qualities like heat and coldness, although this implicit assumption was not as thoroughly theorized as in the Parisian tradition.[17] Following Buridan's guiding ideas, other thinkers like Marsilius of Inghen (ca. 1340-1396) drew the same consequences regarding the nature of the opposition between coldness and heat. Marsilius observes that, although heat (*caliditas*) and coldness (*frigiditas*) as abstract terms referring to individual qualities are contraries and, as such, belong to distinct species, the concrete adjectives 'hot' and 'cold' can refer to things belonging to the same species because there is a continuous scale of degrees between the opposite maximal degrees of heat and coldness. Given that heat and coldness can be reduced, ontologically speaking, to hot and cold things, it follows that heat and coldness can be of the same species:

[14] *Ibid*., p. 31: "Ex istis dictis sequitur sexta conclusio, scilicet quod contrarietas formarum non attenditur ex simplicibus rationibus formarum, sed ex quantitate graduum."
[15] See Roudaut (2021) ch. 7, for further details and references; Caroti (2004); Clagett (1941) pp. 37-8.
[16] As interesting as it is, this thesis appears to be too strong and does not hold up well under detailed analysis since, as we will see below, authors such as John Buridan and Marsilius of Inghen posit a distinction within qualities like heat between active power and resistive power (each of these two powers having its own degree distinct from the other), making the idea of a simple 'opposite sign' problematic. Duhem (1913) p. 402, followed by Clagett, (1941) pp. 37-8, fn. 8, saw Buridan as the initiator of this theory. As evidenced by the existence of similar ideas in the late 13th century, this claim cannot be maintained any longer.
[17] See, here again, Sylla (1973).

> The contrariety of things is not sufficiently determined by their species. This is clear because, if that were the case, any coldness would be contrary to any heat, because any coldness and any cold <thing> and any heat and any hot <thing> belong to the same most specific species.[18]

We can see here that this new understanding of contrariety resulted in a transformation of the conceptual framework proper to Aristotelian physics, in which qualitative causal interactions are structured by oppositions between contrary species, such as heat and coldness, comprised under a common genus.

Not all thinkers accepted this new approach, however. Albert of Saxony (ca. 1320-1390) was a notable dissenter. In his *Questions on Aristotle's Physics*, Albert follows the position described below, which he considers less problematic with respect to the notion of contrariety:

> According to the other position, every degree of heat is contrary to every degree of coldness, and no degree of heat is compatible with any of coldness. This position excludes that intensification and attenuation obtain through the mixture of contrary forms. For instance, the attenuation of heat does not follow from the presence of some degree of coldness [...]. Thus, this opinion conceives that, just like what is in the middle between up and down is not actually in contrary places, thus tepidity, a quality that is in between hot and cold, is not constituted by a mixture of degrees of heat and coldness [...].[19]

Albert's position shows that, even in the late 14th century, there remained some suspicion that conceptualizing heat and its intensive variations in quantitative terms led to problematic metaphysical consequences.

Despite oppositions like Albert of Saxony's to the 'new admixture theory' of primary qualities, this conception of heat and coldness became

[18] Marsilius of Inghen (1521) III, f. 10ra: "Contrarietas rerum non attenditur sufficienter penes speciem. Patet, quia tunc omnis frigiditas omni caliditati essent contraria, quia omnis caliditas cum omni caliditate et omnis frigiditas cum omni frigiditate est eiusdem speciei specialissime [...]."

[19] Albert of Saxony (1999) V, q. 9, p. 838: "Alia opinio ponit quemlibet gradum qualitatis cuilibet gradui frigiditatis esse contrarium nec aliquem gradum caliditatis posse stare cum aliquo gradu frigiditatis. Et ista opinio point intensionem et remissionem non fieri per admixtionem alterius formae. Verbi gratia, non ponit remissionem caliditatis fieri per admixtionem alicuius gradus frigiditatis [...]. Unde ista opinio imaginatur quod, sicut illud quod est in loco medio inter sursum et deorsum non oportet quod sit in locis contrariis, ita nec tepiditas, quae est qualitas inter caliditatem et frigiditate, habet aliquos gradus caliditatis et frigiditatis [...]."

dominant from the 14th century onward. In Italy, which witnessed some of the most significant advances in natural philosophy during the Renaissance, the treatise written by James of Forlì (d. 1414) on the intensification of forms – the most influential treatise on this topic until the end of the 16th century – endorsed the same theory.[20] Blasius of Parma (ca. 1350-1416) and Paul of Venice (ca. 1369-1429), two important masters active at the turn of the 15th century in North Italy, accepted the same view.[21] As Marshall Clagett has shown, what may be regarded as the most innovative works on heat produced during the 15th century, namely those of Giovanni Marliani, relied on the same conception.[22]

This view was still commonly defended in the late 16th century. This is true of 'scholastic' thinkers, who were the leading representatives of the Aristotelian-oriented theories of nature, in contrast to the novel conceptions of nature proposed by the so-called *novatores*. Francisco de Toledo (1532-1596) and the Coimbran commentators explicitly express their allegiance to it.[23] Francisco Suárez (1548-1617) likewise leans toward this view.[24]

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[20] James of Forlì (1496) pars 2, f. 20vb: "Secunda conclusio, licet impossibile sit qualitates contrarias esse simul etc, tamen possible est qualitates que sunt eiusdem specie cum suis contrariis esse in eodem subiecto primo. Cf. 22rb: Tertia conclusio principalis est non est necesse omnes qualitates similes secundum speciem habentes contrarium eidem qualitati contrariari, patet de caliditate summa et caliditate remissa que licet sint eiusdem specie, caliditas tamen summa cuilibet frigiditati est imcompossibilis, et contraria et caliditas remissa non."

[21] On Paul of Venice, see Roudaut (2022). On Blasius of Parma, see Biard (2022b) and the bibliography therein for additional bibliography.

[22] Clagett (1941) pp. 37-8, notes that Marliani's influential *De reductio aquae calidae* assumes this conception.

[23] Francisco de Toledo (1588) II, c. 3, q. 4, p. 240: "Scias enim quod non quicunque gradus formae est incompossibilis cum quocunque gradu, nam calor ut septem potest esse cum frigiditate, ut uno, unde cum illa siccitate ignis, vel cum saltem quinque gradibus illius possunt esse duo vel tres humiditatis [...]"; College of Coimbra (1616) II, c. 3, q. 8, a. 2, col. 602E-603B: "Duae qualitates primae contrariae in gradibus remissis possunt eidem rei inesse. [...] Probatur vero haec sententia hisce argumentis. Aqua tepida habet simul aliquid caloris, et frigoris, igitur frigus, et calor remissa possunt in eodem simul reperiri. Antecedens ostenditur, primum quia tepor nihil est aliud, quam frigoris, et caloris permistio, neque facile est tertiam aliquam simplicem qualitatem excogitare."

[24] Francisco Suárez, *Disputationes metaphysicae*, disp. 46, sect. 2, n. 6; sect. 3, n. 17; cf. disp. 5, sect. 8, n. 23, although Suárez left undetermined in this discussion how contrary degrees relate to one another.

The variety of names associated with this theory should not create the false impression of an absolute consensus regarding the relationship between heat and coldness. First, not everyone accepted this view, as some preferred a more rigid interpretation of the incompossibility of contraries in the same subject. Second, there was ongoing debate about the precise process by which degrees of heat expel degrees of cold, with differing opinions on whether the increase of the former precedes the expulsion of the latter in some way, or if the two were strictly simultaneous.

The scientific importance of what has been termed here the 'new admixture theory' should not be underestimated. Elaborated in technical discussions over intensive variations, this theory implied a clear departure from the opposition of heat and coldness as positive contraries. Since heat and coldness are contraries, according to it, only at their extremes, and since in nature we encounter only mixed bodies that do not possess their elements at their most intense degree, it follows that ordinary heat and coldness are not true contraries. Aware of the potentially devastating character of this view for the coherence of an Aristotelian theory of nature, scholastic thinkers openly tried to maintain a sense in which Aristotle's statements about the incompossibility of contraries in a subject were still true. On a theoretical or, more precisely, *terminological* level, they continued to define heat and coldness as positive contraries. However, *in practice*, their views effectively denied this conception of heat, along with the conceptual framework – based on the theory of genera and species – on which it depended. To this extent, late medieval views on heat were far less opposed to the innovative theories put forward by 16th-century *novatores*, such as Girolamo Cardano, than is typically assumed.

### *3. Positive Contrariety vs. Pure Privation*

The debate over whether coldness should be understood as a positive contrary to heat or as a mere privation of it had deep roots in ancient philosophy. Arguments for the view that cold is simply the absence of heat were available to medieval and Renaissance thinkers through works like Plutarch's *De primo frigido* (Περὶ τοῦ πρώτως ψυχροῦ).[25]

[25] Plutarch (1959).

But some arguments also stemmed from considerations *internal* to the Aristotelian conception of nature. One of them, having to do with cosmology, came from the necessity to reconcile two claims, namely that:

1) Elemental virtues (including coldness) come from the heavens.
2) The light by which the heavens transmit virtues to terrestrial bodies only conveys heat.

One obvious way to reconcile these seemingly contradictory claims was to postulate that coldness arises in terrestrial bodies from a lack of exposure to celestial heat, depending on the duration of exposure or the fluctuating distance from planets reflecting solar light.[26] In the late Middle Ages, as Edward Grant as shown, the problem was lively debated, as experience seemed to show that moonless nights are colder than those with moonlight.[27]

Despite the difficulty of accommodating the cosmological principles of Aristotelianism with such empirical arguments, the view that cold is a mere privation of heat had very few defenders before the 16th century. One of the rare exceptions in the late 14th and early 15th centuries, prior to the rise of openly anti-Aristotelian theories of nature, was Blasius of Parma. Blasius subscribed to the conception of heat and coldness as two extremes on a relative scale described above but, unlike his contemporaries, he argued that this conception implied that coldness is merely a privation of heat:

> In this determination, I will persuasively show that heat does not differ from coldness. And this is the first conclusion. I argue as follows: All heat is a simple form through the privation of degrees of contrary qualities. This clearly appears inductively, for otherwise, any given part of heat would not be heat, and the same applies for all other parts. But heat and coldness together produce one form, which is tepidity. Therefore, it follows that coldness is not specifically distinct from heat. [...] From this, it follows that there is no such thing as coldness, or if there is, it is nothing else than attenuated heat.[28]

[26] This idea seems to have circulated via the transmission of Macrobius. See Macrobius (1847) p. 464: "In coelo easdem inesse zonas quae insunt terrae; atque causam hujus diversitatis esse solem: qui, ut accessu sua causa caloris est, ita recessu frigus inducit." Note, however, that this quote is absent from the new critical edition of the text by Willis.
[27] Grant (1994) pp. 603-5.
[28] Blasius of Parma, *Quaestiones super libros Physicorum*, V, q. 10, f. 156vb: "In quo processu solaciose persuadebo caliditatem a frigiditate non differre. Et hoc pro prima conclusione.

Blasius does not spell out here all the assumptions of his argument but his reasoning may be reconstructed as follows. Heat is a quality that is 'simple' in the sense that it is a quality unmixed with any contrary and not composed of more basic qualities. It is, however, composed of degrees. Since heat and coldness can combine to compose a middle quality – namely tepidity – it follows that the degrees of heat and coldness belong to the same species. Thus, heat and coldness are not different in nature, but only differs in degree.

Blasius offers additional arguments for this view, which he seems to consider plausible. However, in the vast majority of his writings on natural philosophy, he adheres to conventional terminology, describing heat and coldness as contrary species of qualities.[29]

The resurgence of a firmer defense of the privation theory of coldness can be traced to the work of Girolamo Cardano (1501-1576), one of the first thinkers in the 16th century to argue that cold is nothing more than the absence of heat. In his *De subtilitate*, composed in 1550, Cardano presents a new interpretation of the elements, rejecting the Aristotelian quadripartition of fire, water, air, and earth as primary elements of nature.[30] Instead, he argues that fire should not be considered an element in the same way that water or earth are, and by extension, that coldness is not a real, positive quality but simply the privation of heat. Cardano applied the same reasoning to dryness, which he argued was merely the privation of wetness.

Although Cardano rejects the notion of coldness as a positive contrary, he does not challenge the ontological status of heat as a quality. For him, heat remains a real and positive property of matter, and he does not attempt to reduce heat to motion – the central idea of modern thermodynamics.[31] In

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Arguam sic: omnis caliditas est forma simplex per privationem graduum contrariorum qualitatum. Patet inductive, et quia alioquin non quaelibet pars caliditatis esset caliditas, et sic de aliis. Sed caliditas et frigiditas faciunt unam formam quae est tepiditas. Ergo sequitur quod frigiditas non distinguitur a caliditate specifice. [...] Ex hiis sequitur quod nulla est frigiditas, aut si aliqua sit, illa non est nisi remissa caliditas."

[29] This way of presenting radical ideas while labeling them as merely 'probable' and not fully committing to them is characteristic of Blasius' philosophical method; see Biard (2022a) pp. 15-6, 181.

[30] On Cardano's natural philosophy, see Ingegno (1980) pp. 209-71 and (1988); Kessler (1994).

[31] The relationship between heat and motion was discussed by medieval and Renaissance scholars, but the main issue at the time was to explain their correlation through a causal link

fact, as recent research has shown, although Cardano's position can be labeled as 'anti-Aristotelian,' it was deeply influenced by the Paduan Aristotelian tradition.[32] Paduan Masters such as Alessandro Achillini, Pietro Pomponazzi, Agostino Nifo, and Francesco Vimercato, were influenced by Aristotle's *Meteorology*, particularly book IV, where Aristotle assigns primary importance to water and earth and seems to leave aside the usual quadripartition of elements. What Cardano did was to "[develop] the two-element theory of *Meteorology* IV into a veritable cosmology."[33]

The main challenge for Cardano's position is what can be labelled the 'argument from action.' A privation, indeed, cannot act. According to Aristotelian reasoning, coldness must be considered a real quality because it produces observable effects in nature, such as cooling, solidifying, condensing, and separating things:

> However, you reply: 'If cold is nothing in act, but merely the privation of heat, how can cold <bodies> cool, like hot <bodies> heat?' Cold is always to be found with a great amount of matter. It is indeed impossible to find something very thin to be cold. A great amount of matter prevents heat from penetrating and prevents from moving, which is why <coldness> cools. [...] Certainly, coldness is, like I said, nothing else than the privation of heat [...].[34]

As can be seen, Cardano's strategy consists in reinterpreting the terminology of action associated with coldness. Coldness, strictly speaking, does not do anything. It merely *prevents* heat from operating, where the term 'prevents' must be understood as a privation of action caused by a large or dense quantity of matter. All operations attributed to coldness can be reduced to the incapacity of heat to penetrate and move dense bodies. Now, an incapacity,

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(motion causing heat) rather than to identify them with each other or to reduce one to the other. For an overview of the problem, see Galle (2003).

[32] On the Paduan tradition preceding Cardano's activity, see Martin (2022). As pointed out by Del Soldato (2020) p. 124, Cardano's attitude toward Aristotle's authority is more nuanced than it seems, as the Italian philosopher criticizes the Aristotelians of his time far more than Aristotle himself.

[33] Lüthy and Nicoli (2022) p. 19.

[34] Girolamo Cardano (1664) l. II, 61: "Verum rursus dices: si frigus nihil est actu, sed sola caloris privatio, quomodo frigida refrigerant, ut calida calefaciunt? Frigus semper est cum multa materia, impossibile vero tenuissimum aliquid esse frigidum, multa enim materia impedit, ne calor penetrare possit neque moveri, quare hoc modo refrigerat. [...] Equidem (ut dixi) nihil aliud est frigidum, quam caloris privatio [...]."

ontologically speaking, is nothing more than a privation, although it may be described using active verbs.

While Cardano's view represented a sharp rejection of the Aristotelian doctrine, another famous and influential anti-Aristotelian theory of contrariety in the 16th century was that of Bernardino Telesio (1509-1588). Like Cardano, Telesio radically departs from Aristotelian cosmology by rejecting the doctrine of the four elements. He argues that heat and coldness operating in matter suffice to account for the full range of natural phenomena, dispensing with the need for any further physical principles, including substantial forms. In contrast to Cardano, however, Telesio maintains that heat and coldness are *positive* contraries, i.e., opposing real qualities that are the fundamental driving forces of change in the natural world.

Despite Telesio's criticisms of Aristotle, his terminology preserves some aspects of the conceptual background of the Aristotelian theory of contrariety.[35] In Telesio's view, heat and coldness indeed behave like form and privation at the metaphysical level, while retaining their status as positive contraries at the empirical level.[36] Telesio argues that, when properly understood, Aristotle's theory of natural change – as a relation between two contraries successively determining a common substrate – ultimately leads to his own theory of heat (representing the form) and coldness (representing the privation) as the sole two principles acting upon matter.[37] In fact, Telesio relies on passages where the Stagirite himself compared the relation between heat and coldness to that between form and privation.[38]

One important reason for Telesio's theory is that, according to him, not all actions could be reduced to incapacity or privation of heat's operations. In particular, the active character of coldness is necessary for explaining the whole variety of bodies – whose structure can be either homogeneous or heterogeneous – that we observe in nature:

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[35] On Telesio's anti-Aristotelian stance and the evolution of his reputation as an opponent of Aristotle, see Garber (2016).
[36] Hattab (2017) p. 442.
[37] Bernardino Telesio (1587) l. III, p. 83: "Ipse id Aristoteles utrum eadem omnium principia sint inquirens apertissime pronunciat. Omnium, inquit, principia eadem sunt, et non eadem, veluti corporum forsan sensibilium, calidum quidem, ut forma, frigidum alio modo privatio est; et materies id, quod haec est, potentia primum per se."
[38] Arist. *Metaph.* Λ 4.1070b11-13.

The hot, indeed, gathers those things that are of the same kind [*generis*]; for they say that fire separates, as it gathers things that are of the same kind; for it happens to also separate things that are different. Cold, however, joins and gathers similarly both things that are of the same kind and those that are not of the same kind.[39]

Telesio was not isolated. Other *novatores* willing to follow Telesio, like Tommaso Campanella (1568-1639), also posited a relation of real contrariety between heat and coldness.[40] In response to these new doctrines, many 16th-century Scholastics sought to develop consistent rebuttals in defense of the traditional Aristotelian view of heat and coldness. They argued that, while heat and coldness had indeed to be conceived as positive qualities, they alone could not account for all natural changes. Instead, they maintained that these qualities had to be understood in conjunction with the substantial forms of the elements, which explained the deeper ontological structure of earth, air, fire, and water. Regarding the conception of heat and coldness, the essential difference between the Scholastics and *novatores* like Telesio and Campanella lied in the fact that, for the former, the role of heat and coldness in natural change was mediated by substantial forms.

In the 16th century, the reception of the works of Alexander of Aphrodisias (ca. 150-215), renowned as an eminent commentator of Aristotle, further complicated this problem, as Alexander was held to have defended that elemental qualities are the 'forms' (i.e., the substantial forms, in scholastic terminology) of the four elements. Defenders of the traditional scholastic doctrine according to which the substantial forms of the elements are different from elemental qualities pointed out that, while substantial forms do not have positive contraries, qualities like heat and coldness do, thereby

[39] Bernardino Telesio (1587) l. III, p. 87: "Calidum enim, quod congregat ea, quae generis eiusdem sunt; segregare enim quod inquiunt facere ignem, congregare est ea, quae sunt eiusdem generis; contingit nanque, excipere aliena. Frigidum autem, quod coniungit, et congregat similter et ea, quae eiusdem et que non eiusdem sunt generis."

[40] Tommaso Campanella (1939) p. 194: "*Delli principij attivi*. In questa mole corporea materiale di tanta statua disse Dio che nascessero due fabri incorporei, ma non potenti senza corpo stare; et però son nati il calore e'l freddo, principij attivi, et però di potenza diffusive: Subito nemici furo, volendo ciascun di loro occupar tutta la stanza materiale: onde a combattere cominciaro, havendo ordinato Dio che di tal discordia gran bene riuscisse." On Campanella's view on qualities, see Granada (2007).

suggesting that elementary qualities could not be entirely identical to the elements' substantial forms.

The most orthodox scholastic Aristotelians of the 16th century thus maintained a nuanced position:

(1) Heat and coldness are real qualities.
(2) They are real contraries.
(3) However, they are not the substantial forms of the elements themselves.

It is often assumed that the eventual decline of the conception of coldness as a positive contrary to heat was driven primarily by the rise of atomist and corpuscularist theories of matter, which became dominant in the 17th century.[41] This is partly true, as atomism played a decisive role in the reduction of heat to motion. However, the role of atomism in the decline of the contrariety between heat and coldness has been overstated. For instance, key figures in the revival of corpuscularianism, such as Julius Caesar Scaliger (1484-1558) and Daniel Sennert (1572-1637), continued to hold that heat and cold were positive contraries. Even Pierre Gassendi (1592-1655), one of the most radical defenders of atomism, maintained that heat and cold were real opposites. By contrast, one of first modern thinkers who explicitly endorsed the view that coldness is a privation of heat, namely Cardano, continued to think within a quality-based ontology, distinct from mechanicist perspectives that would later reduce heat to motion.[42]

Other traditions undeniably played a role in the transformations of heat in the 16th century. When Galileo (1564-1642), in his early notebooks, enumerates the different conceptions of the relation between heat and coldness, he notes, in addition to the Aristotelian view (which he still deemed correct at that time) and the reductionist stance of Plutarch, that "physicians" hold a hybrid view in which there exist two types of cold – one positive and the

[41] For instance, Rozemond (2009) p. 80, writes: "[...] Insofar as I am aware, thinkers who regarded cold as a privation of heat had a mechanistic account of heat. I know of no representative of the view that cold is a privation of heat where heat as it appears to us is a quality existing in the physical world."
[42] As Lüthy (2012) pp. 86-8, has shown, an atomist reinterpretation of Cardano's natural philosophy can be found in David Gorlaeus.

other privative. Galileo is repeating here doxographical teachings common at that time, and typical of the Jesuit tradition in which he was trained, as evidenced by William Wallace.[43] In fact, this idea that some coldness was privative could be traced back, in the medical tradition, to Galen (129-216), who viewed the coldness proper to aging, to some diseases and death as a decrease of natural heat (*per extinctionem caloris naturalis*).[44] The increasing importance of medical theories for natural philosophy in the 16th century led to the dissemination of the idea that the Aristotelian perspective was ill-equipped to address cases where coldness was more accurately defined as a privative phenomenon in relation to heat. These observations concerning the role of non-Aristotelian traditions in the transformations of the concept of heat raise the question of the precise role that scholastic Aristotelians played in the ultimate rejection of Aristotle's conception of heat and coldness as positive contraries. As the next section of this study will argue, the late scholastic tradition still contributed in its own way to this process.

### *4. The Status of Resistance*

One of the issues that contributed to disentangle the concepts of heat and positive contrariety in the late medieval and early modern period was the problem of resistance and its nature. Understanding this requires an explanation of how resistance emerged as a lively topic of debate regarding the interactions between heat and coldness. This debate was intimately linked to the problem of reaction, where the challenge was to explain how opposing forces could act and react upon each other. The challenge was particularly complex because the Aristotelian understanding of action posits two asymmetric entities, the agent and the patient, with the agent required to exert a force greater than that of the patient (a principle that will be called below the 'principle of the agent's superiority'). How can a cold body react on a hot body that acts upon it, particularly when the hot body is larger and more intense?

[43] See Wallace (1984) pp. 79-80, who demonstrates that Galileo's presentation of the debate closely matches that of the Jesuit Paolo Valla's.
[44] Galen (1643) II, p. 23a.

An influential solution to this problem, developed by Parisian masters of the 14th century such as John Buridan, Albert of Saxony, Nicole Oresme, and Marsilius of Inghen, posited that qualities like heat and coldness could engage in mutual action and reaction because they possess two distinct properties, i.e., an active power (*potentia activa*) and a resistive power (*potentia resistiva*), having different degrees.[45]

For instance, heat was conceived as highly active but with a very low degree of resistance. A cold body could then react on a hot body despite being affected by it, because its degree of activity, while inferior to the hot body's active power, was still superior to the hot body's resistance. This explanation allowed these philosophers to account for how heat and coldness can act and react on each other while saving the principle of the agent's superiority.

This explanation of reaction was widely – though not universally – accepted in the 15th and 16th centuries, yet it raised a serious difficulty: What is the exact relationship between activity and resistance? Are they really distinct powers, or are they aspects of the same quality only distinguished by the mind (corresponding to what scholastic philosophers called a *distinctio rationis*)?

Opposed to the medieval Parisian tradition that defined activity and resistance as two distinct powers, many thinkers – most notably the so-called 'Oxford Calculators' – rejected any real distinction between them, arguing that to resist is simply to act. This debate persisted in the scholastic tradition during the Renaissance.[46] A defender of the conceptual distinction between activity and resistance often discussed in the 16th century was Paul Soncinas (d. 1494). He argues that these properties were *relative*, not absolute, and therefore not mind-independent.[47] For Soncinas, the same coldness can be described as active in terms of its physical effects on bodies (e.g., cooling) but it can also be described as resistive in terms of its impeding effect on heat.[48] This

[45] See Caroti (1989).
[46] See Caroti (1995).
[47] On this topic, see the pioneer work of Des Chene (1996) pp. 49-50, on which this section heavily relies concerning Soncinas, Zabarella, and Suárez.
[48] Paul Soncinas (1579) IX, q. 6, 209b: "[...] Esse activum et esse resistivum est esse relativum, cum dicatur ad aliud, nihil enim est activum aut resistivum in seipsum. Et ideo, sicut eadem res est albedo et similitude, ita eadem res est activitas et resistentia."

mind-dependent character of action-related properties implies that activity and resistance are not ontologically distinct powers (*potentiae*) but simply different ways of describing one quality with respect to other qualities.

By contrast, Jacopo Zabarella (1533-1589) and Francisco Suárez (1548-1617) – representing the Paduan and scholastic branches of Aristotelianism, respectively – both defended the idea that resisting is really distinct from acting. For Zabarella, resistance is not an action but something fundamentally different: resistance is neither an active power nor a passive one. According to him, resistance has no contrary, as it refers to the diminution or privation of another thing's action. By differentiating resistance from any type of action or power, Zabarella makes room for a *sui generis* phenomenon that exists alongside reaction, and which lies outside the class of items organized into pairs of contraries (agent vs. patient; active vs. passive powers). His strategy for legitimizing this particular conception of resistance involves integrating it into the more familiar terminology of reaction by making a distinction between two types of reaction. In contrast with *positive* reaction, which falls into the category of action and occurs when heat positively acts on coldness to diminish it, Zabarella calls "privative reaction" the resistance offered by coldness against its destruction by heat. For a reader familiar with Aristotle's understanding of reaction, where 'reaction' typically signifies 'contrary action' or 'action in return,' the concept of privative reaction might appear as a pure contradiction.

Through this conceptual reworking, resistance is thus presented as a non-active phenomenon – the tendency of a thing to maintain its own state in opposition to external forces, which is defined independently of any contrariety.[49] Zabarella attributes resistance to the effort (*nisus*) of a form to persevere in its own being: When coldness resists heat, it does so not through an active power, but through its natural tendency to conserve its own state.[50] Thus, while the active power of coldness is defined in opposition to heat, its resistance arises from an intrinsic inclination to persist that is not a relational property.

[49] Jacopo Zabarella (2016) vol. 1, l. XII, p. 538, l. 9.
[50] *Ibid*., ll. 8-27.

While pertaining to a different intellectual trend, Francisco Suárez similarly elaborates on the concept of resistance, arguing that it is ontologically identical to a thing's tendency to conserve its own being. Rejecting Soncinas' view, Suárez also notes that resistance essentially entails a type of privation – specifically, the privation of an external agent's action. In his *Disputationes metaphysicae*, he writes:

> Regarding this sense of resistance, therefore, it must be said that it does not consist in any positive act coming from that power which is said to be the force of resistance, but it rather consists in the privation of an act. [...] Hence such a power of resistance is rather some impotency, or some kind of incapacity, than some kind of power. [...] This actual and formal resistance only consists in the fact that the subject, in virtue of a quality or disposition existing in it, prevents another form or action from being introduced in it [...]. And from this, it can be understood that what is commonly said about this latter mode of resistance is true, that one quality can be more active than resistive, and vice versa; because this resistance does not derive from activity, but precisely from information or disposition.[51]

We can see that Suárez is indebted to the medieval Parisian tradition described above, positing a distinction between activity and resistance. However, unlike for Buridan and his ilk, who defined resistance as a *power*, Suárez makes it clear that resistance does not fall into the category of power or action, strictly speaking. The resistance of a quality is, rather, its *incapacity* to undergo change, stemming from its disposition to maintain its own state. As such, resistance is not defined as a positive contrary to anything else.

The same view was common in the late 16th century scholastic tradition. Before Suárez, Francisco de Toledo had distinguished three meanings of the term 'resistance,' defining the resistance proper to a quality as its self-conserving tendency, by which it "defends" itself against external action,

[51] Francisco Suárez, *Disputationes metaphysicae*, disp. 43, sect. 1, nn. 9-11: "De hoc ergo resistendi modo dicendum est non consistere in aliquo actu positivo, proveniente a virtute illa quae vis resistendi esse dicitur, sed consistere potius in privatione actus. Unde talis resistendi vis potius est impotentia, vel incapacitas quaedam, quam propria potentia, ideoque non debuit tertium illud membrum in divisione potentiae adiungi. [...] Unde talis resistendi vis potius est impotentia, vel incapacitas quaedam, quam propria potentia [...]. Nam haec actualis et formalis resistentia solum in hoc consistit, quod subiectum per qualitatem aut dispositionem in ipso existentem, impedit ne alia forma vel actio in ipsum introducatur [...]. Atque hinc intelligitur de hoc posteriori resistendi modo verum esse quod communiter dicitur, unam qualitatem posse esse magis activam quam resistivam, et e converso; quia haec resistentia non consequitur activitatem, sed praecise informationem aut dispositionem."

without being identified to reaction as such.[52] The Coimbran commentators present a similar threefold typology of resistances (negative, privative, and contrary), where a quality's resistance is a special property distinct from action and reaction.[53]

A close conception of resistance also attracted the attention of early modern natural philosophers such as Galileo. In his early works usually called the *Juvenilia*, Galileo discussed the nature of resistance in opposition to contrary actions:

> The first doubt is: What is resistance? [...] I say first that resistance is not formally an action. [...] I say, secondly, that resistance is not a passion. [...] I say, third, that resistance is the permanence in its own state against a contrary action. I said 'against a contrary action.' Resistance indeed, although it is not an action, connotes however a contrary action, which it impedes. I said 'permanence in its own state' because I do not distinguish resistance from the very existence of the thing, as it persists; on the contrary, resistance formally means this permanence in its <own> state, and it connotes the impediment of a contrary action.[54]

Here, Galileo echoes the Jesuit perspective exemplified by Suárez, emphasizing that resistance is neither an action nor a passion but rather the persistence of a thing in its own state against opposing forces. Remarkably, this property is primarily used to define the relations between heat and coldness rather than, as it would later be, the behavior of bodies moving through space. Let us note that for Zabarella, Galileo, or Suárez, resistance is not supposed to *replace* reaction as the correct description of how heat and coldness interact. It is rather presented as a *complementary model* for describing how a quality like heat behaves and relates to external actions, this behavior being defined independently of contrariety.

The recognition of resistance as a distinct concept within Aristotelian natural philosophy has profound implications for the understanding of

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[52] Francisco de Toledo (1588) I, c. 7, q. 15, 144-5.

[53] College of Coimbra (1616) I, c. 9, q. 3, a., 3, col. 490E-491B; a. 4, col. 492D-493B.

[54] Galileo Galilei (1890) pp. 170-1: "Prima dubitatio sit, quid sit resistentia. Dico, primo: resistentia non est formaliter actio [...]. Dico, secundo, resistentiam non esse passionem. [...] Dico, tertio, resistentiam esse permanentiam in proprio statu contra actionem contrariam. Dixi 'contra actionem contrariam': nam resistentia, quamvis non sit actio, connotat tamen actionem contrarii, quam impedit. Dixi 'esse permanentiam in proprio statu': quia non distinguo resistentiam ab ipsa existentiae rei, ut permanet; immo resistentia formaliter dicit hanc permanentiam rei in suo statu, et connotat impedimentum actionis contrariae."

heat-related phenomena. It appears as a complementary conceptual tool alongside contrariety and reaction for explaining the interactions between heat and coldness. However, since this concept may be extended to all sorts of phenomena, unlike reactions based on contrariety, it is easy to see how this complementary model could also appear as a *competing* model for theorizing thermic phenomena.

While scholastic Aristotelians did not eliminate the concept of contrariety or the associated idea of reaction, they increasingly acknowledged that resistance provided an equally compelling explanation for the behavior of heat. Moreover, resistance could be generalized to other natural processes, thus becoming a broader principle for understanding physical change. This shift towards the concept of resistance fits well with the late 16th-century move toward grounding physical explanation in conservation laws and early notions of inertia. The idea that things tend to conserve their own state and resist change would later become central to the development of mechanical philosophy, laying the groundwork for later scientific advancements in understanding the nature of motion and resistance.

## *5. Conclusion*

The evolution of the notions of heat and coldness in the late medieval and early modern periods demonstrates a gradual shift in how these concepts were understood within Aristotelianism. With respect to its final development in the 17th century, this shift was, however, incomplete. The persisting understanding of coldness as a positive contrary to heat in these periods reveals the deep-rooted importance of contrariety for maintaining the coherence of Aristotelian natural philosophy, but also highlights the emergence of significant transformations in the conceptual framework that would eventually lead to a new paradigm of heat.

In the late Middle Ages, confronted with the problem of explaining how one and the same quality can have different degrees of intensity, Scholastics already began to analyze heat and coldness as inverse values on a same scale. While remaining committed to the Aristotelian framework of contrariety, they sought to circumvent the principle of incompossibility of

contraries in the same subject. This shift did not erase the distinction between positive and privative contrariety but it was nonetheless crucial, as it introduced the idea that heat and coldness were not opposite essences, but rather extremes of a single continuum.

In the Renaissance, major transformations occurred, coming from anti-Aristotelian trends exemplified by Cardano or Telesio. The most systematic attempt to destroy the Aristotelian view on heat came from Cardano, who undertook to show that the 'argument from action' in favor of it could be denied. Importantly, these trends, which might be labeled as 'anti-Aristotelian,' were often indebted to doctrines on heat developed within different branches of Aristotelianism itself.[55] These theses and the reactions they generated marked a period of intellectual flexibility around the Aristotelian framework, where traditional concepts such as contrariety, power, and privation could be reconciled with new observations and theories. The resulting landscape was one of doctrinal plurality, where heat was still defined as a real quality, whereas the status of coldness generated much more disagreement.

However, even the most orthodox branches of scholastic Aristotelianism, such as the Jesuit school, began to incorporate a new explanatory framework that moved away from the traditional notion of positive contrariety between heat and coldness. Defining resistance independently from the notions of power and action, which traditionally come in opposite pairs, late scholastic Aristotelians saw this concept as a compelling explanation for thermic phenomena and, simultaneously, as a more universal feature of natural processes. The increasing acceptance of resistance within scholastic thought – even among those who continued to adhere to a quality-based framework – indicates a growing openness to new ways of thinking about thermic phenomena, taking into account self-conserving properties of matter akin to the laws of inertia and conservation principles.

The late scholastic tradition never fully disentangled heat from contrariety, for its understanding was still based on the distinction between an agent and a patient, which implied a duality of (active and passive) powers that

[55] On the relative nature of the term 'anti-Aristotelianism' during the Renaissance and its primarily institutional significance, see Del Soldato (2020) pp. 120-6.

prevented it from viewing heat exchanges as a process aimed at thermic equilibrium through purely quantitative laws. Still, the conceptual shifts that took place between the 14th to the 16th centuries undeniably set the stage for a revised conception of heat, which will eventually acquire a new ontological status in the 17th century. These developments reflect the complex nature of intellectual change in this era, illustrating how terminological continuity and conceptual innovation coexisted in the transitional period separating the premodern world from what is still often called the 'Scientific Revolution.'

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CHRISTOPH SANDER

# LEAST ATTRACTIVE?
## Aristotelian Presuppositions to Explain Magnetic Movements

**Abstract**

Since Antiquity, scholars have sought to explain the cause of magnetic 'attraction' through diverse theories, which raised questions as to whether the magnet attracts iron or vice versa, or if both entities play equal roles. Aristotle himself avoided the notorious question of how magnetic attraction works: his commentators and critics made good for this lacuna. Medieval theories predominantly posited that iron moved towards the magnet for teleological reasons. Medical and alchemical authors in turn emphasized the magnet's active attraction of iron, while only a minority believed in the iron's active attraction of the stone. The seventeenth century saw William Gilbert establish an account of reciprocal attraction between the iron and the magnet. These causal representations, rather than being empirically grounded, were often rooted in natural-philosophical or metaphysical assumptions, especially Aristotle's causal principle of motion. A fierce controversy about the 'correct' account of the causal roles in magnetic attraction grounded, prepared and partly overshadowed the debates on how to explain magnetism. This article will shed light on this little-known controversy. It offers a more balanced account of the tacit and salient impact of Aristotelian natural philosophy by providing a framework that enabled different theories to contradict each other – until even this framework dissolved during the seventeenth century.

**Keywords**

Aristotelian Natural Philosophy, Magnetic Attraction, Aristotelian Paradigm of Causation, Averroes, William Gilbert

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## *1. Introduction*

Birds of a feather flock together. Since Antiquity, maybe even longer, the relationship between a magnet and iron has been considered as an instance of sympathy.[1] These two natural substances seem to have some connection, as they – *prima facie* – attract each other and stick together. The first naturalists, magicians, and physicians writing on the magnet were not primarily concerned about a complex understanding of what was really going on between magnet and iron. For them, it sufficed to marvel at the observation that certain natural objects stand in a fixed relationship to each other – that they fit into a web of sympathy and antipathy.[2]

In ancient natural philosophy, more theoretical reflections on the concept of attraction or movement of magnet and iron emerged with the Presocratics.[3] According to Aristotle, Thales assumed a soul in the magnet, with the help of which it seemingly would move itself to the iron. Magnetic attraction here is deferred to a superior principle, i.e. a soul being the cause of the magnet's movement.[4] Plato criticized common perception and stated that magnets actually do not attract iron.[5] In line with some pre-Socratics he explained magnetic attraction away by subscribing to material and mechanistic principles.[6] The 'avoidance of a vacuum' (*fuga vacui*) or the collisions and movements of atoms thus made attraction, at the theoretical level, an illusory phenomenon that could be reduced to invisible mechanics underlying the visible effects.[7] However, Aristotle himself avoided the notorious question of how magnetic attraction works.[8] His commentators and critics made good for this lacuna, after all.

In fact, Aristotle, or rather, Aristotelian natural philosophy, defined – for a large part – the conceptual framework against which the question of

[1] See Sander (2020) chap. 8.1.3.2.2. This article closely follows, and partly translates, research of Sander (2020) pp. 606-22.
[2] See Lehoux (2003).
[3] See Radl (1988).
[4] See Sander (2020) chap. 8.1.3.2.4.1. See Aristotle, *De an.* 405a19-21.
[5] See Sander (2020) p. 701. See Plato, *Tim.* 80.
[6] See Sander (2020) chap. 8.1.3.2.8.1.
[7] See *ibid.*, p. 621.
[8] See Sander (2023a).

how magnets work was discussed, even by critics. While there was much disagreement of how to exactly explain magnetic attraction – or a movement so-perceived –, a certain web of metaphysical assumptions or distinctions was not as heavily contested until the premodern era: For example, action-at-a-distance was rarely argued for in the natural realm and most philosophers took up a distinction between an active and a passive role in causation.

The metaphysics of causation within the history of Aristotelian philosophy have not escaped scholars' attention, and several studies have shown how much of an (often hidden) Aristotelian metaphysical skeleton laid below the muscles of non or even anti-Aristotelian accounts.[9] Yet, the absence of an authoritative Aristotelian account of magnetism, and the somewhat fuzzy assumption of 'occult qualities' to account for it, have largely blurred the actual Aristotelian embedding informing the diverse pool of premodern accounts of magnetism.[10] Those already mentioned occult qualities, often ascribed to allegedly Aristotelian accounts, are one specific *explanans* for the *explanandum* 'magnetic attraction'. However, several if not the majority of scholars generally took, e.g., for granted that the iron is moved to the iron (being altered by the quality), including the critics of occult qualities. Such a claim or belief can be considered a causal representation – an underpinning of specific causal explanations, such as by 'occult qualities' or atoms. These more fundamental causal representations were to some degree deeply Aristotelian in subscribing to active and passive causal roles, for taking causes to be fundamental to the domain of natural philosophy, and for holding logic, natural language, and 'common-sense' observation as apt point of departures of the natural philosophical investigation. To some degree, this changed in the seventeenth century, in different ways. This article will tell part of this well-known story by way of one concrete example: causal representations of explanatory theories of magnetism from Aristotle to the rise of Cartesianism.

[9] See, e.g., Feingold (2003); Garber (1992); Leijenhorst, Lüthy and Thijssen (2002); Wallace (1981). There are a plethora of studies, this volume included, that show how much Aristotelian philosophy shaped philosophical and scientific thought in the early modern period.

[10] See Sander (2023b). This publication studies the acceptance, criticism, and transformation of the concept of 'occult qualities' in explaining magnetism in depth. Respective assessments below in this article are based on this study.

Focusing on this longue durée reveals that the Aristotelian paradigm of causation, its fundamental metaphysics of causation undergirding hylemorphism and qualitative change, was employed even for non-Aristotelian accounts of magnetic attraction. It provided a syntax of causation, even if matter, form, and qualities were abolished by many in the course of the scientific transformations of the seventeenth century. To put in a nutshell, the Aristotelian causal model, also applied to magnetic attraction, was based on active and passive roles, an agent and its object. This model could work for all sorts of specific explanations, but eventually was contested by another model, proposing causal reciprocity, mutuality, or symmetry.

## *2. Six Ways to Look at Magnetic Attraction*

Any view of magnetic attraction as a particular form of attraction or motion already implies far-reaching causal assumptions about what happens, from the point of view of natural philosophy, when iron and magnet are brought into spatial proximity. What is actually observed here? How is it best described? What attracts what? Or are both objects being attracted equally by each other? Is it even an attraction at all? For most premodern – pre-Hume – natural philosophers, these questions were not to be decided empirically, but are primarily rooted in a theoretical understanding of 'attraction'. This does not primarily relate to the *explanans*, but more importantly to the *explanandum*. Answering these questions required an abstractly defined conception of the actual phenomenon to be explained. To explain *how* something works implies to have an idea of this *something*, most importantly a mapping to causal roles.

To be sure, any answer to these first-order questions of causation already may provide a partial answer to the actual causal question of the 'how?'. The relation of the causal *relata* 'iron' and 'magnet' thus co-determined the causal representation of the object of explanation, which was explained by various theories. Two theories, which seem very similar in terms of their natural philosophical explanatory principles, can explain two actually quite different causal representations of the same phenomenon. Conversely, one single causal representation can also be explained by two very

different theories. This logical variance goes some way to enable both the great variety of premodern magnetism theories and the fierce controversies that this entailed.[11] To study this controversy, the two levels – representation and explanation – have to be logically distinguished, although they have not always been explicitly distinguished as two levels by the actors' themselves.

From a bird's eye view on these premodern debates about causal representations of magnetism, the below abstract typology can serve as a helpful instrument for grouping and relating historical theories to each other. Essentially, authors between late Antiquity and the early modern period argue for six possible modes of causation:

I. The magnet actively attracts the iron.
II. The iron actively attracts the magnet.
III. The magnet and iron attract each other.
IV. The magnet and iron come together.
V. The magnet moves to the iron.
VI. The iron moves to the magnet.

It goes without saying that even within these six modes there is still plenty of scope for different understandings of the causal relations. For example, purely mechanistic accounts of attraction, in which attraction is nothing else than the pushing of material particles, in fact reduced Modes 1 to 3 to options 4 to 6. While the very concept of attraction is superfluous for ancient atomists and early moderns inspired by them, as we shall see, they nonetheless did opt for Modes 4 to 6. They needed a causal model in their metaphysics, too!

Modes 4 to 6, on the other hand, concern the issue of self-movement.[12] The fundamental background to this problem, at least since Late Antiquity, has been a principle of Aristotelian physics: "Everything that is moved is moved by something else" (*omne quod movetur ab alio movetur*).[13] For most natural philosophers, this principle had an axiomatic character and therefore

[11] Whether the causal representation is a consequence or prerequisite of a certain explanatory theory is disputable but also of less importance here.
[12] See also Gill and Lennox (1994).
[13] See esp. Hesse (2005) p. 64; Lohrmann (2008) p. 230; Pines (1961); Sarnowsky (2007) p. 123; Weisheipl (1965).

prompted them to account for apparent self-movements, such as the movement of the elements to their natural location, by involving an internal complexity within the subject of movement to ensure a proper distinction between the mover and the thing moved.[14] A self-movement *per se* was usually attributed exclusively to living beings, with the soul, the intellect, the will, etc., being a mover. A self-movement *per accidens* however applied to inanimate things, such as iron, which was accordingly moved to the magnet by the iron's own form or some other disposition. In the common Aristotelian account, the purpose of such movement was considered a final cause, not only triggering, but strictly causing a movement per accidens. Hence, the iron, once moved to the magnet, was not endowed with some sort of mental intention but acted on behalf of its telos, written into its substantial form and corresponding to the form of the magnet. Vitalist accounts however extended this self-movement even further but considering magnets as quasi-living substances, moving to the iron on their own. While this might require some reconciliation with the Aristotelian axiom for apparent self-movements mentioned above, proponents of this vitalist account often simply ignored it, outrunning any Aristotelian constraints of metaphysics.

These and many other theory-specific conundrums are best analyzed in the light of these individual theories and will thus be largely ignored in the following. The main take-away from this for this article rather is that one and the same phenomenon could be represented in different causal conceptions. This phenomenon is the spatial movement to be observed when magnet and iron are brought into spatial proximity to each other.

In describing this phenomenon, however, the English (this article's language) and Latin (the dominant language of the sources) languages already implicitly define important causal assumptions that must be kept in mind.[15] The verb 'to attract' (*attrahere*) is semantically bivalent, so it usually demands a direct object. This linguistically defines subject and object as *agens* and *patiens*, even if it is used reflexively in the plural ('A and B attract each other').[16] The

[14] The principle thus resembles the assumption largely shared by modern analytical philosophers that causality is not reflexive.

[15] See also Johnson (2010).

[16] In German, unlike in Latin or English, the verb 'bewegen' is necessarily reflexive under certain conditions: in German 'A bewegt sich zu B', while in Latin or English it is 'A movet

verbal syntagma 'to unite (with something)' (*sibi unire*) and the nominal syntagma 'bilateral union' (*unio utriusque*) imply yet another view. These expressions semantically necessarily imply reciprocity, without a causal effect on anything else being presupposed. However, a latent asymmetric relation is often connoted, since the unification can be initiated by one of the *relata*, with the subject occurring in the singular: 'A unites with B'. The lexeme 'to come together' or 'to join' (*coire* or *coitio*) plays a particularly important role. Semantically and grammatically, these expressions tend strongly to demand a subject in the plural (verb) or a genitive object in the plural (noun). In addition, it is grammatically impossible for the lexeme to have an object as a verb and a *genitivus obiectivus* as a noun. Unlike a simple movement, the path of movement for such a join is not determined by direction, that is, A and B usually do not 'join at C'.

The Latin sources examined here use the whole repertoire of these expressions to describe the same phenomenon or event. For the sake of linguistic simplicity, however, the term 'magnetic attraction' will be used throughout this article, although this formulation is actually already the result of a certain causal representation. The following description mostly follows the chronology of the controversy instead of the six modes. This helps illustrate that the development of different causal representations is historically a discursive product. Most actors did not explicitly opt for any of the modes – they presumed these modes, often quite tacitly.

### *3. Ancient and Medieval Background*

Aristotle's theory of motion famously distinguishes between the eternal, circular motion of the celestial bodies and the perpendicular, linear motion of the sublunar world.[17] Among the linear movements, he distinguishes between the natural movements of the elements and four 'violent' forms of movement, that is, motions caused by something external: Pushing, pulling,

ad B' or 'A moves to B'. The fact that the subject's movement affects 'itself' is therefore implied in German, but not necessarily presupposed in natural philosophy.

[17] Cf. Cohen (1994); Falcon (2005) pp. 55-84; Kosman (1969); Machamer (1978); Wallace (1978). See also Sander (2020) chap. 7.3.3.1 and 8.1.2.2.

carrying and turning (*pulsio, tractio, vectio, vertigo*).[18] He does not explicitly classify magnetic attraction in this typology. While one might assume that it could be classified as a form of pulling, this would be inaccurate, as he understands it to mean mechanical pulling, such as when a horse pulls a carriage.[19] Aristotle occasionally mentions other forms of attraction, such as attraction caused by 'heat' – but nowhere in his work does he address magnetic attraction as *explanandum*.[20]

A particularly influential natural-philosophical definition of the concept of attraction has been developed in the medical context – most importantly by Galen – where magnetic attraction is explicitly considered as an example of attraction. Galen acknowledged attraction by suction, i.e. by avoidance of a vacuum.[21] However, he moreover assumed an attraction, which was brought about by a so-called 'natural faculty' (*facultas naturalis*).[22] This attraction he related to a certain 'relationship of qualities' between what was attractive and what was attracted. Being an important theoretical building block, especially in Galen's physiology and pharmacology he explained, for example, how the bodily parts could attract its proper food stuff or how certain drugs could attract corresponding body juices.[23] It is important that Galen defended his concept of attraction against authors who did not concede any 'real' attraction in nature, such as the atomistic theory of magnetic attraction, which ultimately reduces it to the collision of atoms.[24] Galen assumed the magnet as an *agens* to attract a *patiens*, i.e. iron: "The magnet is somewhat stronger, so that it is more suitable for attracting than for being attracted" (ἀλλ' ἰσχυροτέρα πώς ἐστιν, ὡς ἕλκειν μᾶλλον ἢ ἕλκεσθαι ἕλκεσθαι / *verum fortior est quodammodo, ut attrahere sit aptior, quam attrahi*).[25] Galen's account is therefore an exponent of Mode I in the scheme outlined above, and his legacy is bifold.

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[18] See Aristotle, *Phys.* VII 2.243a. On this see also Wardy (2007) p. 127.
[19] Cf. Maier (1943) p. 174. See also Sander (2020) p. 614 n. 120.
[20] See Furley (1983) p. 90.
[21] See Brunn (1967) pp. 108-9, fn. 2; Galen (1916) p. 318; Meyer-Steineg (1913) pp. 443-4.
[22] See Sander (2020) chap. 4.2.1.1.1. See also Hankinson (1998) pp. 395-400.
[23] See Sander (2020) chap. 8.1.3.2.5.1.
[24] See *ibid*., chap. 8.1.3.2.8.1.
[25] This is explicitly stated in Galen (1561) p. 198; Radl (1988) p. 73. See Galen (1821) vol. XI, p. 612. See also Sander (2020) chap. 4.2.1.1. In a similar way, the kidney attracts a certain

On the one hand, Avicenna proposed in his *Canon* an influential tripartite division of types of attraction that is clearly inspired by Galen:[26] attraction by 'heat' (*calore*), e.g, when a burning oil lamp attracts the oil, by 'filling the vacuum' (*implendo vacuum*), as with a water pump, but also an attraction by 'attractive power' (*virtute attractiva*).[27] His example of the latter form of attraction is the magnet with its attraction of iron. Avicenna's commentators interpreted this 'attractive power', which at this point was probably closely related to Galen's concept of *facultas*, as a 'specific form' or 'occult property' (*forma specifica sive proprietas occulta*).[28] This medical idea of active attraction by a non-mechanistic principle, established to a large extent by Galen, remained influential in the Middle Ages. Ugo Benzi, for example, expressly emphasizes with Galen: "The magnet attracts the iron and not vice versa" (*magnes attrahit ferrum et non e converso*).[29]

Galen's contemporary Alexander of Aphrodisias, on the other hand, seems to criticize this conception in the *Quaestiones* attributed to him.[30] He rejects the comparison between magnetic attraction and the physiological attraction of organs. The latter also attract what lies between them, whereas the magnet does not attract any medium, but only the iron.[31] Alexander then points out that the living being is apparently attracted to its food. However,

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part of the blood or a certain drug attracts the body fluid that suits it. Cf. McVaugh (2012); Temkin (1977).

[26] See Avicenna (1522) fol. 22*v*. See esp. Weill-Parot (2013) pp. 371-94. On Avicenna's conception of attraction, see Goddu (1985).

[27] Avicenna notes that some philosophers reduced the attraction of 'heat' to the attraction of 'filling the vacuum'.

[28] Cf. Jacopo da Forlì and Avicenna (1547) fol. 62*r*. See Sander (2020) chap. 8.1.3.2.3 and 8.1.3.2.5.1. On Galen and Avicenna's concept of (magnetic) attraction, cf. also Costeo and Avicenna (1589) pp. 495-523; Luiz (1540) fols. 10*v*, 15*v*; Marcellus and Aristotle (1508) fols. 51*r*-52*r*. See also Siraisi (1981) p. 162. For Avicenna, however, the explanation implicit in Galen that attraction is related to the relationship of qualities between *agens* and *patiens* does not play a role. See Cardano (1548) p. 20.

[29] See Benzi and Avicenna (1485) fol. 37*v*. See also Sander (2020) chap. 4.2.1.2. Similarly in Jacopo da Forlì and Avicenna (1547) fol. 90*v*. Forlì also mentions Averroes's position (cf. *ibid*., fol. 218*r*). See also Taddeo Alderotti and Siraisi (1981) pp. 179-82.

[30] See Alexander of Aphrodisias (1548) p. 128, (1892) pp. 73-74, (2014) p. 31; Radl (1988) p. 84. See also Alexander of Aphrodisias and Aristotle (2011) pp. 131, 143. For Alexander's criticism of Galen, cf. in particular Al-Hasan ibn Musa al-Nawbakhti and Aristotle (2015) pp. 168-73; Pines (1961).

[31] See Sander (2021).

the living being actually moves toward its food because of its need for food.[32] In the same way, the iron is moved to the magnet: not by force emanating from the magnet, but because the iron lacks something that the magnet possesses.[33] Alexander can easily accept this being moved to something for lack of or striving for something, even in inanimate things. This theory's background lies in Aristotelian teleological causality.[34] Alexander's position represents Mode VI.

Alexander's position was, most influentially, taken up by Averroes.[35] Averroes presented Alexander's position in his Middle Commentary on *Physica* (1170), but despite some translations, Latin readers paid far less attention to this comment than to his Great Commentary (1186).[36] In that much-read commentary, Averroes takes on Alexander's position without mentioning his name.[37] Averroes, as well as Alexander himself, deal with the

[32] The text seems to be corrupt in this passage, as shown by Radl (1988) p. 86.

[33] Alexander seems to think of the elementary qualities of the two substances. Cf. Sander (2020) chap. 8.1.3.2.5.2.

[34] See *ibid.*, chap. 8.1.3.2.5.

[35] On Averroes's knowledge of Alexander, see for instance Glasner (2009) p. 159 n. 110. It seems that Alexander has taken up this resolution of the magnetic attraction as motion of the iron to the magnet again in his commentary on the *Physica* of Aristotle, which is largely lost today. See also the commentary by Simplicius in Radl (1988) p. 121. This is also pointed out by Dandino and Aristotle (1610) p. 439.

[36] For the translations, see also Hasse (2010). Two Hebrew translations (Zerahia ben Isaac ben Shealtiel Hen, Qalonymos ben Qalonymos) and three Latin translations (Vitalis Dactylomelos, Abraham de Balmes, Jacob Mantino) are known from the *Middle Commentary*. The seventh book of the commentary relevant here is not edited anywhere, since Mantino died too early to have his edition printed in its entirety. For the *Middle Commentary* see esp. Wolfson and Chasdaj Crescas (1929) p. 562.

[37] See Averroes and Aristotle (1962) fol. 315*r*: "Attractio autem, in qua attrahens est quiescens et attractum motum, non est attractio in rei veritate, sed attractum movetur ex se ad attrahens, ut perficiat se, ut lapis movetur ad inferius et ignis ad superius. Et similiter oportet hoc intelligere de motu ferri ad magnetem et nutrimenti ad membra [...] Nutrimenta vero non moventur ad nutriendum, nisi cum fuerint in quadam dispositione de nutrito, et similiter ferrum non movetur ad magnetem, nisi cum fuerit in aliqua qualitate de magnete. Et ideo quando magnes fricatur cum alleo, amittit virtutem. Nam ferrum non acquirit de lapide in illa dispositione qualitatem, per quam innatum est moveri per se ad lapidem. Et hoc manifestum est in ambra, quod attrahit paleam, quando calefit." See *ibid*., fol. 374*v*: "[...] et similis ferrum est quoquo modo de numero eorum, quae naturali moventur, cum non moventur a magnete, nisi per alterationem, quam acquirit, mediante aere a magnete. Et non quum complexio magnetis transmutatur, non attrahit; sicut accidit ei, quando confricatur cum alliis, et ut dicitur." For a textual variant, see also Rommevaux (2010) p. 623 n. 23.

concept of attraction from Aristotle's *Physica*.[38] Again, the Stagirite did not understand attraction (*tractus*) as a phenomenon such as magnetic attraction, but as mechanical pulling, as in a horse-drawn carriage. Accordingly, Averroes declares that in magnetic attraction one can speak only in the improper sense of 'attraction'. In fact, the iron is moved *ex se* or *per se* to the magnet, just as the food is moved to the body member. The iron has been modified by the magnet in such a way that it performs this movement by itself. This assumption, which is not found in Alexander's work, implies that the supposed attraction is a three-step transitive causal process: First, the magnet changes the medium, which in turn changes the iron, which then moves towards the magnet. He compares this with the kind of self-movement that occurs *per se* or *ex se* and also applies to the elements being moved to their natural place.[39]

Averroes's theory was accepted by the great majority of medieval philosophers, but formulated in various ways.[40] Hebrew authors also dealt with

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For some, the two quoted passages from Averroes' commentary contradict each other, e.g. Montanus (1587) p. 375. Cf. also Avicenna (2009) p. 188: "Unless, that is, that body emits to [the nature] a certain influence or power, and that influence and power are a certain principle that triggers the moved body to move naturally toward [the body], as in the case of the magnet and iron, in which case the motion is forced, not natural."

[38] Cf. also Maier (1943) p. 174: "Aristoteles und Averroes kennen keine attractio, sondern nur einen tractus, d.h. einen Zug im eigentlichen mechanischen Sinn des Worts, bei dem sich sowohl der Ziehende wie das Gezogene bewegen, also etwa der von einem Pferd gezogene Wagen. Hier ist natürlich der erforderliche Kontakt zwischen Beweger und Bewegtem vorhanden. Aber ein Analogon eines derartigen Vorgangs kommt für die Anziehung durch den natürlichen Ort nicht in Frage." See also Weill-Parot (2012) pp. 91-4.

[39] See Weisheipl (1965) p. 36: "Since this natural motion arises from the form, Averroes thinks that this intrinsic form is the immediate mover in natural motions. Consequently the natural movement of nonliving things is somewhat similar to self-movement in animals. But there is an essential difference: the animal soul is a self-mover *per se*, the natural form is a self-mover *per accidens*."

[40] See also Weill-Parot (2012). William of Ockham had a comparatively idiosyncratic interpretation, cf. Goddu (1984) p. 195; Weill-Parot (2012) p. 99. See also Albertus Magnus and Aristotle (1993) p. 523: "Est etiam adhuc advertendum, quod licet quaedam trahant, tamen non omnia quae aliquo modo trahuntur, dicuntur moveri motu tractionis. Sed aliquando moventur plus motu naturali eius quod trahitur, sicut nutrimentum movetur ad membra non motu membri, quod trahit ipsum, sicut locus trahit locatum, sed potius proprio motu, quia cum assimilatum est secundum aliquid membro, movetur ad ipsum sicut ad suum locum salvantem se in forma, quam recipit. Et hoc etiam modo grave movetur deorsum et leve movetur sursum. Et hoc etiam modo magnes movetur ad ferrum propter

Averroes.[41] Many of these debates, following Averroes, were revolving around the extent to which these forms of movement should be regarded as caused *ex se*, whether the magnet should be regarded as a final cause or as the cause of the qualitative alteration of iron, or whether its movement is caused solely by its now altered form.[42] The contingency of this causal relationship is nicely illustrated by a story in Albertus Magnus: some Dominican friar, he tells, observed a magnet in the possession of King Frederick II. This specimen however did not attract iron, but was in fact attracted by it (Mode II).[43] The monk was obviously able to clearly determine which substance was the

similitudinem formae, quam cum ferro habet, et ideo ferrum est locus eius. Et ideo cum impeditur vis illius similitudinis, ferrum non movetur ad magnetem nec e converso. Et ideo cum fricatur suco allii vel lapis vel ferrum, neutrum movetur ad alterum." See Thomas Aquinas and Aristotle (1954) p. 461: "Tertio quia ad hoc quod magnes attrahat ferrum, oportet prius ferrum liniri cum magnete, maxime si magnes sit parvus; quasi ex magnete aliquam virtutem ferrum accipiat ut ad eum moveatur. Sic igitur magnes attrahit ferrum non solum sicut finis, sed etiam sicut movens et alterans. Tertio modo dicitur aliquid attrahere, quia movet ad seipsum motu locali tantum. Et sic definitur hic tractio, prout unum corpus trahit alterum, ita quod trahens simul moveatur cum eo quod trahitur." See Jean Buridan and Aristotle (2010) p. 141: "De magnete dicendum est quod agit in ferrum, sed prius in medium aerem, ut dicit Commentator octavo Physicorum, ita quod aliquam qualitatem imprimit in aerem et multiplicatur impressio eius usque ad ferrum; et tunc ferrum perillam qualitatem sibi impressam est natum moveri ad magnetem propter aliquam convenientiam. Ita etiam conceditur quod sol agit in illa inferiora, sed prius naturaliter, licet non tempore, agit et multiplicat lumen in sphaeras caelestes sibi coniunctas; igitur tangit suum primum passum." See Nicole Oresme and Aristotle (2013) p. 733: "Respondetur sicut dicit Commentator, quod movetur ab intrinseco, videlicet a qualitate inducta in eo per ipsum magnetem, ita quod magnes alterat aerem usque ad ferrum, deinde ferrum." See also Rommevaux (2010) p. 624. Further examples can be seen in Robert Grosseteste (1912) vol. II, pp. 613-4; Walter Burley and Aristotle (1508) fols. 184*v*, 189*v*-190*r*, 191*v*, 218*r*, (1589) pp. 865-7. See also Nicholas of Cusa (1932-2014) vol. V, p. 33: "Nisi enim in ferro esset quaedam praegustatio naturalis ipsius magnetis, non moveretur plus ad magnetem quam ad alium lapidem." See also *ibid.*, vol. XVIII/2, p. 175: "Species seu forma magnetis trahit ad se ferrum, sed non nisi species a forma et virtute procedens mittatur ad ferrum. Postquam spiritus ille missus est ad ferrum ita, quod ibi maneat, tunc movetur ferrum."

[41] See in particular Langermann (2011) pp. 86-9; Wolfson and Chasdaj Crescas (1929) pp. 90-2, 253-7, 562-8.

[42] See Sander (2020) chap. 8.1.3.2.5 and 8.1.3.2.7.

[43] See Albertus Magnus (1890) p. 40: "Narravit mihi unus ex nostris sociis curiosus experimentator, quod vidit Fredericum Imperatorem habere magnetem, qui non traxit ferrum, sed ferrum vice versa traxit lapidem." See also Draelants (2011) p. 109.

attractive one and was astonished by the obvious reversal of the assumed asymmetric causal order.

Petrus Peregrinus, author of a landmark experimental treatise on the magnet in the thirteenth century, chose another representation.[44] He explains that between two magnets the stronger stone has the role of an *agens*, the weaker the role of a *patiens* (*in attractione lapis fortioris virtutis agens est, debilioris vero patiens*). According to the polarity of the magnet, the attraction occurs because the *agens* seeks to unite with the *patiens* (*agens intendit suum patiens sibi unire*). The south pole of a magnet thus attracts the north pole – but also vice versa (*meridionalis septemtrionalem attrahit et e converso*). On the one hand, the idea is unidirectional, in that one magnet is stronger than the other. However, this asymmetric causal relationship is opposed to polar symmetry: The two poles themselves have equal causal valence, i.e. both the north and south poles play an active role in the stronger stone. Peregrinus does not investigate the abstract relationship between magnet and iron, but speaks several times of the magnet "attracting" the iron (*attrahit*). Although Peregrinus thus retains the concept of attraction, the goal of attraction is determined by the concept of "unification".[45]

### *4. Early Modern Debates*

Several early modern authors were well-versed in Averroes's commentary, and frequently engaged with his causal theory.[46] Some even noticed that Averroes had followed Alexander's teaching.[47] Yet, Averroes's account was not merely accepted uncritically.[48] In his commentary on Galen, Fabius

[44] See Georgescu (2013) p. 88; Petrus Peregrinus (1995) pp. 74-8.
[45] See Sander (2020) chap. 8.1.3.2.5.1.
[46] Cf. Alvarus Thomas (2016) pp. 272-6; Graiff and Pomponazzi (1979) pp. 116-20. See also – deviating from Graiff's edition – another version of Pietro Pomonazzi's *Commentarii in Aristotelis octo physicorum libros* in the manuscript in Paris, Bibliothèque nationale de France, Lat. 6533, fols. 311*r*-314*r*. See also Nifo and Aristotle (1552) p. 240*v*: "Teneo igitur primam positionem quod motus ferri ad magnetem per se est alteratio quaedam intentionalis, quae non perficitur, nisi veniat ferrum ad magnetem, sed quoniam accidens ipsum distaret ab magnete, ideo per accidens movetur in loco."
[47] Bodin (1605) p. 244; Dandino and Aristotle (1610) p. 439; Pico della Mirandola (1520) p. 199*r*, (1573) p. 1247.
[48] See also Sander (2020) p. 188 n. 103.

Pacius (1597) inquires as to the cause of the movement of the iron.[49] The form of the iron is already predetermined to move the iron downwards according to the movement of the elements of gravity, rendering it incapable of exhibiting motion in an additional direction.[50] In addition, the iron would then have to be moved from a large distance in the direction of the magnet, which is not the case. Gerolamo Dandino (1610) explicitly concluded that, according to Averroes's theory, there is little evidence to support the concept of 'real' attraction at all.[51]

However, the claim that the magnet exerts an active attraction on the iron persisted, as evidenced by Pacius's case. This position remained attractive even beyond the context of Galen commentaries. Marsilio Ficino (1489) and those who espoused his views asserted that the magnet plays an active role in the process of attraction, given that it is ranked astrologically higher than iron.[52] In 1546, Georg Agricola dismissed Albert the Great's account of a magnet that was attracted *by* iron as so implausible that he chose to refrain from further comment on this and other purported properties of "fabulous stones."[53] For Agricola it was implicitly evident that the magnet attracts the iron and not vice versa.[54] Fortunio Affaitati (1549) addressed the question of why the magnet attracts iron, but not vice versa, in the context of Galen's account. The latter option was regarded as counterfactual.[55]

Andreas Libavius (1601) explained in the context of his alchemical, material theory that the magnet is the active part of attraction (*agens semper est magneticum, patiens vero ferreum*), and therefore attracts iron or another

[49] Pacius and Galen (1597) p. 170. On Pacius's own theory, see Sander (2020) chap. 8.1.3.2.6.
[50] This objection was already made in the Middle Ages by Ockham and others. Cf. Weill-Parot (2012) p. 99. See also Sander (2020) chap. 8.2.2.
[51] See Dandino and Aristotle (1610) p. 439: "Ex his omnibus facile intelligas, motum hunc minime attractionem appellandum esse, si accurate loqui velimus." See also Sander (2020) p. 188 n. 101.
[52] See Sander (2020) chap. 5.1.3.1.
[53] See Agricola (1546) p. 252: "quoniam vero nihil dicturus sum de lapidibus fabulosis, hic reliquo lapidem, quem a ferro trahi dicunt." See also Entzelt (1551) p. 176.
[54] Whether Agricola was familiar with Averroes's account remains unclear. On his scholastic sources,see Nobis and Fritscher (2002).
[55] See Affaitati (1549) pp. 23*r-v*.

magnet by emitting its *spiritus*.[56] The magnet would only move towards the iron by chance, namely if the iron were fixed. Daniel Sennert, Tommaso Campanella, Benedetto Ceruti, Andrea Chiocco and the Paracelsian Johann Agricola also took up this idea. Sennert (1624), who was acquainted with Libavius's theory, concludes that the cause of the attraction must be the magnet itself, rather than the iron (*caussam attractionis potius esse in magnete, quam in ferro*), given that the *spirtus* is able to escape from the unstable magnet but not from the solid iron.[57] Campanella (1635) also argues similarly that the 'spirituous' magnet draws iron and not vice versa (*Magnes enim spirituosus trahit ferrum, et non e contra*).[58] Active attraction here means emitting something that causes the attraction.

[56] Cf. Libavius (1601) p. 103: "Nos dicimus ad trahendum non sufficere cognationem spiritus ferri in magnete, cum eo qui est in ferro, sed in magnete esse spiritum magneticum bituminosum, cum spiritu tamen ferri commistum contemperatumque, ut ita magnes trahat vi bituminea certa ratione disposita, et affectat ergo ferri spiritum. Trahat vero teneatque etiam magnetem, quia huius spiritus cum ferreo societatem habet. Itaque agens semper est magneticum, patiens vero ferreum, quanquam ex accidente eveniat, ut immoto ferro magnes ad hoc transeat." See also *ibid*., p. 91: "ferrum, inquam, is trahit, et ferrum quoque; sequitur trahentem, non pro pondere in primis, sed pro virtutibus maxime nisi nimis id sit vastum fixumque cum deprehensum sit leviore Magnetem ponderosius adduxisse ferrum. Evenit autem etiam, ut ipse seipsum ad ferrum promoveat, si id pertinacius restiterit. Neque tamen ex omni parte trahit excellenter, sed maxime iuxta fluxum virtutis secundum lineam rectam." See, however, *ibid*., p. 97: "Ita solide probavimus sententiam nostram nimirum attractivam istam esse principaliter bituminis conspirantis cum principiis et elementis minerae ferrae, et ob hanc substantiam similem fieri mutuum amorem et allicientem simile quantum fieri potest". On Libavius's theory, see Sander (2020) chap. 2.2.2 and 8.1.3.2.8.2.

[57] Cf. Sennert (1633) p. 434: "Ex quo alterum sequitur, causam attractionis potius esse in magnete, quam ferro. Ferrum enim iam fixum metallum est: Magnes vero nondum fixus est, ideoque vires suas et spiritus liberius emittere potest." See also Sander (2020) chap. 8.1.3.2.8.3.

[58] See Campanella (1635) p. 323. Campanella is not quite consistent in his position within his works, see also Sander (2020) pp. 617-8 n. 150. The same natural philosophical ideas are taken over by later authors. Cf. Ceruti and Chiocco (1622) p. 65: "Magnetem vim ferri attrahendi habere, propter cognationem quamdam, quae sit ei cum ferro." See also Sander (2020) chap. 8.1.3.2.8.2. See Agricola (1646) p. 199: "dieses ist die Ursach/ deß der Spiritus Magnetis et Martis eines ist/ und daß der Magnet das Eysen an sich ziehet/ und das Eysen nicht den Magnet/ ist die Ursach/ daß der Spiritus in dem Marte so hart verschlossen/ daß er seine Kräffte nicht erweisen kan/ hingegen ist der Magnet porosisch/ und gehet gerne auß ihm in seine Wirckung."

Authors such as Anselmus de Boodt (1609) and Ole Worm (1655), on the other hand, attributed the attraction to the magnet for the reason that it retained its forces when placed in iron filings.[59] Here, a seemingly empirical observation thus serves as an argument for the direction of the causal relationship. However, the same observation had been employed by Gerolamo Cardano in *De subtilitate* (1550) for a contrary causal representation of the magnetic phenomenon. Cardano's vitalist theory is not entirely clear in the relevant respect here, but he writes that the magnet desires iron as its food and is moved towards it (Mode V).[60] In his *De uno* (1561), Cardano revisits this topic and presents a comprehensive schematic of all potential causal relationships between the magnet and iron, categorizing them as either attractive or repulsive: magnet draws/repels iron, iron draws/repels magnet, magnet draws/repels another magnet, iron draws/repels iron.[61]

[59] See Boodt (1636) p. 442: "Ita ut non tam Magnes ferrum, quam ferrum Magnetem trahere videatur [...]. Verum verisimilius est Magnetem ferrum trahere, quam ferrum Magnetem, quia sepultus in scobe ferri Magnes vires suas conservat." Cf. Worm (1655) p. 62: "Unde dubitatum a multis, an Magnes ferrum, an vero ferrum Magnetem traheret. Probabilius certe Magnetem ferrum trahere, quia sepultus in scobe ferri Magnes vires suas conservat et auget: ferrum vero rubiginem contrahit et perit, quod sit quia puriorem et subtiliorem ferri partem ad se trahit, sibique unit."

[60] See Sander (2021). See Cardano (1560) p. 494: "Hoc ideo contingit, quoniam ferrum magnes ut pabulum desiderat; qui cum illud ad se trahere nequeat, ad ipsum mutata vice fertur." Cardano, however, ruled out that the magnet would align itself with the poles, since it was too heavy to do so. Therefore the iron needle is needed, since it can be turned more easily. See *ibid.*: "Cum vero ob gravitatem nequeat seipsum movere, ferro affricatum movet illud in aequilibrio positum ob facilitatem; et etiam quoniam principium est quoddam naturale, nihil seipsum movere. Ergo cum duae sint partes, ferrum quod a boreali tangitur, cuspidem illam ad boream dirigit; quod si australem contingat, ad austrum etiam impellitur, non ad boream." Isaac Beeckman also seems to assume that the magnet moves towards the iron, cf. Sander (2020) chap. 8.1.3.2.8.3.

[61] Cf. Cardano (1663) vol. I, 283.

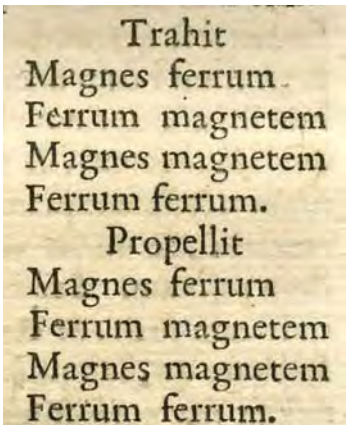


*Figure 1*: Syntax of magnetic attraction and repulsion according to Cardano (1663) vol. I, p. 283. Source: Torino, Biblioteca provinciale dei Frati Minori Cappuccini, MD.55.122 (online).

Cardano places magnetic attraction and repulsion in analogy to sexuality. The male entity (magnet) assumes the active role, while the female entity (iron) assumes the passive role.[62] In his pairs of recombination Cardano only denies the existence of two causal relationships: Iron does not attract iron, and iron does not repel the magnet. The case of the iron attracting the magnet, he again explains in such a way that if the man cannot attract the woman, he approaches her by his movement towards her (*cum enim masculus non potest trahere foeminam ad se, ut etiam in animalibus, accedit ad illam*). It is probably this particular understanding of attraction that Cardano had adopted as prototypical in 1550.

Cardano's idea from *De subtilitate*, that the magnet is moved towards iron like an animal to its food, reversed Averroes's and Alexander's analogy.[63] Although his theory of magnetic food had some alchemical followers, most of them made no comments on the assumed causal representation of this idea. Authors such as Robert Norman (1581) and Tommaso Campanella (1590) explicitly promoted the active movement of the magnet towards

[62] Cf. also Sander (2020) chap. 8.1.3.2.4.4.

[63] Averroes had explained that the food was moved *ex se* to the body part. Although Alexander had compared the movement of the animal to its food with the magnetic phenomenon, in his analogy he attributed the role of the animal to iron.

iron, together with its vitalistic implications.[64] However, Norman limits this movement to occur only if the magnet is good and the iron is heavier than the magnet, stating that "the Weight of the Stone exceed not his Attractive Strength."[65]

The idea of an actively (self-)moving magnet was also met with bitter criticism. The primary criticism levied against this theory was its vitalist implications, but the implied causal representation was rejected as well.[66] The most significant critique was provided by Julius Caesar Scaliger (1557).[67] He elucidated that the iron moves to the magnet for its own perfection, like being conveyed to its maternal source or descending towards the center of the Earth (*Sed movebitur ferrum potius ad Magnetem, tanquam ad matricem suam, cuius abditis principiis perficiatur: quemadmodum ad centrum terrae.*) Scaliger's reply is thus characterized by an Aristotelian notion of teleology, which has guided philosophical thought since the accounts of Alexander and Averroes.[68] This movement, however, is generated by an internal force, as there is no direct contact between the magnet and the iron, which is analogous to the way in which an infant attempts to reach the nipple of the breastfeeding mother (*ab interna virtute potius, quam ab externa, a qua non tangitur, moveatur: veluti movetur catulus ad mamillam*).[69]

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[64] See Campanella (1992) p. 546: "sicut fingit Marta [i.e. Giacomo Antonio Marta], et alii Peripatetici et dicunt de ferro tracto a magnete; non enim trahitur, sed sponte vadit ad ferrum, ut alibi narravimus." This theory is also in line with Campanella's vitalist idea. See Sander (2020) chap. 8.1.3.2.4.3. However, see also Campanella (1992) pp. 373, 547: "Concitatur vero motus ex appetitu acquirendi quod est bonum, sicut currit ad magnetem ferrum et animal ad casam vel citum concitat cursum; quandoque concitatur motus, ut cito fugiatur quod molestum est. [...] Sed nec magnes attrahit ferrum, ut putant illi, sed forma ferri vires intendit et crassitiem devincit, ut ad superpositum tendat magnetem, cuius contactum sui conservativum esse persentit." See also White (1642) p. 277.

[65] Vgl. Norman (1585) p. 3. Similarly in Cyrano de Bergerac (1932) p. 229, (2004) p. 295: "le morceau d'aimant est plus gros, il attire le fer; ou si la pièce de fer excède en quantité, c'est elle qui attire l'aimant, comme il arrivoit jadis dans le miraculeux effet des pommes de Pylade et d'Oreste, de l'une desquelles quiconque avoit mangé davantage étoit le plus aimé par celui qui avoit mangé de l'autre."

[66] See also Sander (2020) chap. 8.1.3.2.4.

[67] Cf. Scaliger (1557) fols. 156*v*-157*r*.

[68] Cf. Sander (2020) chap. 8.1.3.2.5.

[69] However, Scaliger noticed later that it had also been observed that a large piece of iron could attract a small magnet. This, too, he directed, somewhat inconsistently, against Cardanos self-moving magnet, but did not explain whether an internal fortune in the magnet

Although the Jesuit author of a groundbreaking study on magnetism, Leonardo Garzoni (c. 1580), developed an original and independent theory of magnetic attraction and repulsion, he remained committed to Aristotle's natural philosophy at the same time. He assumed the internal cause of the movements of a magnet or iron in its substantial form.[70] While he considered the rotation to the poles as a completely independent, intrinsic movement, the attraction and repulsion of the magnet he believed to be caused by an alteration of the form of the iron from without. As a consequence of this change, the iron moves towards the magnet by its form or quality.[71] Garzoni, however, renames attraction and repulsion to *sequela* and *fuga* because of this internal or intrinsic motion, which was taken up by Niccolò Cabeo (1629).[72]

Another Aristotelian, Fortunio Liceti**,** devoted considerable attention to Scaliger's criticism of Cardano. In 1618, he articulated his perspective in *De spontaneo vivantium ortu*: "It seems far more probable to me that the iron is attracted by the magnet only in the metaphorical sense, but hurries to the

must then be assumed here. Cf. Scaliger (1557) fol. 176*r*. See also *ibid.*, fol. 185*v*: "Nanque etiam Magnes a ferro trahitur." See also Libavius (1601) p. 98, who cited this as his primary counterargument against Cardano.

[70] See also Garzoni (2005) p. 126: "il moto di questa pietra nasca da interno principio, il quale sia forma sostantiale, media, nel grado di essere, tra le forme de gl'elementi et l'anima, che muovendo il suo mobile verso dui termini opposti, non si conveniva a corpo semplice."

[71] See also Ugaglia (2006) p. 65, on this theory.

[72] Cf. Cabeo (1629) p. 168. Cabeo seems to follow Gilbert's expression and the associated notion of reciprocal attraction, see *ibid.*, p. 198. See Sander (2020) p. 620 n. 168. Ugaglia in Garzoni (2005) p. 236 n. 209, refers to Sarpi's expressions *subitio* and *discessio* in Sarpi (1996) p. 147. Sarpi also states: "onde il moto del ferro alla calamita, senza esser toccato, sarà più tosto approssimazion che attrazione." However, Garzoni probably did not know Scaliger's work, and he rejected Cardano's theses, but not because of his causality-theoretical assumption of a magnet moved to iron. In the Aristotelian oriented *Disputationes metaphysicae* (1597) the Jesuit Francisco Suárez essentially adopts Averroes' position, but understands explicitly that the attraction is actually caused by the magnet. Suárez (1866) p. 664: "Breviter tamen, quantum ad rem praesentem spectat, admittimus attractionem illam fieri effective a magnete. [...] Addendum subinde est magnetem imprimere ferro aliquam qualitatem motivam qua illud ad se trahat." Moreover, he sharply differentiates this position from Alexander's opinion, which had already been refuted by Thomas Aquinas, Albertus Magnus and Galen. *Ibid.*: "Alexand. enim, lib. II Quaestionum naturalium, c. 3, existimavit ferrum non trahi a magnete nisi ut a fine, ipsumque interna et innata virtute quasi naturali pondere se movere ad magnetem. Hoc tamen reiiciunt Albertus, II Metaph., tract. III, c. 6; D. Thomas, VII Phys., lect. 3, text. 10; et Galenus, lib. III de Facultatibus naturalibus, c. ultimo." On Galen's criticism of Alexander, see also Pines (1961).

magnet in the physical sense."[73] However, since the magnet is inanimate, it is not moved internally but externally. This is not analogous to an infant seeking the comfort of its mother's breast, but rather to a heavy body seeking the center of the earth.[74] It seems that Liceti was aware of the scholastic distinction between animate and inanimate self-movement, being equivalent to the distinction between external and internal movement.[75]

In his 1640 treatise, *Litheosphorus*, Liceti revisited this concept and once more asserted that the iron did not reach the magnet as a girl hurried to the flower.[76] Liceti also makes reference to Aristotelian teleology as a means of justifying his argument and provides an explanation as to why the iron is more inclined to move towards a magnet that has been reinforced (as an 'armed' or iron capped magnet) than towards one that is pure. In his later works and letters, Liceti reverted to his original causal, eventually quite classical conception, which he distinguished from Scaliger's.[77]

In contrast, Daniel Sennert (1633) disregarded Scaliger's critique, reasoning that the phenomenon would be indistinguishable whether the magnet attracts the iron or vice versa.[78] He postulated that the underlying cause

[73] See Liceti (1618) p. 115: "mihi tamen longe probabilius est a magnete ferrum [...] attrahi metaphorice, [...] physice vero ferrum sponte sua currere ad magnetem."
[74] See *ibid.*, p. 116: "Quum ergo ferrum inanime sit, iam id accurrit ad magnetem, non ab interno, sed ab externo motum principio; non quidem ut catulus ad mammam, aut anima ad beatitudinem, sed ut grave ad centrum, ac leve sursum." See also *ibid.*, pp. 270-1.
[75] Burley, on the other hand, insisted on an internal cause of the movement, since the moving quality resides in the iron. Cf. Weill-Parot (2012) p. 103. See also Graiff and Pomponazzi (1979) p. 116: "Averrois enim, ut vidistis, dicit quod motus ferri ad magnetem non est ab extrinseco, sed ab intrinseco et non est vera attractio."
[76] Cf. Liceti (1640) pp. 184-7: "ferrum, quod movetur ad magnetem esse corpus; negamus primo, ferrum vere ac proprie seu physice a magnete trahi; sed ferrum potius ad magnetem accurrit, ut ab eo perficitur [...] Ut ergo puella sponte movetur accurrens ad florem, a flore non attracta et non mota nisi metaphorice [...], tamquam a fine [...] sic ferrum sponte movetur ad magnetem, non attrahitur a magnete, nisi metaphorice, velut a fine quo perficitur. Nec obstat, quod magnes videatur ferro perfici, nam armatus habet maiorem vim attrahendi ferrum [...] Ferrum igitur accurrit magis ad magnetem armatum ferro, quam ad inermem; quia simul et ad magnetem perficientem, et ad ferrum sibi simile fertur. [...] ferrum sponte sua ab interna seu virtute, seu propensione moveri potest, ad magnetem a quo perficitur."
[77] See Liceti (1645) p. 29, (1646a) p. 299, (1646b) p. 223.
[78] Cf. Sennert (1633) p. 433: "Nam hic iam non disputo id, quod Scaliger, Exercit 102. s. 6. habet, An magnes trahat ferrum, an ferrum magnetem. Sive enim hoc, sive illud verum sit, una tamen caussa est."

must be identical in both scenarios. Others, such as Petrus Magirus (1639), openly criticized Scaliger's arguments. Magirus, in fact, advanced the claim that iron is the more perfect metal, reversing the teleological logic while simultaneously invoking the alchemical concept of attraction by some *spritus.* Consequently, he asserted that the magnet is deficient, and "therefore the iron draws the magnet and not the magnet the iron" (*Quapropter ferrum trahit magnetem, et non magnes ferrum*).[79] The notion that iron attracts the magnet (Mode II) had already been put forth by Scaliger himself, albeit without any substantial theoretical backing, as an empirical observation. However, Magirus, despite being a vocal critic of Scaliger, offers a natural philosophical (*ad hoc*) justification for this proposition.

The aforementioned schemes all assume a unidirectional, causally asymmetrical representation, whereby a distinction can be made between an *agens* and a *patiens* or a *motum* and a *finis*. In 1652, when Alexander Ross engaged in combat with his adversary Thomas Browne, a reciprocal concept of magnetic causality had already gained significant traction among numerous authors, including Browne:

> [...] when [Browne] saith, "There is coition, syndrome, and concourse of the Load-stone and Iron to each other"; For I doe not think that the stone is moved at all to the Iron, for every naturall motion hath its reason and end; the end of attraction in animals and vegitables is for aliment; the motion of stones and other heavy bodies downward, is to enjoy their Matrix, or Center: but no end can be assigned why the Loadstone should draw or move towards the Iron: the motion therefore is in the Iron, and other metals, which are moved to the Loadstone, as to their Matrix, saith Scaliger; therefore it is no more wonder for Iron to move to the Loadstone, then to move downwards, the end and efficient cause being the same in both motions, to wit, the enjoyment of their proper place or matrix.[80]

Ross, to some extent, is reactionary in his rebuke of the opinions expressed by not only Browne but also René Descartes, Johann Baptist van Helmont, Mark Ridley, Fortunio Liceti, and William Gilbert. He aligns himself with Scaliger and his teleological idea in this critique.[81] Browne, the more

[79] Cf. Magirus (1639) p. 157. See also Sander (2020) chap. 2.1.2.4.
[80] Ross (1652) p. 191.
[81] Browne (1646) p. 66, (1650) p. 51: "And first not only a simple Heterodox, but a very hard Paradox, it will seem, and of great absurdity unto obstinate ears, if we say, attraction is unjustly appropriated unto the Loadstone, and that perhaps we speak not properly, when

progressive of the two, correctly identified an important linguistic insight: "perhaps we speak not properly, when we say vulgarly and appropriately the Loadstone draweth Iron." The underlying concept of "coition of the Loadstone and Iron to each other," which may be considered groundbreaking, rejects the traditional search for an active and passive component and abandons the concept of 'attraction' to some degree. This perspective was prominently articulated by William Gilbert in his 1600 treatise, *De magnete*. In this context, he elucidated that the conjunction of two magnetic bodies manifests a *coitio*, which precludes the possibility of 'attraction' in the manner observed with amber and light bodies.[82] In the taxonomic classification of 'magnetic bodies' established by Gilbert, no qualitative distinction is made between minerals such as magnet and iron. This lack of differentiation also raised questions about the logical coherence of ascribing different causal roles to these minerals.[83] In Gilbert's model, magnetic bodies, regardless of composition (e.g., iron, steel, or magnet), move towards each other from their own magnetic form (Mode IV). According to Gilbert, causality here is not reciprocal. Instead, the two bodies are drawn together by a kind of self-movement, rather than by a mutual attraction.[84]

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we say vulgarly and appropriately the Loadstone draweth Iron; and yet herein we should not want experiment and great Authority. The words of *Renatus des Cartes* in his Principles of Philosophy are very plain: *Praeterea magnes trahet ferrum, sive potius magnes et ferrum ad invicem accedunt, neque enim ulla ibi tractio est*. The same is solemnly determined by Cabeus [1650: *Cabius*]. *Nec magnes trahit proprie ferrum, nec ferrum ad se magnetum provocat, sed ambo pari conatu ad invicem confluunt*. Concordant hereto is the assertion of Doctor Ridley, Physitian unto the Emperour of Russia, in his Tract of Magnetical Bodies, defining Magnetical attraction to be a natural incitation and disposition conforming unto contiguity, an union of one Magnetical Body with another, and no violent haling of the weak unto the stronger. And this is also the Doctrine of Gilbertus, by whom this motion is termed Coition, and that not made by any faculty attractive of one, but a Syndrome and concourse of each; a Coition alway of their vigours, and also of their bodies, if bulk or impediment prevent not. And therefore those contrary actions which flow from opposite Poles or Faces, are not so properly expulsion and attraction, as Sequela and Fuga, a mutual flight and following. [1650: *Consonant whereto are also the determinations of Helmontius, Kircherus, and Licetus.*]"

[82] See Gilbert (1600) pp. 46-60, 130-1; Sander (2020) chap. 2.3.2.1. On this, see also Georgescu (2017); King (1959); Roller (1959) pp. 141-4; Wang (2016) p. 712.

[83] Cf. Sander (2020) chap. 8.1.3.2.5.1.

[84] For more details, see *ibid*., chap. 8.1.3.2.4.1 and 8.1.3.2.7.2. See also Gilbert (1600) p. 68.

Upon evaluation of the positions of Ross's name dropping, it can be stated that Mark Ridley and Gilbert followed this idea closely.[85] Liceti, however, had not opted for this idea. In contrast, Van Helmont does not discuss a mutual approach or *coitio* but rather a mutual pull.[86] In this instance, the causality is therefore reciprocal, given that both attract each other respectively (Mode III). This concept was subsequently embraced by alchemical theories, as evidenced by the works of Robert Fludd (1636) and Pierre Jean Fabre (1646). These theorists postulated that both the magnet and iron exhibit a mutual attraction through an exchange of a *spiritus*.[87] In this case, a mutual, active attraction is postulated.

[85] See Ridley (1613) p. 80.

[86] See Helmont (1652) p. 856: "An videlicet Magnes ferrum trahat, an vero ferrum trahat ipsum Magnetem? Nescientes utrimque esse reciprocum tractum."

[87] Cf. about Fludd (1638) fol. 126*v*: "Sed, quoniam ferreum corpus non tam cito relinquet Spiritum suum internum, ideo sequitur, simul cum suo Spiritu attrahi ad Magnetem: (experientia enim docemur, quod magnes a ferri Spiritibus nutriatur et in suo vigore augeatur) atque iterum, ipsum ferrum Spiritus sibi similes in Magnete reperiens, appetit pariter aequali coitione, ut ipsorum fieret particeps atque in coniunctio sive unio haud aliter inter eos facta, quam inter marem et foeminam." Cf. also Fabre (1646) vol. II, p. 242: "hinc magnes trahit ferrum, et ferrum magnetem, quod habeant invicem eandem et similem substantiam primordialem et seminalem, ex qua fiunt et componuntur in visceribus terrae, quae substantia similis, et eadem similis et eosdem de se mittit et eiicit spiritus subtiles et tenues, qui ab attrahente substantia, in se ipsam convertuntur, tanquam in alimentum sui ipsius, hinc fit ut attractis hisce spiritibus, attrahatur et ipsa substantia, ex qua oriuntur hi spiritus, ut fonte potiatur ipsorum spirituum." Cf. also Sander (2020) chap. 2.1.2.3.1 for these theories. See also Cyrano de Bergerac (1932) p. 229, (2004) p. 295: "Or le fer se nourrit d'aimant, et l'aimant se nourrit de fer si visiblement, que celui-là s'enrouille et celui-ci perd sa force, à moins qu'on les produise l'un à l'autre pour réparer ce qui se perd de leur substance." Fludd, however, is not consistent in his causal description and in other parts of his work formulates a transitive, unidirectional theory of attraction. See also Fludd (1638) fol. 111*r*: "Accidit ob hanc causa[m], spiritum internum Martialem in Magnete attrahere ferrum ad se, et occulto quodammodo videri nutrimentum ex eo ad se fugere et allicere." Thus Fludd, *ibid*., fol. 116*r* refers to a "mutual love", based on a sexual analogy of attraction, but then claims that the female stone attracts the male iron, and thus positions himself explicitly against Averroes, Scaliger and Nicholas of Cusa, who assume that the iron approaches the magnet as its mother. Cusanus actually calls the magnet the "mother" of iron, according to the language of the alchemists. See Sander (2020) p. 58 n. 78. Scaliger had also used a similar analogy (*mammilla).* See *ibid*., p. 618 n. 155. On Fludd's theory, see also *ibid*., chap. 5.1.3.4.2 and 8.1.3.2.4.4.

René Descartes's magnetism account of his *Principia philosophiae* (1644) is presented in yet a different manner.[88] He emphasizes that iron and magnet do not really attract each other, but approach each other. Neither the alchemical concept of mutual attraction nor the notion of an intrinsic movement of both *relata* make such a claim.[89] For Descartes, the air between the magnet and the iron is displaced by outflowing particles, resulting in the successive closing of the gap as the magnet and the iron are 'budging up'. This corpuscularian explanation has a long history, dating back to antiquity, promoted by Plato, Plutarch, and Lucretius.[90] Alexander of Aphrodisias had critiqued the theory of the pre-Socratic Empedocles, arguing that it had the allegedly counterfactual consequence of positing that magnet and iron move towards each other.[91] For Alexander and the majority of his successors, the immovable role of the magnet was an indisputable fact that every theory had to take into account. Even atomistic theories, such as those proposed by Democritus (according to Alexander's testimony) or Epicurus (according to Galen's report), implied a mechanical attraction of iron to a stationary magnet caused by atoms rather than a mutual approximation.[92]

Robert Fludd (1638) characterized Lucretius's ancient stance as a form of *coitio* and identified Giovanni Costeo (1589), among other proponents, as an adherent of this view.[93] Indeed, Costeo referenced this concept in his

[88] See Descartes (1964-1974) vol. VIII, p. 302: "Praeterea magnes trahit ferrum, sive potius magnes et ferrum ad invicem accedunt; neque enim ulla ibi tractio est, sed statim atque ferrum est intra sphaeram activitatis magnetis". See also Sander (2020) chap. 8.1.3.2.8.3.2.2, (2022), (2024).

[89] Descartes admits, however, that the iron moves more easily than the magnet.

[90] Cf. Radl (1988) p. 189. See also Sander (2020) chap. 8.1.3.2.8.1.

[91] Cf. Radl (1988) p. 79.

[92] Alexander emphasizes, for example, that Democritus's doctrine states that he had provided an explanation as to why the magnet was not conveyed to iron, but remained unmoved.

[93] Cf. Fludd (1638) fol. 97*v*: "Lucretius Carus, quidam sectae Epicureicae Poeta, videtur somniare, ferri attractionem procedere ab atomorum ex subiecto effluxione: Nam, quemadmodum (inquit ille) iuxta Epicureorum opinionem, atomi subtiles ex re qualibet emanant, ita pariter atomi, quasi semina Magnetica a ferro per quandam coitionem ipsius cum Magnete in locum sive spatium interpositum, quod est inter eos, emittuntur, et per unionem aut complicationem corporis utriusque, ferrum attrahitur etc." In what follows, however, he criticizes the idea of an eccentric, spherical propagation of particles or atoms. Although Fludd relies on Gilbert (1600) p. 3, who also mentions Costeo, he avoids the word *coitio* and does not criticize it here either.

corpuscular theory, which he expanded upon in his Avicenna commentary. He stated that the attraction was "common work and fruit of both magnet and iron" (*mutua ergo utrique est opera et mutuus fructus*), a notable shift from his earlier work (1578), where he still advocated for Averroes's model.[94] Pierre Gassendi also offered a critique of the unidirectional causal representation, advocating instead for a reciprocal model that would align with his corpuscular natural philosophy.[95] In a critical letter dated 1642, Pierre de Cazré lectured Gassendi, relating to the latter's corpuscularian theory, that magnet and iron spontaneously move towards each other (*utrimque sponte naturae incitata in mutuos amplexus accurrunt*).[96] Cazré's argument aligns with Gilbert's, abandoning the concept of attraction. Gassendi however raises the objection that it is then impossible to explain why the magnet is only able to exert its attraction within a relatively limited sphere of influence.[97]

Other opponents of the corpuscular idea argued that these theories simply and unjustly denied a fundamental mode of action – that of attraction. They asserted that the entire removal of this principle renders the theory inconsistent with reality, as it implies that everything is merely a matter of pushing and shoving. Such allegations were leveled by Martin Schoock against Descartes and by Jacques Primerose against Henricus Regius, a disciple and later colleague of Descartes.[98] Schoock explicitly refers to the Aristotelian theory of motion and subsumes magnetic attraction

[94] Cf. Costeo (1578) p. 268; Costeo and Avicenna (1589) p. 515. See also Sander (2020) chap. 8.1.3.2.8.2.

[95] See Gassendi (1658) vol. II, pp. 5, 123, 126, 133; see also Hobbes (1839) vol. I, pp. 427-8: "Supposito ergo corpuscula minima, ex quibus in ipsis terrae visceribus concrevit magnes, motum sive conatum a natura sua, per lineam prae brevitate invisibilem, habere, ut modo dictum est de gagate, reciprocum, una erit in utroque lapide attractionis causa. [...] Siquidem enim in magnete motus reciprocus sive itus reditusque partium supponatur."

[96] See Gassendi (1658) vol. VI, p. 450. On this controversy, see Sander (2020) chap. 8.2.2.

[97] Cf. Gassendi (1658) vol. III, p. 633. Cf. also Sander (2020) chap. 8.1.2.2.3.1.

[98] Cf. Schoock (1643) pp. 229-31: "Sin vero nex de illis studiosus credere debeat agere per attractionem, quod nihil per attractionem agere soleat, liquido ostendatur attractionem entium classe movendam esse [...] Democriti atomi magneticis profluviis seminibusque turgeant [...] definire placuerit quid aut corpus magneticum sit, aut quid magnetici in quoque corpore inveniatur, et ad qualium entium classem hoc referri debeat." See also Schoock (1660) pp. 228, 246, 249. See the *Antidotum adversus Henri Regii* in Maire (1647) pp. 9-10. See also Sander (2020) chap. 8.1.3.2.8.3.2.1.2.

under the concept of traction. Despite the existence of a 'sympathy' between the magnet and the iron, the attraction between them is nevertheless 'violent.' Primerose, on the other hand, aligns with the theories put forth by Galen and Averroes. He asserts that Averroes espoused a variety of forms of attraction and that the iron's movement towards the magnet constitutes one form of attraction.[99]

The concept of mutual magnetic movement, or attraction, had already emerged in the sixteenth century, before Gilbert and corpuscular philosophy.[100] Cardano conceded that iron was attracted by a magnet, but he already observed that the attraction was mutual.[101] In 1589, Giambattista della Porta also discussed the "mutual attraction and repulsion between magnet and iron" (*De mutua magnetis et ferri attractione et expulsione*) in his *Magia naturalis*.[102] Although della Porta incorporated significant portions of Garzoni's unpublished manuscripts, he depicted the causal relationship between the magnet and iron in a markedly different manner and did not cite Aristotelian principles of natural philosophy. Instead, he interpreted the phenomenon of "mutual love" (*mutuus amor*) as an exemplification of 'sympathy.'[103]

## *5. Conclusion*

The numerous and highly different premodern magnetic 'attraction' theories imply or are based on different causal representations of the phenomenon to be explained. While causal theories were *prima facie* meant to 'simply' explain the phenomenon, they actually explained a specific causal representation of the phenomenon under scrutiny. The actual event (or, its perception) – magnet and/or iron move – is mapped to some more abstract,

[99] Primerose misunderstood Averroes because he explicitly distinguishes metaphorical attraction (*finis trahit ad sese*) from magnetic attraction, although these were identified with each other in Averroes.
[100] According to Goddu (1985), the idea of a 'mutual attraction' can already be found in Avicenna and Copernicus, but not with reference to magnetic attraction.
[101] Cf. Cardano (1560) p. 504: "Ob id igitur ferrum a magnete trahitur ac rapitur; mutuo tamen, ut dixi, feruntur alterum ad alterum." What Cardano exactly means by this seems rather unclear.
[102] See Porta (1589) p. 137.
[103] Cf. Sander (2020) chap. 7.1.2 and 8.1.3.2.2.

theory-laden description of what is to be explained. To put it in an overly exaggerated way, no philosopher ever engaged in explaining magnetic attraction as a phenomenon but in explaining a causal representation of this phenomenon. Any causal representation's profile can be specified by two overlapping questions: (1) Is there an attraction between magnet and iron or is one moving towards the other? (2) Do magnet and iron have an actively attracting or passively moving role, or are both equally active and passive? These questions give rise to the six modes of recombining reasonable answers to the two questions. They represent the 'same phenomenon' in six different modes. Each of these modes was argued for in premodern accounts as matter of fact. The many-to-many relations between modes and explanations, i.e. that one mode could lead to many explanations and vice versa, underscores the underdetermination of the theory (explanation) not only by data, but also by more fundamental representations of data (i.e. modes). In a sense, underdetermination of the explanation by data actually depends on the underdetermination of the causal modes by their data.

The favorite option during the Middle Ages was to assume that the iron would move towards the magnet. This mode can rightly be called the 'Aristotelian mode', although Aristotle himself never claimed it. Attraction, properly speaking, did not feature in this causal representation. Instead, its basis was a teleological assumption about the causal relationship. Final causes, or, more generally, purposes and aims in nature, were taken as granted in an ordered cosmos. However, especially in medical authors – following Galen –, the view prevailed that the magnet exerts an active attraction on the iron in analogy to bodily organs. This view was also taken up by numerous alchemical authors, albeit supported by completely different explanations. Only very few thinkers claimed that iron actively attracts the magnet, which underscores a so-believed hierarchical order in the mineral world. On the other hand, many authors referred to Cardano claiming that the magnet moves actively towards the iron driven by vitalistic principles, which implicitly imported final causes or at least desires in substances without minds. Authors of the seventeenth century revived a position occasionally implicit in some ancient atomists, namely that magnet and iron attract each other reciprocally or unite. Gilbert in particular promoted this model strongly by

way of a vitalist assumption, which eventually also was implemented and transformed into corpuscular, mechanistic theories. While the vitalist version again relied on teleological thinking to some degree, thinkers such as Descartes openly rejected final causes in (material) nature as Aristotelian chimeras. As for magnetic attraction, they were dispensable through deterministic and mechanistic accounts of causality. Yet, the causal mode is agnostic to whether iron and magnet move to each other for some vitalist desire or for some vortex of particles. This not only enabled the success of Gilbert's causal model independently of his rather crude explanation but also moves the historiographic focus away from the traditional perspective: the controversy about the causal representation was not about whether there are final causes or just chunks of matter but about how to map the empirical to a foundational, pre-explanatory model.

And yet, or specifically for the foundational status of these models, authors rarely based their respective models on empirical observations, and when they did, their evidential character resulted in theory-laden conclusions from the observed. If, for example, the *agens* role of the magnet in the attraction was concluded from the fact that it preserves its force in iron filings, the premise is that this conservation presupposes a force in the magnet, which thus actively included the capacity of attraction. Some also took the physical size of magnet or iron into account for causal relationality, for example when they claimed that only a particularly large piece of iron was able to attract the magnet. But the authors partly explained this themselves by the fact that the greater weight only had the effect that this object was inert to move because of its weight. Another interesting observation is that while the described causal modes were crucial to map the phenomenon of magnetic attraction, these modes were rarely involved in another high key issue: explaining geomagnetism and the North-pointing of a compass needle.[104] While Gilbert or Descartes designed homologue accounts of both the earth's magnetism and magnetic attraction, the very phenomena of geomagnetism were unknown to antiquity, and not much addressed by medieval natural philosophers. Its causal relation to magnetic attraction remained rather vague for many authors before 1600. Whether authors

[104] See Sander (2020) chap. 6.2.2.

regarded it as a mere corollary to their accounts of attraction, or just begged the question, is difficult to say.

It was natural-philosophical or metaphysical assumptions about the nature of 'attraction' that determined the actors' side-taking in this debate. The most important natural philosophical assumption was that every movement had to be caused by something else. This Aristotelian principle was often explicitly mentioned in the debates, or the magnetic phenomena were explicitly discussed as a challenge for that principle – not only by supporters of Aristotelian natural philosophy, but also by Neoplatonists or adherents of corpuscular philosophy.[105] In this lies a strong legacy of Aristotelian natural philosophy: it didn't quite define the vocabulary but the syntax, by asking the virulent question instead of giving the definite answer.

Many philosophers explicitly discussed these tacitly Aristotelian questions controversially. The 'true' causal representation of magnetic 'attraction' was thus an important point of contention for the actors. It might be a modern intuition (or insight) that magnetic phenomena do not obey the logic of a unidirectional and asymmetric causal model presupposed by a concept of attraction in the strict sense. However, this account informed by eighteenth-century electromagnetism must not obscure that precisely these unidirectional models of causality dominated much of Aristotelian physics and remained attractive to premodern scholars for a great part. This hidden Aristotelian factor playing out might have even benefited from Aristotle's silence on the matter itself – his 'only preparing' a conceptual framework enabled and coordinated disagreements. It allowed for one controversy with conflicting but commensurable positions.

Mapping these individual positions (specific magnetism theories) to their underpinnings (causal modes) allows for a different, alternative historiographical view. It breaks the narrative of camps, such as 'Aristotelianism vs corpuscularism' etc., by providing a discursive map of intriguingly

[105] Cf. for example Campanella (1638) vol. I, p. 155; Collegium Conimbricense and Aristotle (1592) pp. 670-3; Digby (1645) p. 232; Ficino (1559) p. 120; Hobbes (1839) vol. I, p. 427; Liceti (1618) p. 115; Marcellus and Aristotle (1508) fol. 51*r*; Nifo and Aristotle (1552) fol. 240*r*; Pandolfi (1658) p. 258; Pico della Mirandola (1520) fol. 199*r*; Schoock (1660) p. 249; Suárez (1866) p. 664; Walter Burley and Aristotle (1589) pp. 865-7; Wolfson and Chasdaj Crescas (1929) pp. 90-2.

different demarcation lines and implicit alliances among those camps, which many actors and many historians took (and take) for granted. This is not an argument to replace or revise these 'traditional camps' – which historiography has greatly challenged on various accounts already – but proposes a different take on the history of natural philosophy: One that highlights the immanent multilayered nature of premodern theory making over the rhetorics of controversy.

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YUAN TAO

# THE FLUIDITY OF A CONCEPT
## Auditory *Species* in the *Conimbricenses*, Arriaga and Schelhammer

**Abstract**

The terminology of "auditory *species*" was prevalent in theories of sound and hearing from Antiquity to the Early Modern period for its use in explaining the intermediary stages of sound propagation and perception. Its very existence, however, was a topic of extensive debate among the scholastics. Each tried to square their account with Aristotle's mention of "sensible forms" in *De an*. II 12, while going far beyond Aristotle's text and looking for opportunities for creative interpretation of the terminology, as Aristotle himself never clearly defined what they are, nor specified their way of generation and existence in the medium and the sense organs. With regard to auditory perception, the most general account holds that auditory *species* proceed from the sounding object to the ears, where they are captured by the sensory faculty. Over the centuries, the terminology and general account have remained in use, yet the specific ideas behind them have changed dramatically. In this paper, I shall point out three distinct ways of putting auditory *species* to use in 16th- and 17th-century authors differently connected to the Aristotelian tradition, namely the Coimbra commentators, the Prager theologian Rodrigo de Arriaga, and the German medical professor Christoph Günther Schelhammer. I argue that the terminology of auditory *species* can be creatively accommodated to an astoundingly wide spectrum of philosophical frameworks that have different takes on the gradation of materiality, the mode of interaction between the material and the immaterial, and the nature of air motion that contributes to sound generation and propagation.

**Keywords**

Aristotelian Natural Philosophy, Auditory *species*, *De anima*, *Conimbricenses*, Arriaga, Schelhammer

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The term "auditory *species*" belongs to the category of sensible *species* in scholastic philosophy.[1] *Species* is a Latin translation of the Greek term εἶδος,[2] whose most basic meaning is the image, form, or likeness of a thing.[3] With regard to sensible *species*, it means something that causes our perception of a sensible object, be it colour, sound, smell, taste or touch, and bears a likeness to it but is not the object itself.[4] One major difference between a sensible object and its *species* is that the object of perception is a sensible quality that stays or, to use a scholastic term, "inheres" in the thing that has that quality as its subject of dependence,[5] in the same way redness inheres in an apple of that colour, while its *species* is free to depart from the subject of inherence – *species* of redness spread[6] across the room and reach our eyes, thus making the redness visible to us.[7]

There has been much debate among the scholastics about whether the positing of such entities is in fact necessary. While Francisco Suárez embraces them for every sense,[8] Peter Olivi and William of Ockham reject them

[1] Spruit (1994) pp. 1-27. In addition to *species*, other terms can designate the same entity, such as "form," "impression", or "similitude. Peter Auriol, for example, uses different terms to highlight different aspects of *species*. Cf. Lička (2016) p. 10 n. 29.

[2] Spruit points out that the translation of εἶδος into *species* gave rise to scholastic controversies about their nature. Cf. Spruit (2011) p. 1211.

[3] Marmodoro (2014) pp. 80-6. For a brief discussion on both sensible *species* and intelligible *species*, see Spruit (2011) pp. 1211-3; Perler (1996) p. 232.

[4] *Ibid*. For a discussion on Arriaga's understanding of the representational role of *species*, see Leinsle (2016) p. 110.

[5] For a brief discussion on the term "inherence," see Pasnau (2011) p. 53 n. 9.

[6] There is a great diversity in the ways in which authors describe how auditory *species* spread across the medium. Rather than saying that the medium is "actualised" by auditory *species*, authors tend to use terms that are closely related to motion or production, such as "multiplicare" in Suárez, "multiplicare" and "devenire" in the *Conimbricenses*, and "producere" and "spargere" in Arriaga. See Suárez (1635) p. 155; CAJC p. 140; Arriaga (1669) pp. 677, 679.

[7] There is little literature on auditory *species* in particular. For discussions on medieval theories on auditory perception and perception in general see Pasnau (2000) p. 38 and (2011) pp. 53-9; Knuuttila (2008) p. 16.

[8] Heider has several detailed studies on Suárez's theory of perception, see Heider (2018) pp. 78-80, (2016a) pp. 38-66, (2017) pp. 61-84.

categorically,[9] and others like Roger Bacon allow them for certain senses but not others.[10] The problem is partly an exegetical one that tries to make sense of Aristotle's statement in *De anima* II 12: "Sense is that which is receptive of the form of sensible objects without the matter, just as the wax receives the impression of the signet-ring without the iron or the gold."[11] The fact that Aristotle himself never clearly defined these sensible forms, nor specified their way of generation and existence in the medium and the sense organs, left much room for creative interpretation.[12] Indeed, the term "sensible *species*" that is widely used in scholastic commentaries to refer to Aristotle's "sensible form" is a later invention that Aristotle could not have anticipated,[13] and the rich content added to the concept by Latin commentators is a development that goes far beyond Aristotle's text.[14]

For those who believe in sensible *species*, disagreement persists about their ontological status[15] and whether they can be somehow reduced to the purely physical changes that happen in the medium and the sense organ. While the common way of posing the question, asking "whether *species* are spiritual or material," certainly echoes a Neoplatonic tendency to emphasise the division between the material and the intellectual/spiritual,[16] scholastics often find ways of reconciling the two sides by clarifying what materiality or spirituality means.[17] Henry Bate, for example, considers *species* to be "material" in the sense that they arise from the potentiality of matter and change matter,[18] but is also fine with calling them "spiritual" because of their

[9] Lička (2016) p. 10; Heider (2016b) p. 185.
[10] Bacon, *De mult. spec.* I 2.1-29 = Lindberg (1983) pp. 21-3. On the disagreement between Arriaga and Haunold on for which senses sensible *species* exists, see Leinsle (2016) p. 104.
[11] Arist. *De an.* II 12.424a17–22: […] ἡ μὲν αἴσθησίς ἐστι τὸ δεκτικὸν τῶν αἰσθητῶν εἰδῶν ἄνευ τῆς ὕλης, οἷον ὁ κηρὸς τοῦ δακτυλίου ἄνευ τοῦ σιδήρου καὶ τοῦ χρυσοῦ δέχεται τὸ σημεῖον, λαμβάνει δὲ τὸ χρυσοῦν ἢ τὸ χαλκοῦν σημεῖον, ἀλλ᾽ οὐχ ᾗ χρυσὸς ἢ χαλκός […].
[12] For a discussion of different contemporary readings, see Caston (2005) pp. 247-316.
[13] Spruit (2011) p. 1211.
[14] For an excellent catalogue of Latin Aristotle commentaries, see Lohr and Colomba (1988).
[15] For Aquinas's reception of Aristotle's sensible forms, see Cohen (1982); for a comparison between Aquinas's and Giles of Rome's readings, see Trifogli (2019) p. 260.
[16] I am grateful to an anonymous reviewer for pointing out the Neoplatonic influences here.
[17] The problem becomes messy when terms are used in different senses. Aquinas, for example, does not define spirituality explicitly. Trifogli (2019) p. 253.
[18] Guldentops (2001) pp. 82-4.

imperceptibility *per se* and their existence in some matter in which the sensible quality they represent does not usually inhere.[19] One popular term scholastics come up with for the ontological status of sensible *species* is "diminished being" (*esse diminutum*), which highlights the fact that *species* cannot independently exist on their own.[20]

Setting aside the controversies, authors who believe in the existence of auditory *species* take it to be something that is in the likeness of the sound produced by a sounding object and has a great mobility that allows it to traverse the medium. It performs one or both of the following two explanatory functions.[21] The first is to bridge the spatial gap between the origin of sound and the ear and explain what happens in between. The kernel of the problem here is that there has to be something to transport the sound over a long distance, yet there is no massive, perceptible motion of the air that seems to be capable of doing so.[22] Moreover, since Aristotle describes the air during sound propagation as a continuous unity, it means that attributing the propagation of air to different parts of the air acting upon and against one another might cause exegetical problems.[23] Here, *species* must fill in. Theophrastus describes the *species* of sound as one unity, disparate from the air but supervening upon it, and so is able to make sound audible to every hearer within a certain distance.[24] Simplicius' view is slightly different: the sounding object endows the air with *species* (συνειδοποιέω) that are passed on to the air further

[19] *Ibid*., pp. 86, 90.
[20] Tellkamp (2012) p. 8.
[21] Note that these two functions are not exhaustive. For other roles auditory *species* play, such as guaranteeing the objective correctness of sensory perception, see Leinsle (2016) p. 103.
[22] Suárez, for example, notes the lack of "violent and sensible motion of air" when we hear sounds. Suárez (1635) p. 155.
[23] Arist. *De an.* II 8.419b34-35.
[24] Prisc. *Metaphr.* 14, 30-33 = Huby (1997) p. 23: "Surely it is because it is necessary for some effect to have occurred and for the air to have been set in motion earlier, and the form of the sound supervenes upon it as a whole later; and the effect and the movement are in time, and the form as a whole supervenes later upon what is happening. In the particular case of sound, therefore, the form of the activity <supervenes> later upon the effect, to the extent that the effect gets through by means of the continuity of the air."

away from the origin by means of the sympathy between parts of the air, while the air remains a unity during the process.[25]

The second function is to bridge the physical-phenomenological gap between a sound external to us and our phenomenological experience of it. How is sound, something that originates in the physical world, able to make itself accessible to our sensory capacities? Auditory *species*, again, come in handy at this point of transition. For Themistius, auditory *species* (τὰ εἴδη τῶν ψόφων) are received by the air congenital with the eardrum, something that serves as the border between the pneuma and the external air and transmits them to the origin of perception.[26] This mediating role of *species* is also found in Augustine and William of Auvergne. Speaking of sensible *species* in general, they consider them to arise from external objects and later get impressed on the organs of the senses, thus functioning as the link between external objects and our sensory powers.[27]

Without a doubt, many ambiguities are lurking in each of the accounts with regard to both functions. It seems rather puzzling, for example, how something supervenient on the air and not affected by air motion is produced, when it is obvious that the generation of sound is closely related to the motion of the sounding object, which, in turn, must have an impact on the surrounding air. The mode of *species*' propagation in the air is also unclear – if there is just one *species*, how is its expansion and ultimate fading in space determined? If there are multiple, are they multiplied from one another,[28] or is there motion involved? Moreover, how *species* get received by the sense and transported further also remains mysterious. This opens up a huge space for later scholastic and early modern authors to fill in.

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[25] Simpl. *De an.* 142, 9-14 = Steel (1997) p. 174: "the latter parts [of the air] are not struck or shaped by former ones, but sympathise and are endowed with the same *species* (συνειδοποιεῖται) by that which strikes and activates in the beginning."
[26] Them. *De an.* 86, 28 = Todd (2013) p. 109.
[27] August. *De trin.* XI 9.16: "[...] from the *species* of the body itself, there arises that which comes to be in the sense of the perceiver; and from this, that which comes to be in the memory; and from this, that which comes to be in the mind's eye of the perceiver." Todd (2000) p. 56: "I have already told you that to sense includes two things in itself, namely, to receive an impression from that which is sensed and to judge concerning it. I mean: to judge its quality and to receive from the external sensible object an impression that is in the organ of the sense and is impressed upon it by the sensible agent."
[28] Suárez (1635) p. 155.

In the following, I shall focus on three early modern works that have dealt with sound and hearing, the *Coimbra Commentaries*, Arriaga's *Philosophical Course* and Schelhammer's *On Hearing*, and discuss how the two functions of auditory *species* play out with different nuances in different philosophical frameworks to which the authors commit. The reason for choosing these authors is that they each capture an important moment in the designation of auditory *species*' explanatory function in the theory of sound and hearing. Auditory *species*, being an immaterial entity in the *Coimbra Commentaries*, fulfils the function of transporting the sensory data across a distance with no air motion, and bringing about perception through a hylomorphist union with the sensory power. Arriaga agrees with the *Conimbricenses* on the first role of the *species*, but rejects its "immateriality" and its union with the sensory power. For him, *species* causes perception upon immediate contact with the sensory power without any need for union with it. Schelhammer, on the other hand, completely mechanises the auditory *species* as the shape of air that contracts and dilates during sound propagation. Inspired by Athanasius Kircher, he assigns auditory *species* a linear propagational path to facilitate a geometrical analysis of sound interface with its surroundings on the same model as light rays.

### *1. The Coimbran 'Species': Mediated Perception through Union*

The *Coimbra Commentaries* provide a good example of how auditory *species* and its functions can be squared with a philosophical framework in which materiality comes in different degrees.

The so-called *Comentarii collegii conimbricensis*, or *Cursus conimbricensis* consists of eight commentaries on the Aristotelian Corpus published between 1592 and 1606 under the direction of Manuel de Góis as a collective undertaking to update the Jesuit philosophical teaching in Coimbra.[29] The content most relevant to our topic is the commentary on *De anima* II 8 mostly written by Góis himself.[30]

[29] For the authorship of the *Coimbra Commentaries*, see Carvalho (2018) pp. 7-15; Oliveira e Silva (2022) pp. 73-90.

[30] Carvalho (2019). Although Góis is the main author and compiler of the *De anima* commentary, inconsistencies in the work hint at the fact that it is most likely a collective

### *1.1 Gradation of Materiality*

For Góis, the sensible quality of an object, the sensible *species* of that quality, and the soul that perceives the quality exist on different levels of materiality.[31] Entities at the ends of the spectrum of materiality cannot interact with one another without mediation.

> For from the constitution of nature, and the order between sensitive cognition and the cognised thing, *species* is in the middle: lest a transition should take place without a medium from the sensible thing, which is too material for cognition, to that which approaches immaterial nature, but by the interposition of *species*, which has less materiality than a sensible object. Whence Aristotle teaches absolutely in chapter 12 of this book, in text 121 which immediately follows, that it is common for the senses to receive forms without matter, that is, to receive the images of objects.[32]

What Góis describes here is the gradation of materiality: the sensible object is too material (*nimium materialis*) for cognition, so that something less material is needed to bridge the sensible and the sense. Note that occasionally, there appears to be some confusion in the use of the term *materialis*. When explaining why the souls of living things are superior to the lifeless things, Góis says:

> [...] in their (the soul of living things) operation they make use of simulacra of things, or *species* which, though still material insofar as they emerge in small amounts from matter: for example, the similitude of colour is indeed of a purer and more purified nature than colour itself; and finally that they use images of things no longer inherent in a body, but truly immaterial, and of a higher order.[33]

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enterprise. For example, in the discussion on the organ of touch, the commentators overturn the Aristotelian principle that the temperament of the tactile organ should not be too terrestrial, which they adhere to in one place of the text, but put forward a new principle for locating the sense organ based on daily experience in another place. CAJC pp. 538, 630.

[31] On materiality in other early modern authors, see Äkerlund (2025).

[32] CAJC p. 652: "Namque ex naturae instituto, atque ordine inter cognitionem sensitivam, et rem cognitam media est species: ne a re sensibili, quae nimium materialis est ad cognitionem, quae ad immaterialem naturam prope accedit, fiat transitus sine medio, sed interjectu speciei, quae minus habet materialitatis, quam objectum sensibile. Unde Aristoteles hoc lib. cap. 12. proxime sequenti, text. 121. absolute docet commune esse sensibus formas sine materia, hoc est, objectorum imagines recipere."

[33] CAJC p. 294: "[...] illae operando utantur objectarum rerum simulachris, seu speciebus, quae etsi materiales adhuc sint, aliquantulum a materia emergunt; siquidem purioris, et defaecatioris naturae est similitudo coloris, verbi gratia, quam ipse color; aut denique quod

Here, Góis applies materiality and immateriality to sensible *species* at the same time, which seems to disrupt the hierarchy of materiality. Upon a closer look, however, the sense in which he uses the word *materialis* varies. When he says that *species* are "material," he emphasises the fact that *species* originate entirely from the physical world, namely bodies and their movements; when he says that they are "immaterial," he points to the fact that *species* do not inhere in bodies like sensible objects do. Thus, immateriality, taken in this sense, is clearly distinct from spirituality, which, strictly speaking, only applies to the intellect.

Different degrees of materiality exist also within *species* of different sensible qualities. Auditory *species*, for example, are considered to be more material than visual *species*:

> [...] sound, and auditory *species* are transported not instantly, but in time [...] for just as sound is more material than its *species*, so are (auditory *species* more material) than images of colours.[34]

It is a common experience that we hear a sound a moment later than we see the motion that causes the sound when it takes place far away from us. In this passage, Góis explains the tardiness of the arrival of auditory *species* in comparison to visual *species* by means of the greater materiality of the former than the latter. The criterion by which Góis judges the degree of materiality seems to be how much it has in common with solid bodies, whether it is by being bound by bodies spatially, or by sharing similar characteristics, such as being slow in its movements.

*1.2 Union as the Mode of Interaction between the Material and the Immaterial*

Because of its position between the sensible object and the sensory faculty in terms of its materiality, auditory *species* plays an important mediating role in the *Coimbra Commentaries* by being the formal principle of a union between

utantur rerum imaginibus non iam corpori inhaerentibus; sed prorsus immaterialibus, atque altioris ordinis."

[34] CAJC p. 516: *Commentarii in III de anima* II 8 q.1, a. 2: "[...] sonum, et species audibiles non instanti, sed tempore deferri [...] quia tam sonus quam eius species magis materiales sunt, quam imagines colorum."

sound and the faculty of hearing, which Góis considers to reside in the "congenital" air[35] that is built into our ears from birth.

> Note, however, that a *species* concurs not only actively for operation, as we have said, but also formally, insofar as it concurs for the specification of an act, by determining the power to this rather than to that kind of operation. Likewise, insofar as it guarantees the union of the object with the power in the being of the cognised thing, which union is the proper effect of a formal cause. And truly, the power is united sensibly with the cognised thing before it tends towards the object; a *species* is a formal principle before it is an efficient principle [...][36]

Góis understands the occurrence of perception in terms of an Aristotelian hylomorphist relationship, which involves three elements: form, matter and the informed object. With regard to perception, the counterpart of form is the sensible quality that its *species* represents, that of matter is the sensory power, and that of the informed object is the perception that arises from the union, an act that is defined in terms of its kind[37] and its direction in which it targets the object.[38] Note that here, *species* is the formal principle, while the union is achieved between the sensible object and the sensory power, which deviates from the usual hylomorphist model in which the formal principle itself is united with the material principle. This irregularity seems to arise from the underlying concern that for perception to reliably render reality, a union has to take place between the cognised thing and the cognising power,

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[35] CAJC p. 538: "[...] the congenital air, or in-built air in the ears, which we said was enclosed by the membrane, lest it should disperse to the outside or be exposed to external injuries, is the true and proper instrument of hearing."

[36] CAJC p. 384: "Adverte autem speciem concurrere non solum active ad operationem, uti diximus: sed etiam formaliter, quatenus concurrit ad specificationem actus, determinando potentiam ad hanc potius, quam ad illam operationis speciem. Item quatenus praestat unionem objecti cum potentia in esse cognoscibili; quae unio est proprius effectus causae formalis. Et vero, quia prius est potentiam uniri intentionaliter cum re cognita, quam tendere in objectum; prius se habet species ut principium formale, quam ut principium efficiens [...]."

[37] I take the "speciem" in "determinando potentiam ad hanc potius, quam ad illam operationis speciem" to mean kind. Species decides which kind of perceptive activity is turned on – *species* of colour activates vision, *species* of sound hearing, etc.

[38] This role of mediating the material and the immaterial is absent in Suárez, who nevertheless thinks that union is in principle necessary between the sense and the object of perception. Suárez (1635) p. 107: "Unio objecti cognoscibilis cum potentia necessaria est in omni cognitione." Suárez also differs from the *Conimbricenses* in believing that sensible species serves only as the efficient cause and not the formal cause. *Ibid*., p. 112.

yet in the case of auditory perception, the union can only be initiated by *species* since it is the only thing that is able to come into contact with the power. Therefore, the union is a strange one in which the formal principle is not united with the material principle but brings about the union of the latter with something else.

To summarise, auditory *species* in the *Coimbra Commentaries*, being less material than sound and more material than the power of hearing, is able to bring forth a hylomorphist union between sound and the power of hearing. In the Coimbran world, beings exist on a spectrum of different shades of materiality, and things that are far apart in terms of their materiality need intermediaries to interact.

## *2. Arriaga's 'Species': Immediate Perception without Union*

Three decades after the publication of the *Coimbra Commentaries*, Rodrigo de Arriaga, Spanish by birth but devoted to the promotion of wisdom and faith in the Province of Bohemia since 1624, composed a complete philosophical course at the Jesuit College of St. Clement in Prague.[39] Just like the *Coimbra Commentaries*, Arriaga's *Philosophical Course* is a gigantic set of commentaries on Aristotle's works, yet the philosophical framework in which his concepts operate is already quite different.[40] Auditory *species* now functions in a world in which the gradation of materiality is absent and touches the sensory power without initiating any union.

### *2.1 Clear-cut Boundary between the Material and the Spiritual*

Arriaga rejects the gradation of materiality and draws a clear line between the material and the spiritual, avoiding the term "immateriality" that might cause confusion between the strictly material and the spiritual. The trend is already visible in Suárez, who emphasises that sensible qualities, though being quite subtle, are distinguished from the "proper spiritual and immaterial

[39] Hurter (1874) pp. 1-3; Ribadeneira (1576) pp. 728-9.
[40] Arriaga's *Cursus* was first published in 1632, then in 1653 before it was published for the last time in 1669 after substantive revision and augmentation. All passages from the 1669 edition cited in this paper are identical to the earlier editions.

qualities" of the intellective soul.[41] Arriaga takes a step further and draws the line between the spiritual and the material by means of the presence of quantity and impenetrability.

> Let us say, then, that a material thing is, in general, a quantitative being. [...] So by contrast, a spiritual being must be defined as a non-quantitative being. Indeed, we will later explain that quantitative disjunctive, either that which is *per se* impenetrable with another individual similar to itself, or has a commensuration with such an impenetrable thing.[42]

This passage shows a strikingly Cartesian take on the division between materiality and spirituality.[43] A thing is either material or spiritual, and the sole criterion for deciding where it belongs is by its relationship to bodies and quantity. There are two situations in which a thing is material: it is either a body that is impenetrable by another body, meaning that two bodies cannot take up one space at the same time; or it is commensurate with a body and is dependent on it, for example the redness of an apple extends across the flesh of the apple and is dependent on it, yet the redness itself is not a body. A spiritual being is just the opposite and is defined as being entirely constituted through the negation of impenetrability with bodies or a dependence on them.[44] By saying that "the spirituality of the soul does not depend on the intellective power, but on the independence from matter,"[45] Arriaga sharply distinguishes himself from his scholastic predecessors who define spirituality

[41] Suárez (1635) p. 32: "Unde in eodem sensu negatur, animam sensitivam operari per qualitates corporeas; non quia operetur per proprias qualitates spirituales, et immateriales, sed quia per subtiliores formas aliquo modo a crassitudine materiae abstractas operatur."
[42] Arriaga (1669) p. 721: "Dicamus ergo, rem materialem in communi esse ens quantitativum. [...] Postea vero explicabimus illud quantitativum disjunctive, vel quod est per se impenetrabile cum alio individuo sibi simili, vel habet commensurationem cum tali re impenetrabili."
[43] Descartes takes the nature of body to be extension. For him, a body is essentially an extended space and any two bodies cannot penetrate each other, i.e., be co-present at the same time and in one place. Cf. CSM I, p. 224: "the nature of matter, or body considered in general, consists not in its being something which is hard or heavy or coloured, or which affects the senses in any way, but simply in its being something which is extended in length, breadth and depth."
[44] Arriaga (1669) p. 730: "[...] spiritualitas constituitur per negationem impenetrabilitatis aut dependentiae a subjecto materiali."
[45] *Ibid*., p. 767: "[...] spiritualitas animae non pendet ex virtute intellectiva, sed ex independentia a materia."

in terms of the intellect, thus safeguarding the immortality of the soul that remains independent, and thus incorruptible by the decay of bodies.[46]

What category, then, does auditory *species* belong to? Arriaga calls all *species* of the external senses "material *species* (*species materiales*),"[47] and emphasises their dependence on matter by attributing their generation to material causes.[48] Much as auditory *species* are not bound to the sounding bodies or the air immediately around them, the dependency still holds between the *species* and the material objects, since the *species* emerge from matter and corrupt in matter. Therefore, auditory *species* are purely material and are in no way superior to the sensible quality they represent.

### *2.2 Immediate Perception without Union*

Arriaga attributes the cause of sense perception to the concurrence of *species* and the sensory power without any union. For him, *species* are "received" in sensory organs in the same way as they are received in external bodies, such as air or water.

> The material *species* of the external senses, both in man and in animals, are received in prime matter alone. This I approve openly, because those *species* are of the same reason as those which are produced by air or crystal; but these are received in matter alone, and not in the form of air or crystal, as everyone admits: therefore they are received only in matter also in the pupil itself.[49]

Arriaga uses sight here as an example to show that sensible *species* interact with our sense organs in no way differently than with lifeless objects such as air and

[46] *Ibid*., p. 749: "Probanda ergo est animae spiritualitas ex independentia quam habet a materia et quantitate, quae independentia probatur ex immortalitate ipsius [...]."
[47] Suárez also takes this position. Suárez (1635) p. 111: "Species intentionales in solo intellectu sunt spirituales, et individibiles; in allis autem potentiis cognoscitivis sunt materiales, et divisibiles."
[48] Arriaga (1669) p. 823. Again, Arriaga is similar to Suárez on this point. Suárez (1635) p. 32: "Si vero per qualitates materiales intelligamus qualitates extensas in materia, et ab illa pendentes, etiam anima sensitiva per qualitates tantum materiales operatur [...]."
[49] *Ibid*.: "Species materiales sensuum externorum tam in homine quam in brutis in sola materia prima recipiuntur. Hanc probo aperte, quia illae species sunt eiusdem rationis cum his, quae per aërem vel crystallum producuntur; sed hae in sola materia, et non in forma aëris aut crystalli recipiuntur, ut omne fatentur: ergo etiam in ipsa pupilla solum recipientur in materia."

crystals.[50] *Species* of the colour of a red apple, for example, can spread across the air and be imprinted on a mirror, and then become reflected by the mirror and get "received" by our pupil. The pupil, though being part of our organ of vision, is essentially a surface just like the mirror where *species* land.

Correspondingly, there is no union of any sort either between the *species* and the power, or the sensible quality and the power. The *species* acts solely as the effective cause that brings about perception. In fact, Arriaga no longer admits the *species* of smell, taste and touch because of the immediacy of these senses. Indeed, for these senses, the sensible quality alone can trigger perception without mediation.

> Next I add, that *species*, in order to concur with power, does not require the union of itself with it, but it is sufficient that it be contiguous to the power: for just as (as many teach, and we together with them in the following) a contiguous object concurs for the cognition of itself immediately, as in touch, smell, and taste; why a contiguous *species* received in a contiguous subject penetrated with power, will not be able to concur for the cognition of its object? Especially since the cause for operation in whatever view does not require a greater approximation than contiguity.[51]

Arriaga argues for a much less strict condition for *species* to bring about perception than Góis. For him, the contiguity of *species* and the sensory power is sufficient to generate perception. The keyword here is "concurrence" (*concurrere*) rather than union, which means that two or more causes work together to produce a certain effect, which alone does not indicate any union between the causes that contribute to the effect. The underlying reason for Arriaga's position, I suggest, is that since there is no transition between the material and the spiritual, beings from the two sides of the dichotomy must be able to interact without mediation to achieve a certain effect.

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[50] It is puzzling why Arriaga says that *species* are received in prime matter, though the word fades out in the sentences that follow.

[51] Arriaga (1669) p. 763: "Addo deinde, speciem ad concurrendum cum potentia non requirere unionem sui cum illa, sed sufficere, eam esse contiguam potentiae: sicut enim (ut docent plurimi, et nos infra cum illis) objectum contigua concurrit ad cognitionem sui immediate, ut in tactu, olfactu, et gustu; cur etiam species contigua recepta in subjecto contiguo, vel penetrato cum potentia, non poterit concurrere ad cognitionem sui object? Praesertis cum causa ad operandum in quacumque sententia non requirat majorem approximationem, quam contiguitatis."

In arguing for the superfluousness of the *species* – power union, Arriaga offers an argument from the cognition of angels:

> [...] indeed the most common and most true opinion is that an object proportionate and present, even if it is not united with the power, can concur with it for its cognition, just as in fact God concurs with the intellect of a blessed one, and one angel with another, and in touch and taste – this will be proven below. [...] if Gabriel, for example, having the spiritual *species* of some object, were to be penetrated with another angel lacking those *species*, that other angel with those *species* of Gabriel is able to bring about the cognition of the object of which they are (*species*).[52]

With the example of angelic cognition, Arriaga aims to show that there can be cognition without the union of *species* and sensory power. The spiritual *species* of some object in one angel can be cognised by another when two angels penetrate each other, but without any union taking place between the spiritual *species* of the object and the cognising angel. The reasoning is that, if no union is needed for spiritual *species*, the same applies to sensible *species*.

In short, bridging the spatial distance between the origin of sound and the ear is the only role Arriaga's auditory *species* takes on. For him, sensible *species*, just like spiritual *species*, can cause perception without being united with the cognising power.

### *3. Schelhammer's 'Species': Shape of the Air and Sound Rays*

At the end of the 17th century, Günther Christoph Schelhammer, a member of the medical faculty of the University of Helmstedt and a scholar of the *Academia naturae curiosorum*, made a curious attempt to reconcile scholastic terms with the mechanical philosophy that was gaining ground at the time.[53] His approach stands in stark contrast with that of mechanistically-minded scholars like Galileo, Mersenne, Descartes and Emmanuel Maignan, who

[52] *Ibid*.: "[...] etenim communissima, et verissima sententia est, objectum proportionatum,et praesens, etiamsi non uniatur potentiae, posse cum illa concurrere ad cognitionem sui, ut concurrit de facto Deus cum intellectu beati, et unus angelus cum altero, et in tactu, et gustu infra probabitur. [...] Unde valde arbitror probabile, si Gabriel verbi gratia habens species spirituales alicujus objecti, penetraretur cum altero angelo carente eis speciebus, posse illum angelum alterum cum illis speciebus Gabrielis efficere cognitionem objecti cujus illae sunt."
[53] Zedler (1742) p. 1178; Gurlt *et al.* (1884) p. 214; Günther (1980) pp. 3-8.

distanced themselves from the use of the scholastic term *species* and replaced it with descriptions of the motions involved in the auditory process.[54] Maignan, for example, thinks that sensible *species* should be called "images" or "pictures" only metaphorically, since they are in fact "expressions of motions" communicated to the brain.[55] In his explanation of auditory perception, he totally avoids using the term auditory *species* for sound, which he considers to be "not some superadded quality, but the motion of vibration itself."[56]

Compared to Maignan, Schelhammer holds a much deeper respect for scholasticism, although he shares the same mechanistic viewpoint of seeing sound in terms of vibration, elasticity and wave-like motions of air.[57] His unique contribution in reconciling early modern mechanistic philosophy and scholasticism consists in pouring new wine into old skin by attributing to auditory *species* a brand-new sense, namely the purely physical form of the air.

### *3.1 Species as the Shape of the Air*

When talking about sound, Schelhammer does not use the term *species* in any way differently from when he uses it to talk about the form of bodies. When citing Falloppio's anatomical observation, Schelhammer refers to the form of an auditory foramen as its *species*:

> Gabriele Falloppio and others who came after him noted that the foramen which the (auditory nerve) enters, and through which it is carried into the ear, is shorter and has the form (*species*) of a certain vaulted cave or portico in children, but receives completely the form of a passage and a tunnel in adults, with the bone enlarged and with the previous form (*species*) changed [...][58]

[54] Downing and Nolan (2011); Shea (1970).
[55] Maignan (1673) p. 532. I am grateful to an anonymous reviewer for suggesting to incorporate Suárez and Maignan into the narrative.
[56] *Ibid*., p. 545: "[...] sonum non esse qualitatem superadditam, sed esse ipsummet motum vibrationis [...]."
[57] LSB VIII 3, p. 90.
[58] Schelhammer (1684) p. 71: "De foramine vero quod ingreditur, ac per quod fertur in aurem, notavit Gabriel Fallopius et post eum alii, in pueris brevius esse, et cujusdam fornicati antri vel porticus speciem habere, in adultis vero, adaucto osse, mutataque priori specie, meatus ac cuniculi formam penitus recipere [...]."

Just as the *species* of the foramen is just its form, the *species* of sound, for Schelhammer, is quite literally the form of the air in motion.

Schelhammer's understanding of the form of air is deeply influenced by Leibniz, who was working on a theory that explains the generation of sound "entirely mechanically (*plane mechanice*)"[59] around the same time as Schelhammer was composing *De auditu*.[60] Both men knew of each other's work and shared their thoughts on the topic with much collegial spirit and little reservation. Schelhammer writes: "I confess that this discovery is not due to me alone but to a great extent to a most ingenious man equipped with various doctrines and erudition."[61]

In a letter addressed to "the most brilliant men in Germany and France,"[62] obviously including Schelhammer, Leibniz explains the origin of sound by describing how motion is communicated from the sounding body to the surrounding air to make sound (see fig. 1):

> But it must be explained more clearly how one portion of the air receives the tremor from a sounding body. Let the string LM be extended[,] fig. 3, and let the body AB be attached to it, hitting the air while the string is vibrating (by this body we mean the parts of the string themselves, according to the thickness which is here considered not unless in AB at the moment). Therefore, when the vibrating string from LAM proceeds into L(A)M, then the attached body proceeds from AB into (A)(B), and expels and strikes the air positioned in place B(B), and at the same time when the vibrating body occupies the place B (B) leaves place A(A), hence it happens that just as the anterior air BC is compressed by the blow, so the posterior air AF is dilated in turn to fill the empty space [...]. But the extended air, that is compressed or dilated (for I generally take the word "tension"), restores itself by its elastic force (the cause of which I will not now touch upon) and, in the same way as other extended bodies, produces a great number of vibrations of the same duration as the first one if nothing hinders it.[63]

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[59] LSB VIII 3, p. 91.

[60] It is hard to track down the precise authors who influenced Leibniz's theory of sound, as Leibniz was in touch with so many advocates of physico-mechanics. One known influence is from the French Jesuit mathematician Ignace-Gaston Pardies. Cf. Beeley (2007) p. 64.

[61] LSB VIII 3, p. 125: "Hoc autem inventum non mihi soli deberi fateor, sed magna ex parte viro ingeniosissimo ac varia doctrina atque eruditione instructissimo."

[62] LSB VIII 3, p. 94.

[63] LSB VIII 3, pp. 98-9: "Sed explicandum est distinctius quomodo una aliqua aeris portio tremorem a corpore sonoro accipiat. Sit chorda LM tensa[,] fig. 3, annexumque ei corpus AB vibrante chorda aerem feriens (quo corpore designatae intelligi possunt ipsae partes chordae, secundum crassitiem quae hic non nisi in AB nunc consideratur). Cum ergo chorda vibrans ex LAM procurrit in L(A)M, tunc corpus annexum ex AB procurrit in

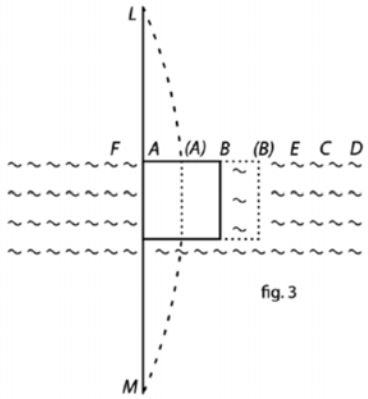


*Fig. 1*: Leibniz's drawing that shows how he imagines the air to be compressed and dilated. LSB VIII 3, p. 99.

There are a few things worth noting here. First, the vibrating string represents bodies capable of producing sound by trembling. Second, the body AB that looks like an attachment or extension of the string represents the string itself that has a certain thickness. The advantage of representing the thickness of the string in this way is that one can, for the time being, ignore the change in size of the elastic string that occupies a larger space when it is extended and arched, while still conveying the same idea with the rectangle staying the same size and simplifying the issue. Rectangular shapes also allow us to see the change in space more clearly. The main idea is this: when the string slashes the air, the air that used to occupy B(B) has nowhere to go but proceed towards C, so that in a very short time what used to occupy the area BC has to occupy only (B) C, thus compressing itself. The opposite happens to the air that comes after the string. The air AF now has to occupy (A)F, thus dilating itself. This is all because air is elastic.

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(A)(B), aeremque in loco B(B) positum expellit et percutit, et cum eo tempore quo corpus vibrans occupat locum B(B) deserat locum A(A), hinc fit ut quemadmodum ictu comprimitur aer anterior BC, ita vicissim dilatetur aer posterior AF ad locum desertum implendum [...] Aer autem tensus, hoc est compressus vel dilatatus (generaliter enim tensionis vocem accipio), sese vi sua elastica (cujus causam nunc non attingo) restituit et more tensorum aliorum vibrationes plurimas peragit primae aequidiuturnas, si nihil impediat."

What Schelhammer creatively gets from this is a mechanical way of understanding the concept of *species* that was so elusive in the scholastic tradition. For Schelhammer, *species* is both the form of the string and of the air being pushed out of place when the former "impresses" its form on the latter:

> But since the air is a compressed fluid body, and therefore endowed with elasticity, and apt to be moved into tremor, it is evident that this can happen in no other way, than because once the *species* of sound has been impressed, one small part running into another, with the whole air trembling together, propagates the same by itself [...] For it is not unlike when we see a string moved, and by reciprocal blows run hither and thither, and the whole air also seems to be moved; hence one small part of air continuously imparts to another its impressed *species*, until at last, owing to the reaction of the small parts, all force and motion ceases, and the sound ceases to be propagated.[64]

The air, having been impressed upon, takes on (*induit*) the form or *species* of the sounding bodies.[65] Different instruments, such as the violin, the cello, and trumpet and the flute, have different figures that are impressed on the air, thus producing sounds of different timbres that "differ not in their magnitude or pitch, but in *species*."[66] Once pressed upon, the part of air gets compressed, then dilates again and pushes back on the neighbouring air because of its elastic nature, in the same way as the vibrating string runs in the opposite direction when it tries to restore itself. By doing so, it impresses the same *species* on its neighbouring air. This back-and-forth vibrating motion goes on

[64] Schelhammer (1684) pp. 124-5: "Cum vero aër sit corpus fluidum compressum, indeque elastro praeditum, ac in tremorem agi aptum, patet non alio modo id fieri, quam quia impressam semel speciem soni, una particula in aliam decurrente, totoque aëre contremente, per se ipsum idem propaget [...] Non secus enim ac videmus chordam commoveri, ac reciprocis ictibus huc illuc decurrere, aër quoque commoveri totus videtur; hinc una aeris particula alteri impressam speciem perpetuo communicat, donec ob reactionem particularum vis tandem ac motus omnis elanguescat, et sonus propagari desinat."

[65] Schelhammer (1684) p. 166: "[...] for then the air takes (*induit*) on the species of the solid, and so reacting upon the thing that was acting upon it [...]."

[66] *Ibid*., pp. 124-5: "[...] therefore, sound is very different in what they call the violin, whose body is hollow and is composed of two wooden boards [...], (sound is) very differently formed in the cello, yet differently in the trumpet, yet differently in the wooden flute, and so on for the rest. This is to be attributed not only to the size of the bodies, but also to the shape, by which the air is much affected: for these sounds differ not in magnitude, or in pitch, but in species."

until it gradually ceases because of the resistance of parts pushing one another in opposite directions.

*3.2 Species as Sound Rays*

In the foregoing account, auditory *species* are the impressions made on the air by sounding bodies. Schelhammer's next strategy is to identify auditory *species* with sound rays:

> Can we not say that those sonorous rays are nothing else than an impression made upon the air by the first violent collision of two bodies, and is then propagated perpetually by very small corpuscles touching one another, until the force of all resistance and reaction of those corpuscles perishes: in the same way as a thrown stone retains the impression made on it by the arm for some time?[67]

What then, are these sonorous rays? Almost directly taking from Athanasius Kircher,[68] Schelhammer considers them to be similar to the light rays which are straight lines stretching from centre of the source to the circumference:

> For as from an illuminated object, e.g. near the sun, there are straight lines, which from the circumference of the circle to the centre, diffusing light, converge into one, and are called visual rays, so also necessarily from the sonorous circles to the phonic point or point of sounds there is an in-between (space) full of sound, with a straight line running from the circumference to the centre: and that is what we call sonorous rays.[69]

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[67] *Ibid*., p. 119: "Annon radios illos sonoros possumus dicere nihil esse aliud, quam impressionem a prima duorum corporum violenta coitione in aërem factam, et deinde per minima ejusdem se contingentia corpuscula perpetuo propagatam, donec vis omnis renitentia et reactione corpusculorum illorum pereat: pari modo ut lapis projectus impressionem a brachio sibi factam aliquandiu retinet?" The title under which the above passage is written is: "The sonorous ray is not sound itself, but only its *species*." It is not clear what this title means, for if sound rays are not sound, but are *species* of sound, it follows that *species* of sound are not sound. Yet in Schelhammer's account, sound as it exists in the external world is just the air being compressed and dilated as different parts of the air impress *species* upon each other. It could be that by "sound," Schelhammer means something more than the *species*, namely the air together with the *species* or forms that they take on.

[68] Van der Miesen (2020) pp. 3-5; Asmussen (2016).

[69] Schelhammer (1684) p. 115: "Ut enim ab objecto illuminato verbi gratia ad solem, dantur lineae directae, quæ a circumferentia circuli ad centrum, lucem diffundentes, in unum concurrunt, et radii visivi appellantur, sic etiam necessario a circulis sonoris ad punctum phonicum seu sonorum datur intermedium sono plenum, recta linea ad centrum a circumferentia decurrente: atque illud ipsum est, quod radios sonoros appellamus."

The circle of sound is the circular area where sound spreads, as according to our daily experience that we can hear sound from all sides. By invoking the sound-light analogy, Schelhammer is determined to create a linear sound path by modelling sound rays after straight light rays. These sound rays, just like those in Kircher's *Phonurgia nova*,[70] obey the rule of reflection and map neatly onto different acoustic experiences, such as the passing of rays at a certain location maps onto the perception of sound at this particular place, and the intersection of rays at a certain point or the concentration of rays inside a certain space maps onto the perception of increased amplitude (see fig. 2).

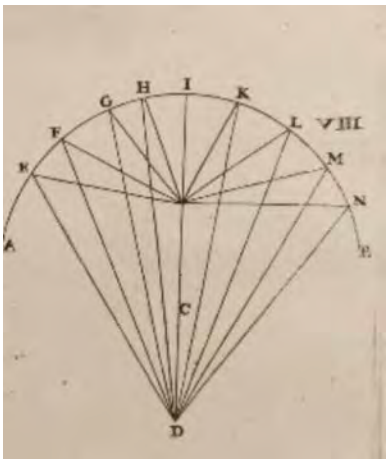


*Fig. 2*: Sound rays gather at point D, where sound is amplified. Schelhammer (1684) Tab. II.

Since these straight sound rays follow "infallible laws of mathematics,"[71] they inspire Schelhammer to investigate the interaction of sound with the inner

[70] Kircher (1673) *Preface*, pp. 4-5.

[71] Schelhammer (1684) *Preface*: "You see that I have divided it into three parts, the first of which instructs you about the organ, the second about the object, sound, and the last of these, as if it draws conclusions from two premises [...]. In the conclusions, however, I have followed only the correct reason, and have been mindful of nature in describing the organ, of experience and the infallible laws of mathematics in describing the object, so that the whole work may be seen as demonstrative, since indeed it teaches by what means nature

structure of the ear by imagining and illustrating how the sound rays inside it are reflected and concentrated at the exact right places to be amplified and transmitted to the next structure until they reach the auditory nerves. For example, Schelhammer considers the shape of the auditory canal to be most suitable for promoting hearing by offering images that demonstrate the influence of the shape of the auditory canal on the direction of sound rays.

> Let the external ear be A. The auditory canal B. Its internal mouth C. The auditory cavity DEF. It is obvious that if the auditory canal were directly opposed to the surface D, the sonorous rays would return to him, and no doubt they would be confused with each other so that nothing at all would be perceived, as is clear from the figure. Now, not only does the canal itself run obliquely, but it is also inserted obliquely, so that this cannot be more so, as is clear from the other figure, that the rays E are not reflected in themselves but into the subject cavity.[72]

By juxtaposing two figures (see fig. 3) in which the auditory canal is shaped differently, Schelhammer makes a sharp contrast between the sound-propagating effect of a straight canal and that of an oblique canal. The figure on the left shows an imaginary scenario in which the auditory canal has a straight shape. The straight lines that are parallel to one another represent the sound rays that go from the external ear A into the tympanic cavity DEF, but are then reflected back along the same route. By contrast, the figure on the right shows the real scenario in which the auditory canal runs obliquely so that the rays go through a series of reflections both inside the canal and the cavity and do not get reflected back. The visual rhetoric used here is that the sound rays are arranged intentionally parallel to one another, and the cavity DEF is shaped regularly to ensure that the rays stay on the same paths after being reflected upon it.

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itself uses to project, stop it, amplify or suppress it, and applies everything faithfully to the little cavities of the ear."

[72] *Ibid*., p. 199: "Sit externa auris A. Meatus auditorius B. ejus internum os C. cavitas auditoria D. E. F. Manifestum est, si meatus auditorius directe opponeretur superfici D; radios sonoros in illum esse regressuros, et haud dubie inter se ita confusum iri, ut nihil prorsus perciperetur. Uti ex figura patet. Nunc autem non modo oblique decurrit ipse meatus, sed etiam oblique inseritur, ut id fieri amplius nequeat, uti ex alter figura manifestum sit, ubi radii E. non in se reflectuntur sed in subjectam cavitatem."

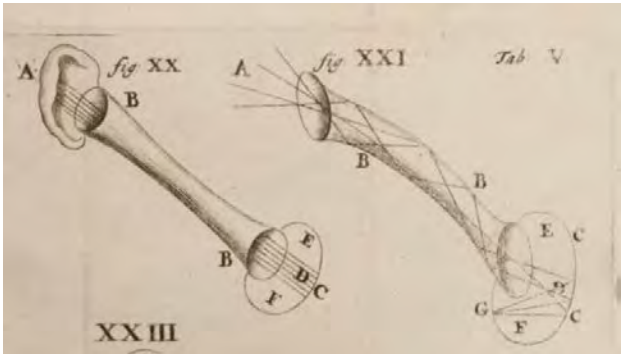


*Fig. 3:* Schelhammer shows that the auditory canal is designed to prevent sound rays from reflecting back to where they come from. Schelhammer (1684) Tab. V.

To summarise, auditory *species* is transformed by Schelhammer into something completely different from its usual meanings and functions in scholastic commentaries. This shows impressively how a scholastic concept can be creatively updated by later developments in mechanics and can still play important roles in a philosophical framework quite alien to that in which it originated.

## *Conclusion*

In this paper, I have demonstrated the remarkable fluidity of the concept of auditory *species* and its ability to fit different philosophical frameworks with three examples from 16th and 17th-century authors[73] who entertained different ideas about the division between the material and the spiritual, the generation and propagation of sound, and how auditory perception takes place. In the *Coimbra Commentaries*, Góis describes a world in which there are different grades of materiality, and auditory *species* serves as the intermediary between the material and the spiritual, uniting the faculty of hearing with sound by acting as the formal cause of auditory perception. Arriaga, on the other hand, is in favour of a clear-cut dichotomy of the material and the spiritual, and considers auditory *species* to be purely material beings that only

[73] For more discussions on the transformation of Aristotelian terminologies in the early modern period, see Omodeo (2025).

serve as the efficient cause of hearing upon immediate contact with the sensory power. Schelhammer fully mechanises the generation and propagation of sound and defines auditory species as the shape of the air during condensation and rarefaction. He goes further to assign a linear path to sound rays to explain the inner workings of the ear in a visually comprehensible way.

The greater inference to be drawn is that scholastic vocabulary and early modern mechanics often evolved hand-in-hand. Terms like auditory *species* were never fixed to Aristotelian scholasticism in their use, but took on different meanings and functions as they became absorbed into the fabric of mechanistic explanation. While the particular focus of this paper on just three authors who had distinct understandings of auditory *species* might make the shift of the term seem rather discontinuous, further research that sheds light on the historical context that underlies the shift will certainly enrich our understanding of the intricate processes of the transformation of early modern Aristotelian terminology.

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## Abbreviations

CAJC = *Curso Aristotélico Jesuíta Conimbricense. Tomo IV: De Anima*. (2022) Eds. M.C. Camps, M.S. de Carvalho and T.S. de Pinho. Coimbra: Coimbra University Press.

CSM = Cottingham, J., Stoothoff, R., and Murdoch, D. (trans.) (1984). *The Philosophical Writings of Descartes*. Vol. 1. Cambridge: Cambridge University Press.

LSB VIII = Knobloch, E. (ed.) (2021) *Leibniz Sämtliche Schriften und Briefe*. Reihe VIII, Bd 3. Berlin: De Gruyter Akademie Forschung.

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Pietro Daniel Omodeo

# PAROLE E SENTIMENTI DELLA MATERIA
## Eternità e materialismo cosmologico nel Rinascimento tra Averroè e Bruno

**Abstract**

The present study examines the relationship between cosmology, Aristotelian notions of the eternity of the world, and materialism in Renaissance thought, focusing on the influence of Averroes and its reception in Giordano Bruno. The medieval debate between al-Ghazali and Averroes on 'creation' versus 'eternalism', transmitted through Latin translations, forms the starting point for exploring the re-emergence of these themes in Renaissance Aristotelianism and heterodox traditions. Bruno's work is of particular interest in this regard, as his cosmology integrates Aristotelian and Averroist notions of eternal matter with Neoplatonic and Cusanian motifs. This integration gives rise to his famous doctrine of infinite worlds, universal animation, and an immanent unity of matter and form. The analysis draws upon Ernst Bloch's concept of 'cosmological materialism' in order to situate Bruno's philosophy within a broader historical trajectory of materialist thought. The essay posits the argument that Bruno's work represents a radicalisation of Averroistic ideas, including the notion of the productive potentiality of matter and the denial of creation ex nihilo. Additionally, it introduces innovations that are linked to post-Copernican cosmology and monistic immanentism. In doing so, Bruno both inherits and transforms themes of the 'Aristotelian Left', reshaping them into a vision where necessity, infinity, and vitality converge in an eternal, animated universe.

**Keywords**

Aristotelian Tradition, Averroes Reception, Theory of the Heavens, Eternity, Cosmological Materialism, Ernst Bloch

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**English Title**

Words and Feelings of Matter: Eternity and Cosmological Materialism in the Renaissance between Averroes and Bruno

## *Introduzione*

Nel *Tahafut al-tahafut* Ibn Rushd (qui per comodità Averroè, 1126-1198) riporta la critica mossa da al-Ghazali (ca. 1058-1111) alla pretesa dei filosofi di conciliare due concezioni cosmologiche antitetiche: creazionismo ed eternità del mondo. Nella traduzione latina del filosofo ebreo Calo Calonimo di Arles (1286-ca. 1328), *Destructio destructionum philosophiae Algazelis* (Venetiis 1527), i difensori della posizione eternalista sono tacciati di eresia (*sunt Haeretici*). Si legge infatti nella *Disputatio IV*, "Quod non possunt afferre rationem, quod sit efficiens mundo":

> Ait Alga[zel]: Et dicimus quod homines dividuntur in duas sectas. Prima est secta hominum veritatis, qui opinati sunt mundum esse innovatum, et sciverunt necessario quod innovatum non innovat seipsum, sed indiget efficiente; et intelligitur opinio eurum, cum dicunt agens. Et alia secta sunt Haeretici, qui existimant mundum esse antiquum, prout est, et non constituerunt ei efficientem, et opinio eorum bene intelligitur licet rationes indicent destructionem eius. Philosophi autem opinantur mundum esse antiquum, deinde constituerunt ei cum hoc efficientem; et haec opinio quasi contradicit sibi ipsi, et non indiget destructione.[1]

Si notino le scelte terminologiche di Calonimo: *innovatus* per creato, *efficiens* e *agens* per creatore, *antiquum* per ciò che è eterno in quanto non ha inizio e *destructio* per refutazione. L'aggettivo *innovatus*, derivato da *innovatio*, acquista il significato di 'contingente' nella traduzione italiana di Massimo Campanini; "le monde advient" si legge in quella francese di Taïeb Meriane.[2] Nella versione latina colpisce il termine 'Haeretici,' resi diversamente nelle principali traduzioni moderne: 'materialisti', 'matérialistes' e 'materialists'.[3] Ma il termine originale arabo, *al-dahrīya*, si riferisce a ciò che è sempiterno, dunque increato, mantenendo il significato di *dahrī* come di colui che

[1] Cito dall'edizione giuntina che accorpa la *Destructio destructionum philosophiae* e altre opere di Averroè, tra cui il cosmologico *Sermo de substantia orbis* e il *De animae beatitudine, seu epistola de intellectu*; Averroè (1573) f. 69*r* (a). La punteggiatura è ammodernata e le legature sono sciolte in questa e nelle seguenti citazioni latine. Cfr. Averroè (2015) p. 275.
[2] *Ibid*.; Averroè (2022) p. 259.
[3] Per la traduzione inglese mi avvalgo della traduzione di E.J. Wilkinson Gibb in Averroè (2012) p. 86.

devia dalla verità introducendo idee che se ne discostano. Di qui la resa di Calonymo, 'haeretici'.[4]

In questo saggio mi soffermo sul nesso tra cosmologia, eternità del mondo, 'efficienza' e materialismo nel tardo Rinascimento tenendo conto della problematicità teologica di tali questioni, il rischio di eresia appunto.[5] Per molti pensatori, che hanno interpretato la filosofia di Aristotele sulla scia dei commenti di Averroè, l'eternità del mondo ne costituiva effettivamente una tesi centrale. Il professore peripatetico padovano Cesare Cremonini (1550-1631), nella *Disputatio de coelo in tres partes divisa* (Venetiis 1613) – le cui tesi tennero impegnata l'Inquisizione fino ad essere messe all'Indice[6] – prese le mosse proprio dall'assunto che l'eternità del cosmo fosse un pilastro incrollabile della concezione aristotelica. La prima sezione del primo capitolo della sua *Disputatio de coelo* recita appunto: "Proponitur Aristotelis sententia de coeli aeternitate".[7] Desidero qui occuparmi dell'orizzonte all'interno del quale si iscrissero cosmologia, materialismo e critica del creazionismo nel Rinascimento. In che misura questo complesso tematico può essere considerato aristotelico e più specificamente averroista? Per rispondere a questa domanda sarà utile riallacciarsi agli studi sulla storia del materialismo che, in tempi recenti, hanno evidenziato il pluralismo delle correnti materialistiche sin dall'antichità, non riducibili al solo atomismo e alla matrice democritea.[8] In questa prospettiva, tematiche come l'immanenza dell'essere, il monismo o l'eternalismo cosmologico sono state valorizzate per il loro contributo alla storia del materialismo. Tale rivalutazione è debitrice nei confronti del lavoro di Ernst Bloch (1885-1977), filosofo che ha proposto un'apertura dei canoni storiografici e teorici del materialismo. Farò qui particolare riferimento al suo *Avicenna und die aristotelische Linke* (1952) per

[4] Sono estremamente grato a Jon McGinnis per il chiarimento lessicale nell'originale arabo.
[5] Il termine *efficientia* si trova utilizzato in contesto scolastico in riferimento al problema della causa e degli effetti dei moti celesti, ad esempio nel manoscritto *De coeli efficientia* di Cremonini, mai approdato alle stampe per motivi di censura, preservato nella Biblioteca Universitaria di Padova (Ms. 200/1) e nella Biblioteca Nazionale Marciana di Venezia (Mss. latini VI 176). Cfr. Del Torre (1966).
[6] Baldini and Spruit (2009) I, pp. 1485-6; Muir (2007) p. 33.
[7] Del Torre (1966).
[8] Si veda Wolfe and Symons (2024).

delineare il concetto di 'materialismo cosmologico' che affonda le radici nella filosofia arabica, in particolare nelle concezioni di Averroè.

La ricezione medievale di questo pensatore andaluso, il Commentatore di Aristotele per eccellenza, è ancipite. Il fortissimo debito nei suoi confronti fu segnato da altrettanto energiche critiche. Queste passano per le censure del Trecento, ad esempio negli *Errores philosophorum* di Egidio Romano (1243-1316) contro Aristotele, Averroè, Avicenna (Ibn Sina) (980-1037), al-Kindi (m. ca. 870), al-Ghazali e Mosè Maimonide (1138-1204), nonché per il *De unitate intellectu contra Averroistas* di Tommaso d'Aquino (ca. 1224-1274).[9] Eppure l'impatto di Averroè nel pensiero rinascimentale e successivo fu duraturo, sebbene non sempre esplicito. Jean-Baptiste Brenet ha parlato di Averroè quale fonte repressa del pensiero filosofico moderno, la quale continuamente riaffiora nella cultura europea.[10] Similmente Koert Debeuf denuncia un'operazione storiografica relativamente recente che avrebbe occultato la tradizione di pensiero arabica della filosofia moderna in generale nonché le radici extraeuropee di quella ellenica favorendo un'immagine eurocentrica della filosofia.[11] Esistono tuttavia studi di rilievo, ad esempio un recente lavoro collettivo curato da Anna Akasoy e Guido Giglioni volto a riaffermare l'importanza della sfaccettata ricezione latina di Averroè quale "a tale of many creative misunderstandings [...] an extraordinary case of philosophical acculturation".[12]

Avvalendomi di questi studi dirigerò la mia attenzione sulla questione del materialismo cosmologico. Considererò dapprima i termini chiave della problematica con riferimenti tratti da opere lessicografiche di matrice aristotelica del Cinque e Seicento. Presterò poi attenzione alla filosofia di Giordano Bruno (1548-1600), che Bloch ha considerato il culmine del materialismo cosmologico rinascimentale, e la loro possibile filiazione averroistica, seguendo anche in questo le suggestioni dell'*aristotelische Linke*, oltre che alcune preziose indicazioni di Eugenio Canone.[13] È un'esplorazione che ho avviato in

[9] D'Ancona (2005). Sulla ricezione rinascimentale, cfr. Martin (2010).
[10] Brenet (2019).
[11] Debeuf (2025). Cfr. Hasse (2016).
[12] Giglioni's "Introduction" in Akasoy and Giglioni (2010) p. 5. Su snodi cruciali dell'Averroismo rinascimentale si può sempre con profitto consultare Nardi (1958).
[13] Canone (2003) pp. 79-120: "Bruno lettore di Averroè".

una recente pubblicazione, in cui ho tratteggiato le coordinate storiche della questione che qui approfondirò sul piano lessicografico e concettuale, focalizzandomi sui tre temi interconnessi dell'eternità del mondo, efficienza della materia e animazione universale.[14]

### *1. Cosmologia: anacronismo ma non troppo*

La 'cosmologia', quale area specifica dell'investigazione filosofico-naturale, acquisì diritto di cittadinanza in filosofia nel 1731 con la pubblicazione della *Cosmologia generalis methodo scientifica pertractata* di Christian Wolff (1679-1754), il quale la concepì come *metaphysica specialis*.[15] Questa è solitamente considerata l'introduzione ufficiale del termine nella *respublica philosophiae*, anche se non mancano precedenti significativi. Dario Tessicini ha individuato nell'opera di Antoine Mizauld (1510-1578) un caso degno di nota. L'astrologo francese pubblicò nel 1570 un poema didascalico che recava appunto il titolo di *Cosmologia*.[16] Si trattava di un'opera letterario-didascalica ispirata ad una tradizione che idealmente comprende l'*Astronomica* di Marco Manilio (I sec. d.C.) e l'*Urania* di Giovanni Pontano (1429-1503). Mizauld vi illustrava il concetto di *mundus*, la provvidenza divina sottesa all'ordine celeste, le partizioni della Sfera e la centralità della Terra.[17]

Il libello attesta una precoce apparizione del termine 'cosmologia'. Per una definizione più rigorosa dobbiamo però rivolgerci ad opere più tarde, ad esempio al *Lexicon philosophicum* dell'aristotelico luterano Johannes Micraelius (latinizzazione di Lütkeschwager) (1597-1658). [18] Formatosi a Königsberg e Greifswald, divenne professore di retorica al *Paedagogium Illustre* di Stettino nel 1624 e vi ricoprì pure la carica di rettore. Il suo lessico fu pubblicato per la prima volta nel 1653 (e ristampato postumo nel 1661 e

[14] Omodeo (2024).
[15] Wolff (1731) p. 1 offers the following definition: "Cosmologia generalis est scientia mundi seu universi in genere, quatenus scilicet ens idque compositum atque modificabile est". Viene distinta dall'*ontologia* quale filosofia prima relativa all'essere in generale.
[16] Tessicini (2022).
[17] Mizauld (1570).
[18] Bülow (1885).

nel 1662) ad uso degli studenti 'ginnasiali' (ossia della Facoltà delle Arti o "filosofica"). Vi si legge:

*Cosmologia* est pars Physicae, tractans de mundo tanquam compage seu systemate ex coelo et terra, iisque quae in illis continentur, concinnato.[19]

Questa idea di una fisica dei cieli è riconducibile alla lezione del *De coelo* aristotelico. Per Micraelius l'ambito disciplinare della cosmologia andrebbe distinto rispetto all'astronomia matematica, di cui è complementare:

*Cosmographia* est scientia Mathematica, continens generaliora Astronomiae et Geometriae. Adeoque ferentia sphaerae mundi; corporis scilicet illius rotundi, quod coelum et terram continet, in quo indagat quantitatem, figuram sphaericam, situm partium, haemisphaerium superius et inferius, partem anteriorem seu occidentem, posteriorem seu orientem, desteram seu septentrionem, sinistram seu meridionalem, quatuor item cardines seu plagas, totidem quadrantes longitudinem ab occidente versus orientem, latitudinem septentrione versus meridiem, item varios circulos, eorumque axes, polos et circumferentias.[20]

La voce 'mundus' nello stesso *Lexicon* del Micraelius è direttamente correlata alla definizione di cosmologia e cosmografia. Il termine viene spiegato a partire dal greco κόσμος (ornato): allude alla perfetta bellezza del mondo (*nihil pulchritudinis deest*). Esso è oggetto specifico della cosmologia (*mundus contemplatur Cosmologia*).[21] Micraelius lo definisce in un'ottica di 'sistema' per contrapporre quella che secondo lui è la corretta concezione peripatetica rispetto a concorrenti interpretazioni vitalistiche, che egli attribuisce alla Stoà. Secondo gli Stoici, il mondo sarebbe un grande animale:

*Mundus* est compages seu systema corporum naturalium tam coelestium quam elementarium. *Mundus* secudum Peripateticos non informatur anima aliqua seu forma universali, ceu Stoici docuerunt, quia singulae partes mundi suam peculiarem formam habent. Et hac est causa, quare mundum per systema definiant, non per animal, ut Stoici.[22]

Il posizionamento di Micraelius contro l'*anima mundi* investe oltre che lo stoicismo anche il platonismo e tutte le riprese del tema dell'animazione

[19] Micraelius (1653) p. 288.
[20] Ivi, p. 289.
[21] Ivi, p. 689.
[22] *Ibid.*

universale nell'ecletticismo filosofico del Rinascimento.[23] In questo non è particolarmente originale. Ad esempio, anche i gesuiti erano estremamente critici del vitalismo.[24] Nondimeno l'affermazione di Micraelius che i Peripatetici tutti rigettassero la definizione del mondo come animale è incorretta. Difatti una simile concezione riscontrò ampio successo tra gli estimatori, commentatori e seguaci di Aristotele incluso Averroè. Vi tornerò. Quel che serve ora fissare è come l'dea della cosmologia come disciplina che indaga il mondo, il suo ordine, sostanza e fondamenti nella prima età moderna (ben prima di Wolff) non sia anacronistica. Anzi, la definizione più tarda del suo ambito trasse linfa e plausibilità da una tradizione filosofica e astronomica consolidata e fortemente influenzata dall'insegnamento aristotelico.

Per quanto riguarda la questione controversa dell'eternità del mondo, Micraelius riconobbe che si trattava di una tesi di Aristotele basata su una considerazione dei moti celesti – il rimando è al libro lambda (XII) della *Metafisica*. A questa concezione – accusata di materialismo da al-Ghazali e detta eretica da Calonimo – Micraelius contrappose la verità *ex autoritate Scripturae*, in particolare quella della *Genesi* (*Hexaoemerum*), su cui si fonda la convinzione che il mondo sia stato creato (*conditum*).

I predecessori andalusi del tardo-scolastico tedesco erano stati ben più radicali in questo. Il cronista del Magreb, lo storico Abd al-Wahid al-Marrakusi (1185-1250) riporta del primo incontro di Averroè con il sovrano almohade Abu Ya'qub Yusuf (1138-1184), a cui fu introdotto dal filosofo e alto dignitario di corte Ibn Tufayl (latinizzato come *Abubacer Aben Tofail*) (1115-1186). Come si legge, Averroè si trovò in grande imbarazzo di fronte alla richiesta di pronunciarsi riguardo all'eternità del mondo. Dopo un tentennamento iniziale, sarebbe stato confortato dalla libertà filosofica dei suoi astanti. Secondo le parole che al-Marrakusi attribuì allo stesso Averroè:

> Quando fui introdotto davanti al Principe dei credenti Abu Ya'qub [...] [egli] diede inizio alla conversazione rivolgendomi questa domanda: "Che cosa pensano i filosofi del cielo? Lo credono eterno, o venuto all'esistenza nel tempo?" Preso da confusione e da timore, tentai di scusarmi e negai di essermi mai occupato di filosofia, poiché non sapevo che Ibn Tufayl e lui avevano convenuto di mettermi alla prova.

[23] Bondì (2018) pp. 1-14.
[24] Gulizia and Omodeo (2024).

Il principe dei credenti si accorse del mio spavento e della mia confusione. Si volse verso Ibn Tufayl e si mise a parlare della questione che mi aveva posto. Ricordò ciò che avevano detto Aristotele, Platone e tutti i *falasifa*, citò inoltre gli argomenti portati contro di loro dai musulmani. Io constatai presso di lui una erudizione che non avrei sospettato nemmeno in qualcuno di quelli che si occupano esclusivamente di questa materia. Fece tanto per mettermi a mio agio, che finii col parlare ed egli apprese ciò che avevo da dire a questo proposito.[25]

È da questo clima intellettuale che sarebbe emersa la refutazione averroistica delle tesi filosofiche di al-Ghazali *in philosophos*, a partire dalla questione se il rapporto tra Dio e il mondo vada inteso come una creazione e se la realtà mondana possa avere cominciamento e fine.

## *2. Materialismo cosmologico*

Nell'ormai classico *Geschichte des Materialismus* (1866), Friedrich Albert Lange (1828-1875) considerò la speculazione sul cosmo e la sua unità strutturale di rilievo per la storia del materialismo. Per lui, una simile *Spekulation über das Weltganze und seine Zusammenhang* ricevette trattazione canonica nelle filosofie seicentesche ma fu anticipata, sul finire del Cinquecento, da Giordano Bruno. Lange ne apprezzò l'immanentismo cosmologico e l'adesione alla concezione atomistica, fondata sull'idea che la materia non sia soltanto possibilità (o potenza) ma anche una realtà produttiva ed efficiente: "Bruno [erfaßte] die Materie nicht als das Mögliche, sondern als das Wirkliche und Wirkende".[26] Nondimeno Lange esprimeva la sua perplessità riguardo al sincretismo filosofico di Bruno, recettivo di istanze che egli considerava aliene rispetto al materialismo deterministico, che era per lui l'unica impostazione coerente. Tali stravaganze includevano l'animazione universale, oltre al principio di una variabilità non-deterministica dell'essere in sé stesso. Bruno difendeva inoltre caso e finalismo contro la necessità causale. Altro elemento spurio, rispetto a moderne forme di razionalismo e materialismo, era per Lange lo stile poetico, perché secondo lui ammantava di oscurità misticheggiante (*mystisches Dunkel*) concezioni altrimenti illuminate e proto-illuministiche. Nonostante questi limiti, l'impostazione materialistica, ossia la considerazione della materia quale fonte di tutte le forme, valse

[25] Ibn Tufayl (1983) pp. 14-5. Cfr. Geoffroy (2005) pp. 729-30.
[26] Lange (1974) p. 201.

a Bruno l'apprezzamento di Lange, che lo volle addirittura superiore a Nicolò Copernico (1473-1543). L'astronomo della teoria eliocentrica sarebbe stato votato all'astrattezza matematica di matrice pitagorica piuttosto che ad un solido materialismo. Il cosmo policentrico post-copernicano di Bruno invece, costellato di infiniti sistemi planetari simili al nostro, avrebbe costituito non solo un ampliamento spaziale della concezione eliocentrica, ma anche un suo approfondimento sul piano filosofico-naturale, materialistico appunto.

Sono note le influenze platoniche nell'opera di Bruno, mutuate in particolare dalla filosofia emanativistica e della *coincidentia oppositorum* (la *complicatio* della molteplicità nell'unità) del *De docta ignorantia* di Nicolò Cusano (1401-1464).[27] Di quest'ultimo, Bruno elogiò la geometria speculativa sui paradossi dell'infinito, in cui raggio e arco, retta e curva, coincidono.[28] Nel cerchio infinito – e questa è tesi che dalla considerazione delle forme passa alla cosmologia infinitistica policentrica – ogni punto è centro, sicché il concetto di periferia scompare. Ciò permette di relativizzare il punto di vista dell'osservatore, oltre che di promuovere un principio di omogeneità cosmologica, secondo il quale gli stessi elementi presenti sulla Terra occuperanno tutti gli spazi, che un tempo si sarebbero distinti come sovralunari.[29] È questo, per Bruno, un principio copernicano, che permette di equiparare la nostra sede agli infiniti corpi celesti distribuiti nello spazio. La coincidenza degli opposti, fondamento della teologia filosofica di Cusano, viene recepita quale base di una filosofia naturale che, in particolare nel *De la causa* bruniano, assume la coincidenza di potenza e atto – e dunque l'infinità in atto dell'universo.

Bloch fu però maggiormente interessato alla filiazione aristotelica, avicenniana e averroistica, del suo pensiero. Di tali radici, Bloch esaltò soprattutto la diffusione della tesi dell'eternità del cosmo sia nella filosofia orientale sia in quella occidentale del mondo islamico medievale, basata sulla tesi secondo cui tutti i mutamenti attestati in natura altro non sono che una "eductio formarum ex materia".[30] La negazione della creazione divina sarebbe diretta conseguenza di tale impostazione. Bloch ritenne che essa

[27] Secchi (2006).
[28] Bruno (2002) I, p. 738. Cfr. Omodeo (2014b).
[29] Bruno (2002) I, pp. 509-10 e 730-1.
[30] Bloch (1972) p. 501.

trovasse un precedente antico in Alessandro d'Afrodisia (III sec. d.C.) e promuovesse una tendenziale coincidenza tra Dio e mondo. Sebbene tale identificazione non si possa trovare in maniera incontrovertibile negli autori da lui discussi – neppure in Bruno (!) – la tendenziale coincidenza di essenza ed esistenza e l'idea *omnem vim divinam in natura sita*[31] sarebbero sufficienti a qualificare questi pensatori quali antesignani del materialismo cosmologico.

Charles Wolfe ha recentemente riportato tale indirizzo materialistico alla tesi fondamentale: "tout ce qui existe est matériel".[32] Bruno espresse quest'idea nel *De vinculis in genere* (rimasto inedito e pubblicato a fine Ottocento), "Extra et sine materia nihil", in un articolo (n. 15) che merita di essere citato per esteso:

> Perfectissimum ergo est illud principium, quod fieri vult omnia et quod non ad particularem formam fertur et particularem perfectionem, sed ad universam formam et ad universam perfectionem. Eiusmodi est materia per universum, extra quam nulla est forma, in cuius potentia, appetitu et dispositione omnes sunt formae, et quae in partibus suis vicissitudine quadam omnes recipit formas, quarum simul vel duas recipere non posset. Et divinum ergo quoddam est materia, sicut et divinum quoddam esse forma, quae aut nihil est aut materiae quiddam est. Extra et sine materia nihil.[33]

Secondo quanto scrive anche Averroè, nella prima sezione della *Destructio destructionum philosophiae*, ogni cambiamento presuppone una materia-sostrato eterna (*subjectum* nella versione di Calo) che garantisca la possibilità del contingente (*innovatio*), dell'atto (*actum*) e del passaggio dall'uno all'altro:

> Cum non sit possibile ut sit possibilitas praecedens innovatum absque subjecto omnino; et impossibile est ut agens sit subjectum, nec possibile; nam possibile cum pervenit ad actum, aufertur possibilitas; igitur non remanet nisi quod sit subjectum possibilitatis res recipiens possibilitatem: et est materia. Materia autem non generatur, in eo quod est materia, quoniam indigeret alia materia, et procedet in infinitum.[34]

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[31] Ivi, p. 498.
[32] Wolfe (2020) p. 31.
[33] Bruno (1962) III, pp. 695-6.
[34] Averroè (1573) f. 34*r* (a). Cfr. Averroè (2015) pp. 152-3: "Dal momento che è assurdo si dia una possibilità antecedente a un contingente, senza sostrato, né è ammissibile che l'agente o lo [stesso] possibile siano il sostrato, poiché il possibile, una volta attualizzato, non è più possibile, cioè la materia. La materia, in quanto tale, non è soggetta al cambiamento, poiché altrimenti avrebbe a sua volta bisogno di un'[altra] materia, e così via all'infinito".

Una delle note più elogiative nei confronti di Averroè da parte di Bruno si incontra nel quarto dialogo del *De la causa, principio et uno* (1584), dedicato proprio alla materia quale 'soggetto' (ovvero sostanza e sostrato). Secondo Bruno, Averroè avrebbe inteso meglio di molti altri commentatori, inclusi i greci (Alessandro? Temistio? Simplicio? Filopono?), la funzione della materia quale universale generatrice di forme, nonostante non avesse accesso diretto all'Aristotele greco. L'unico difetto del grande commentatore sarebbe stata l'eccessiva aderenza all'insegnamento di Aristotele, da lui quasi divinizzato.[35] Nel dialogo bruniano, la figura di Dicsono osserva, riguardo alla non-dimensionalità della materia, che essa "non viene ad ricevere le dimensioni come di fuora, ma a mandarle a cacciarle come dal seno".[36] Teofilo, che nel dialogo rappresenta l'alter ego di Bruno, approva e glossa:

> Dice molto bene: oltre che è consueto modo di parlare di Peripatetici ancora, che dicono tutti l'atto dimensionale e tutte forme naturali uscire e venir fuori dalla potenza de la materia. Questo intende in parte Averroe, il quale quantumque arabo et ignorante di lingua greca, nella dottrina peripatetica però intese più che qualsivoglia greco che abbiamo letto: et arebbe più inteso, se non fusse stato cossì additto al suo nume Aristotele. Dice lui che la materia ne l'essenzia sua comprende le dimensioni interminate: volendo accennare che quelle pervengono a terminarsi, ora con questa figura e dimensioni, ora con quella e quell'altra, quelle e quell'altre, secondo il cangiar di forme naturali. Per il qual senso si vede che la materia le manda come da sé, e non le riceve come di fuora.[37]

Si tratta appunto di quella *eductio formarum ex materia* indicata da Bloch quale tesi centrale del materialismo cosmologico aristotelico, di cui Bruno è estimatore e prosecutore *sui generis*. In tempi più recenti, Rita Sturlese ha sottolineato l'importanza del sincretismo platonico-averroistico di Bruno, tramite l'immissione della *complicatio* cusaniana nella materia di Averroè, ma ha limitato la ricezione cosmologica di quest'ultimo alla critica del cosmo finito aristotelico (e averroistico).[38]

[35] Cfr. Canone (2003) pp. 79-120.
[36] Bruno (2002) I, p. 715.
[37] Ivi, pp. 715-6.
[38] Sturlese (1992) pp. 274 e 261-2.

### *3. Parole e sentimenti circa la materia secondo Bruno*

Bruno distingue tra il linguaggio e le verità che esprime, chiamandoli rispettivamente "paroli" e "sentimenti". Egli privilegia i secondi in quanto, per lui, la filosofia deve mirare al senso e non alla lettera degli autori di cui tratta. Un esempio di sapere che non si ferma alle parole, anzi se ne emancipa, è per lui la medicina di Paracelso il quale, pur non conoscendo né il greco di Galeno (ca. 130-ca. 200 d.C.), né l'arabo di Avicenna e neppure il latino, sviluppò una conoscenza dei farmaci e della medicina superiore a quella di molti dotti. Analogamente "un che non sa greco può intender tutto il senso d'Aristotele, e conoscere molti errori in quello".[39]

Tenendo presente questa distinzione, si può apprezzare la mirabolante varietà di termini e concetti, latini e volgari, che Bruno mobilita in riferimento alla materia all'inizio del quarto dialogo del *De la causa*. È il pedante aristotelico, la figura dialogica di Polihimnio, a parlare:

> Polihimnio: *Et os vulvae nunquam dicit: sufficit: id est, scilicet, videlicet, utpote, quod est dictu, materia* (la qual viene significata per queste cose) *recipiendis formis numquam expletur*. [...] La materia dumque di Peripatetici dal prencipe e dell'altigrado ingenio del gran Macedone moderatore, *non minus* che dal Platon divino et altri, or *chaos*, or *hyle*, or *sylva*, or massa, or potenzia, or aptitudine, or *privationi admixtum*, or *peccati causa*, or *ad maleficium ordinata*, or *per se non ens*, or *per se non scibile*, or *per analogiam ad formam cognoscibile*, or *tabula rasa*, or *indepictum*, or *subiectum*, or *substratum*, or *substerniculum*, or *campus*, or *infinitum*, or *indeterminatum*, or *prope nihil*, or *neque quid, neque quale, neque quantum*; tandem dopo aver molto con varie e diverse nomenclature (per definir questa natura) collimato: *ab ipsis scopum ipsum attingentibus*, femina vien detta; *tandem inquam (ut una complectantur omnia vocula), a melius rem ipsam perpendentibus foemina dicitur*. E *me hercle*, non senza non mediocre caggione a questi del Palladio regno senatori ha piaciuto di collocare nel medesimo equilibrio queste due cose: materia e femina.[40]

Nel *De la causa, principio et uno* Bruno sviluppa una concezione del reale dal carattere uni-trinitario, come egli indica sin dal titolo tripartito. La causa è la componente formale del reale, l'*anima mundi* che vivifica l'universo e tutti gli enti, agendo dal loro interno. Il molteplice è generato dalla materia – "nessun savio disse mai le forme riceversi da la materia come di fuora: ma quella

[39] Bruno (2002) I, p. 674.
[40] Ivi, pp. 700-1.

cacciandole come dal seno, mandarle da dentro".[41] Nondimeno il principio formale non è completamente riducibile ad essa. Neppure l'uno, l'unità prima e ultima nella quale "come nel proprio seme si contiene et implica la moltitudine delle conclusioni della scienza naturale",[42] è riducibile all'universo o ai contrari che tiene uniti. Il materialismo cosmologico di Bruno non è dunque 'perfetto' ma in esso permane qualcosa della teologia negativa cusaniana. Si può forse parlare di immanentismo monistico-diadico. La materia è però la protagonista del dialogo. Essa è principio attivo che fa scaturire da sé la varietà del reale:

> È dumque [la materia] una specie di soggetto, del qual, col quale e nel quale la natura effettua la sua operazione, il suo lavoro; et il quale è da lei formato di tante forme che ne presentano a gli occhi della considerazione tanta varietà di specie. E sì come il legno da sé non ha non ha nessuna forma artificiale, ma tutte può avere per operazione de legnaiolo; cossì la materia di cui parliamo da per sé et in sua natura, non ha forma alcuna naturale, ma tutte le può aver per operazione dell'agente attivo principio di natura.[43]

È l'idea averroistica dell'artigiano interno che, a differenza di una causa estrinseca, produce dal proprio intimo il suo oggetto (quale *factor in aliquo facto*).[44] Nella *disputatio tertia* della *Destructio destructionum*, in cui Averroè espone il suo punto di vista su materia, ordine, moti e gerarchie cosmiche, la differenza tra creazione divina e artigianale serve a distinguere tra un atto che continua a persistere, quale principio, in ciò che da esso dipende e un rapporto causale di esternalità, per cui il prodotto dell'artigiano, una volta fatto esistere, può persistere senza il suo produttore.[45] Nella *disputatio quarta*, queste considerazioni serviranno da base per distinguere causa, principio e unità del reale, in una sezione sul rapporto tra Dio e mondo e la dimostrazione del Creatore (*De declaratione, quod non possunt afferre rationem, quod sit efficiens mundo*) la cui impostazione aleggia nelle analoghe distinzioni bruniane del *De la causa*.

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[41] Ivi, p. 604.
[42] Ivi, p. 607.
[43] Ivi, p. 680.
[44] Averroè (2015) p. 113. Cfr. Averroè (1573) f. 24*v* (a).
[45] Averroè (2015) p. 202.

Gli studiosi bruniani saranno consapevoli che il termine 'soggetto' del passo citato traduce qui il latino *subjectum*, corrispondente al greco ὑποκείμενον, ovvero la sostanza in quanto sostrato delle qualità. Lungi dal concepirla come un *prope nihil*, Bruno attribuisce alla materia pienezza d'essere. Mentre nel *De vinculis in genere* egli si sarebbe spinto all'affermazione radicalmente materialistica "extra et sine materia nihil",[46] nel *De la causa* egli confessa piuttosto un'iniziale adesione al materialismo, appreso da fonti eterodosse, antiche e moderne, ma di essersene poi distanziato in nome appunto di una visione del reale come articolazione materiale-formale, sul cui sfondo aleggia nondimeno una fondamentale unità:

> Democrito dumque e gli Epicurei, i quali quel che non è corpo dicono esser nulla, per conseguenza vogliono la materia sola essere la sustanza de le cose, et anco quella essere la natura divina, come disse un certo arabo [Sic!] chiamato Avicebron [Salomon ben Gabirol], come mostra in un libro intitolato *Fonte di vita*. Questi medesmi, insieme con Cirenaici, Cinici e Storici, vogliono le forme non essere altro che certe accidentali disposizioni della materia et io molto tempo son stato assai aderente a questo parere, solo per questo, che ha fondamenti più corrispondenti alla natura che quei di Aristotele; ma dopo aver più maturamente considerato, avendo risguardo a più cose, troviamo che è necessario conoscere nella natura doi generi di sustanza, l'uno che è forma, e l'altro che è materia: perché è necessario che sia un atto sustanzialissimo, nel quale è la potenza attiva di tutto; et ancora una potenza et un soggetto, nel quale non sia minor potenza passiva di tutto: in quello è potestà di fare, in questo è potestà di esser fatto.[47]

Il concetto di materia di Bruno è duplice; essa è sia potenza attiva sia sostrato. Nella sua produttività infinita tende a coincidere con l'universo eterno ed illimitato: "[...] si conchiude l'eccellenza della materia, la quale cossì coincide con la forma, come la potenza coincide con l'atto".[48] Ciò avviene perché "l'universo è tutto quello che può essere".[49]

L'unicità dell'anima è principio altresì averroista. Essa è equiparabile alla luce, unica e rifratta da molteplici specchi. Il molteplice, viceversa, è prodotto della materia, quindi non può darsi distinzione e pluralità di individui separati da essa:

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[46] Bruno (1962) III, pp. 695-6.
[47] Bruno (2002) I, pp. 678-9.
[48] Ivi, p. 603.
[49] Ivi, p. 602.

Ponere autem animas absque materia multas numero est quid non notum ex opinionibus philosophorum. Nam causa multitudinis numeralis est materia apud eos; causa vero distinctionis in multitudine numerali est forma. Reperiri autem multa numero, eadem tamen forma absque materia, est quid dubium. Nam non cognoscitur, nec distinguitur individuum ab individuo aliquo attributo, nisi per accidens, quoniam reperitur aliud, quod communicat ei in attributo illo: distinguitur tamen individuum ab individuo ex parte materiae.[50]

Per quanto riguarda il rapporto tra Dio e mondo, Averroè critica il tentativo di al-Ghazali di separare principio e principiato, dato che essi si coimplicano quali corpo e ombra. All'ulteriore questione se Dio sia anteriore causalmente ma non temporalmente al mondo "sicut prioritatis hominis respectu umbrae suae", Averroè risponde che il paragone può risultare fuorviante, poiché si tratta di mettere in relazione temporale Dio, il quale si pone al di fuori del tempo, in quanto eterno, ed il mondo, la cui natura è di essere da sempre e per sempre nel tempo.[51] Andando oltre la concezione del mondo quale ombra di Dio, Averroè si distanzia pure da una concezione non-sostanziale della materia quale *prope nihil* o privazione di essere.

Sul fronte della refutazione dell'eternalismo emanativistico – ancorché di stampo platonico – il commentatore cristiano di Aristotele Giovanni Filopono (490-570 d.C.), nella sua critica di Proclo circa l'eternità del mondo, aveva censurato la definizione umbratile della materia. In un testo che circolò a stampa nel Rinascimento sia in greco (Venezia 1535) sia in duplice traduzione sulla base di un manoscritto marciano, *Liber duo de viginti adversus Procli successoris rationes De mundi aeternitate* (Venezia 1551 e Lione 1557), Filopono aveva rigettato il nesso di causalità tra corpo e ombra. Il capitolo rilevante (il V) è intitolato "Negat corporis umbram esse effectum, neque cum corpore simul esse, probat", poiché "umbra nihil aliud esse, quam luminis privationem".[52] Gli faceva seguito un capitolo (il VI) contro l'emanativismo: "Negat comparationem luminis ad solem esse eam, quae est Dei ad mundum".

Invece per Averroè e, in seguito, Bruno la materia ha carattere sostanziale. Si può leggere il famoso motto "umbra profunda sumus" che campeggia sul frontespizio del *De umbris idearum* (1582):

[50] Averroè (1573) f. 20*r* (b). Cfr. Averroè (2015) p. 95.
[51] Averroè (1573) f. 27*r*. Cfr. Averroè (2015) pp. 123-4.
[52] Philoponus (1551) f. 3*r*.

Protestatio:
*Umbra profunda sumus, ne nos vexetis inepti.*
*Non vos, sed doctores tam grave quaerit opus.*[53]

La profondità è d'altra parte attributo che Bruno riserva ad Averroè. Come esclama Burchio il pedante, nel *De l'infinito, universo et mondi* (Londra 1584), confrontandosi con la cosmologia infinitista post-copernicana presentata per bocca dell'avveduto filosofo Fracastoro:

Burchio: Andate andate, più dotti ch'Aristotele; via via, più divini che Platone, più profondi ch'Averroè, più giudiciosi de sì gran numero de filosofi e teologi di tante etadi e tante nazioni, che l'hanno commentati, admirati e messi in cielo. Andate voi che non so chi siete e d'onde uscite, e volete presumere di opporvi al torrente di tanti gran dottori.[54]

### *4. Infinito temporale e spaziale: pensare Averroè oltre Averroè*

Il nesso tra infinità spaziale e temporale – due capisaldi della filosofia bruniana – è un tema che emerge dal confronto di Averroè con al-Ghazali, specificamente nelle prime due sezioni[55] della *Destructio destructionum*. Nella prima Averroè difende l'eternità del mondo *ex ante* (la sua *antiquitas*, in latino); nella seconda la sua eternità *ex post*, ovvero il rigetto della possibilità dell'annichilazione che fa da controparte all'impossibilità della *creatio ex nihilo*. Averroè offre una buona sintesi del suo punto di vista in un passo nel quale, con riferimento all'autorità di Aristotele ("princeps Philosophorum, Aristoteles"), si apprende, con una certa ridondanza, che:

Et hic quidem modus infiniti non habet apud eos [philosophos] principium, nec finem, quare non est verum dicere de aliquo eius, quod finiatur, neque quod sit ingrediens ipsum esse in tempore praeterito, nec finiet, cum omne, quod finitur, iam incoepit; et quod non incoepit, non finietur, et hoc etiam est manifestum ex eo, quod principium, et finis sunt in praedicamento relationis. Quare sequitur ei, qui dici quod est infinitas in revolutionibus orbis in futurum, ut non ponat in eis principium. Nam omne, quod habet principium, habet finem; hoc autem non habet finem, ergo non habuit principium.[56]

[53] Bruno (1582) al frontispizio.
[54] Bruno (2002) II, pp. 113-4.
[55] *Disputationes* per Calonimo, rese come *problemi* in italiano da Campanini.
[56] Averroè (1573) f. 19*r* a-b. Cfr. Averroè (2015) p. 91.

Sarebbe stato Pietro Pomponazzi (1462-1525) ad esplicitare le conseguenze radicali per l'immortalità dell'anima del principio, tratto dal *De coelo* aristotelico, che tutto ciò che ha inizio ha pure fine. Il Bruno cosmologo si sarebbe concentrato sul rovescio dell'argomento: ciò che non ha inizio non ha fine. Che questo abbia implicazioni sul piano dell'infinità spaziale, fu al-Ghazali a metterlo in luce, come si apprende dalla refutazione di Averroè nella *Destructio destructionum*.

Secondo al-Ghazali, infatti, la difesa dell'eternità del mondo segue una linea argomentativa uguale a quella presupposta per dimostrarne la sua infinità spaziale. Si baserebbe infatti sui limiti dell'immaginazione, incapace di accettare che non vi sia stata alcuna realtà prima della creazione del mondo. Analogamente, non ci si riesce a figurare un corpo limitato senza che qualcosa si possa trovare oltre la sua estensione.[57] Inoltre, come i filosofi antieternalisti presuppongono che Dio non potesse dar principio al mondo prima del momento attuale della sua creazione, così al-Ghazali non intende perché essi debbano accettare che Dio non abbia potuto creare una sfera del mondo più ampia di un cubito, di due o di infiniti cubiti rispetto a quella data.[58] Pertanto, la difesa del tempo e dello spazio infiniti si coimplicano. Al-Ghazali ne deriva ulteriori conseguenze: egli si domanda se lo spazio esterno alla sfera sia vuoto o pieno. Nel secondo caso, si dovrebbe ammettere che vi sia una pluralità di mondi, dato che la materia esterna alla sfera in cui ci troviamo avrebbe luoghi naturali differenti dal nostro. L'alternativa, che lo spazio infinito esterno alla sfera delle stelle fisse sia vuoto è, a detta di al-Ghazali, più facilmente ammissibile.[59] Ma questa tesi si infrangerebbe contro altri capisaldi della fisica aristotelica, in particolare il rigetto della possibilità del vuoto. In definitiva, sia l'eternità dei cieli e dei loro moti, sia l'infinità dello spazio con i corollari della pluralità dei mondi o dell'esistenza del vuoto sarebbero erronei in filosofia. La considerazione di tali difficoltà dovrebbe indurre i filosofi ad ammettere creazione e finitezza del mondo.

Nelle sue repliche, Averroè accusa al-Ghazali di ignorare i principi della filosofia aristotelica e, in varie occasioni, di basarsi sulle fuorvianti filosofie

[57] Averroè (2015) p. 129.
[58] Ivi, p. 140.
[59] Ivi, pp. 144-5.

platonizzanti di al-Farabi (873-950) e Avicenna, oppure di essere un criptofilosofo, costretto dalle circostanze e dai tempi, ad atteggiarsi a critico dei filosofi.[60] Averroè riprende argomenti aristotelici noti, ad esempio la dottrina dei luoghi naturali, dell'ordine del mondo e della sua finitezza attestata dal moto delle stelle fisse. Se lo spazio fosse infinito, egli osserva, si darebbe l'infinito in atto, tesi inammissibile.[61] Spazio e tempo sono inoltre incomparabili perché istante e punto sono eterogenei. Equipararli come fa al-Ghazali è sofistico.[62] In definitiva, lo spazio ha carattere assoluto e non può essere relativizzato: i poli del mondo, così come l'alto e il basso corrispondono ad un'architettura unica e necessaria. Inizio e fine temporali, invece, non hanno carattere assoluto.[63]

Bruno affronta questi temi sia nei dialoghi filosofici italiani, in particolare nel *De l'infinito, universo e mondi*, sia nei poemi francofortesi, soprattutto nel *De immenso* (Francoforte 1590).[64] Sebbene l'obiettivo polemico di Bruno siano Aristotele – la sua dottrina dei luoghi, la finitudine del cosmo, l'idea della centralità e immobilità della Terra, dell'unicità del mondo – e gli Aristotelici – ad esempio i sostenitori della dottrina delle sfere celesti (compresi gli averroisti) – è chiaro che essi costituiscono pure un punto di riferimento argomentativo e sistematico. Numerose sono le eco dell'opera di Averroè e, indirettamente, di al-Ghazali. Ad esempio, Bruno afferma in linea con il secondo che l'immaginazione offre un argomento a favore dell'infinito attuale:

> Si comincia [nel primo dialogo del *De l'infinito*] a dimostrar l'infinitudine de l'universo e si porta il primo argumento tolto da quel, che non si sa finire il mondo da quei che con l'opra de la fantasia vogliono fabricargli le muraglia.[65]

La dimostrazione dell'infinito attuale, dell'universo senza confini spaziali, si fonda sulla ragione e non sui sensi, come Bruno sostiene al principio del *De*

[60] Ivi, p. 157.
[61] Ivi, p. 170.
[62] Ivi, p. 133.
[63] Ivi, p. 136.
[64] La letteratura sulla cosmologia bruniana è vasta, ma si faccia riferimento soprattutto all'opera di Miguel Ángel Granada. Tra i suoi molti studi si veda in particolare l'introduzione all'edizione spagnola del *De la causa*: Granada (2018). Si veda anche Michel (1962).
[65] Bruno (2002) II, p. 11.

*l'infinito*.[66] Ma anche la fantasia svolge un ruolo importante, ad esempio nel fornire metafore o immagini utili all'esercizio della ragione. Questo vale, tra l'altro, per il cosiddetto argomento di Archita: se ci si trovasse all'estremità del mondo, che gli Aristotelici vorrebbero finito, e si allungasse un braccio, questo dove verrebbe a trovarsi?

La dottrina dei luoghi è uno degli obiettivi polemici di Bruno. Le direzioni assolute, alto e basso, gravità e leggerezza, non esistono per lui. Sono mere fantasie che svaniscono con l'aprirsi della possibilità dell'universo infinito.[67] Nella polemica tra Averroè e al-Ghazali, sulla questione della difendibilità dello spazio infinito e della relatività dei luoghi, Bruno (mi sia concessa la congettura) si sarebbe schierato dalla parte del secondo, anche se la rotazione assiale della Terra post-copernicana gli offrì argomenti ulteriori a supporto della possibilità di estendere lo spazio oltre una supposta e ormai inutile sfera delle stelle fisse.

Una reminiscenza della *Destructio destructionum* si può evincere nella questione che segue la 'distruzione' del finitismo cosmologico: "Resta ora vedere se è cosa conveniente che tutto il spacio sia pieno, o non".[68] La risposta di Bruno va oltre quella di entrambi i filosofi arabici,[69] fondandosi su un principio di pienezza secondo cui l'esistenza dell'infinito è l'unica opzione compatibile con l'onnipotenza e bontà di Dio:[70]

> Come sarebbe male che questo spacio non fusse pieno, cio è che questo mondo non fusse; non meno, per la indifferenza, è male che tutto il spacio non sia pieno; e per consequenza l'universo sarà di dimensione infinita, e gli mondi saranno innumerabili.[71]

I corollari dell'eternità del mondo di al-Ghazali si trovano tutti difesi da Bruno: oltre all'infinità spaziale, anche la pluralità dei mondi (anzi dei

[66] Cfr. ivi, p. 35.
[67] Ivi, pp. 68-9.
[68] Ivi, p. 40.
[69] Accolgo l'indicazione di Koert Debeuf di utilizzare l'aggettivo 'arabico' anziché 'arabo' o 'islamico' per riferirmi a tale tradizione per includere persiani, ebrei ed altri filosofi i quali, sebbene non arabi o islamici contribuirono alla medesima tradizione filosofica. Cfr. Debeuf (2025) p. 10.
[70] Cfr. Granada (1994).
[71] Bruno (2002) II, p. 41.

sistemi solari)[72] e, per ultimo, il vuoto. Questo è però riconcettualizzato come etere, pienezza infinita d'essere dello spazio illimitato.

Di Averroè – o forse sarebbe meglio dire, di Aristotele, che il filosofo arabico difende – Bruno accoglie però la necessità dell'universo imperituro, coeterno rispetto al suo principio. Cremonini, dopo di lui, avrebbe riassunto la posizione averroistica, da lui stesso difesa quale corretta interpretazione di Aristotele, in tono lapidario: "Philosophus non ponit in Deo voluntatem".[73] Bruno esprime il concetto in maniera più convoluta, argomentando sulla scia di Platone che Dio non può essere né ozioso né invidioso, che quindi dovrà necessariamente creare l'universo infinito, immagine atta a rappresentare *extensive* ciò che nel principio unitario si dà *intensive*. Più che assenza di libertà, quest'ultima per Bruno coincide con la necessità. Così afferma la figura di Fracastoro nel *De l'infinito*:

> Certo non è soggetto di possibilità o di potenza quello che giamai fu, non è, e già mai sarà; e veramente se il primo efficiente non può voler altro che quel che vuole, non può far altro che quel che fa. E non veggo come alcuni intendano quel che dicono della potenza attiva infinita, a cui non corrisponda potenza passiva infinita; e che quello faccia uno e finito, che può far innumerabili ne l'infinito et inmenso: essendo l'azzion sua necessaria, perché procede da tal volontà, quale per essere immutabilissima, anzi la immutabilità istessa, è ancora la istessa necessità; onde sono a fatto medesima cosa libertà, volontà, necessità, et oltre il fare col volere, possere et essere.[74]

Ecco quindi che l'immanentismo cosmologico, il materialismo della cosiddetta "sinistra aristotelica" di Bloch, emerge dall'opera di Bruno come in quella di Averroè quale eternità necessaria del mondo e rapporto co-eterno tra principio e principiato. Bruno però recepisce, rigetta e fonde gli argomenti dei suoi predecessori. Il fatto che i due filosofi arabici dissentissero – l'uno difendendo eternalismo e finitezza del mondo, l'altro connettendo infinità spaziale ed eternità, per rigettarle entrambe – giustifica forse la loro recezione come filosofi degni di pari stima da parte di Bruno. Nel dialogo *De gli eroici furori*, egli li porta ad esempio di una razionalità che si distacca dalle "filosofie volgari le quali son dalla moltitudine tanto più stimate vere, quanto

[72] Granada (2007).
[73] Cremonini (1613) p. 385.
[74] Bruno (2002) II, p. 49.

più accostano al senso comune".[75] L'atteggiamento di Averroè viene esteso ad al-Ghazali anche per quanto riguarda il rapporto tra ragione e religione:

> [...] per questo disse Alchazele filosofo, sommo pontefice e teologo mahumetano, che il fine delle leggi non è tanto di cercar la verità delle cose e speculazioni, quanto la bontà de costumi, profitto della civilità, convitto di popoli; e prattica per la commodità della umana conversazione, mantenimento di pace et aumento di republiche. Molte volte, dumque, et a molti propositi, è una cosa da stolto et ignorante, più tosto riferir le cose seconda la verità, che secondo l'occasione e comodità.[76]

Tale considerazione di al-Ghazali, visto quale cripto-filosofo (quasi un 'libertino') costretto dalle circostanze a presentare argomenti in maniera talvolta debole, è in linea con quanto suggerisce in alcuni passi anche Averroè.[77] L'idea di adattare il linguaggio alle capacità dell'uditorio viene riproposta da Bruno, in chiave post-copernicana, per difendere il moto terrestre e la centralità del Sole rispetto ai pianeti (e degli infiniti soli-stelle rispetto alle loro 'terre'). Non sarà riprovevole per il seguace di Copernico dire nella quotidianità "Nasce il sole e tramonta" ma in ultima istanza occorrerà adattare il significato delle parole, anche quelle dei testi sacri, alla verità naturale.[78] Il filosofo non deve limitarsi ai "paroli", ma comprenderne i "sentimenti".

### *5. Animazione universale*

Resta da affrontare la questione dell'animazione universale. Per Averroè, da cui siamo partiti, i corpi celesti sono grandi animali semoventi, dotati di un'anima che agisce internamente. In ciò si differenziano da quegli enti che sono determinati estrinsecamente, ad esempio il ferro attratto dal magnete. Dalla spinta interna al moto derivano le regolarità dei moti celesti.

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[75] Ivi, p. 729.
[76] Bruno (2002) I, pp. 523-4. Sul complesso rapporto tra filosofia e legge religiosa in Averroè si può fare riferimento all'introduzione di Campanini ad Averroè (2018) pp. 5-50.
[77] Circa la lettura etico-politica di Averroè da parte di Bruno si veda Campanini (2016).
[78] Bruno (2002) I, p. 524. Cfr. Omodeo (2014a) cap. 4.

Consydera quod quilibet orbis orbium caelestium est vivens: quoniam sunt habentes corpora determinatae mensurae, et figurae, et moventur ex se ex partibus determinatis, non ex quacunque sit: et omne quod est tale, est vivens necessario.[79]

Per Averroè i cieli sono costituiti di una quintessenza incorruttibile. Inoltre, come si evince dal *De substantia orbis* e dai commentari al dodicesimo libro della *Metafisica*, i cieli sono costituiti da un sistema di sfere concentriche diafane, che trasportano gli astri a noi visibili (il sole, la luna, gli 'altri' pianeti e le stelle fisse) con moti circolari secondo direzioni differenti (essendo le sfere incardinate su diversi poli) che producono la complessa fenomenologia astronomica. Pertanto i grandi animali celesti di Averroè sono sfere materiali semoventi in quanto provviste di anime. Tale concezione è in linea con interpretazioni precedenti di Aristotele, come quella di Alessandro di Afrodisia. Il commentatore antico aveva presentato un'influente sintesi cosmologica di temi aristotelici derivati da *Fisica* VII-VIII, *Metafisica* XII e *De anima* III, 5: la dimostrazione dell'esistenza del primo motore immobile a partire dai moti circolari uniformi delle sfere, e l'identificazione di quest'ultimo con l'intelletto agente. Nei contesti islamici e monoteisti in genere, primo motore immobile e intelletto agente sarebbero stati posti in relazione con il Dio unico della religione rivelata.[80] Fonte di riferimento in astronomia fu il *Mabadi' al-kull* (pseudo)alessandrino (*Sui principi del tutto*), le eco delle cui tesi aleggiano sulle cosmologie omocentriche andaluse del dodicesimo secolo, in Averroè come in Alpetragio (o al-Britruji) (m. ca. 1204), e nei loro emuli rinascimentali, tanto neoplatonici, come nel caso di Girolamo Fracastoro (1478-1553), quanto peripatetici, come Giovanbattista Amico (ca. 1511-1538).[81]

Nel *De substantia orbis* Averroè stabilisce che i corpi celesti sono provvisti di anima, condizione necessaria dei loro moti motivati finalisticamente da un desiderio intellettuale indirizzato al primo motore immobile. I moti circolari degli astri imiterebbe appunto il più alto principio, che è eterno, attraverso rivoluzioni perenni che ne offrono una rappresentazione mobile nel

[79] Averroè (1573), f. 24*r* (a). Cfr. Averroè (2015) p. 111.
[80] Omodeo (2020).
[81] Cfr. Sabra (1984) e Di Bono (1990). Sull'autenticità o meno del *Mabadi' al-kull* si veda l'introduzione di Genequand ad Alessandro d'Afrodisia (2001).

tempo. Averroè pone altresì una pluralità di intelletti separati, uno per ciascuna sfera. Il suo estimatore rinascimentale Pomponazzi negò che l'animazione dei cieli dimostrasse la loro composizione ilemorfica, perché gli parve incompatibile con la loro incorruttibilità.[82] Per questo considerò l'animalità dei cieli metaforica, a differenza di altri interpreti e commentatori del commentatore, tra cui il suo acerrimo avversario su questioni *de immortalitate animae*, Agostino Nifo (1470-1538).[83] Averroè stesso sostenne che la composizione materiale-formale dei corpi celesti differisce rispetto a quella dei corpi sublunari perché questi ultimi sono soggetti a nascita, accrescimento, decrescita e morte mentre i primi sono imperituri e soggetti soltanto a moto locale. Se la materia è potenzialità incompiuta mentre la forma è principio teleologico di attualizzazione, non si potrà affermare che i corpi celesti siano composti nello stesso senso in cui lo sono quelli terreni. Come si legge nella traduzione latina di Abramo di Balmes (1440-1523) del *De substantia orbis*, il programma dichiarato di Averroè è di esaminare la problematica della natura dei cieli:

> In hoc tractatu igitur perscrutaturi sumus de his duabus naturis, ex quibus corpus coeleste componitur, utrum sint similes illis naturis, ex quibus generabilia componuntur, quarum una dicitur forma, altera materia, scilicet utrum haec materia, et forma, quae sunt hic, sint eadem cum illis, aut diversa, secundum magis, et minus. Sed, si sint diversae specie, tunc aequivoce dicitur de eis corporeitatis, aut secundum prius et posterius.[84]

Averroè affronta per esteso il problema nella terza sezione della *Destructio destructionum*, dove spiega che i corpi celesti sono semplici, non già sinolo di materia e forma, altrimenti sarebbero corruttibili.[85] Invece, nessuna attualizzazione o divenire possono avere luogo nella sfera celeste, ad eccezione del

[82] Cfr. Pomponazzi (1996) p. 201, *Quaestio de materia coeli Petri Pomponatii Mantuani*: "Queritur an celum sit compositum ex materia et forma, et videtur quod non, primo quia omne compositum ex materia et forma est generabile et corruptibile, celum est ingenerabile et incorruptibile, ergo non est compositum ex materia et forma. Maior est nota ad sensum, minor vero est Aristotelis, I *Caeli* 22".
[83] Pomponazzi (2013) p. 990: "Est et differentia inter Intelligentiam et intellectum humanum in dependendo ab organo, quoniam humanus recipit et perficitur per obiectum corporale, cum ab eo moveatur, at Intelligentia nihil recipit a corpore caelesti, sed tantum tribuit".
[84] Averroè (1573) f. 3*r* (a-b).
[85] Averroè (2015) pp. 257-60.

moto locale.[86] Ciononostante, i cieli agiscono quali causa di mutamento nella sfera terrestre, attraverso i loro influssi. Per la precisione, ne sono *causa universale*.[87] Gli astri stessi sono grandi animali celesti così come la sfera mondana, nella sua totalità, è un macro-vivente.[88] Per una riproposizione seicentesca dell'argomento si può fare riferimento ancora una volta a Cremonini, oltre al suo allievo Giulio Cesare Lagalla (1571-1624), la cui difesa averroistica di un'animazione universale dei cieli allarmò i gesuiti e altri censori romani.[89] Secondo quanto si legge nella *Disputatio de coelo* (1613) del maestro e nella *De coelo animato disputatio* (difesa a Roma nel 1613 e pubblicata ad Heidelberg nel 1622) del seguace, il cielo è un essere animato che ha in se stesso i principi del moto.[90]

Nel contesto peripatetico padovano e bolognese del Cinquecento si discettò a lungo sulla natura dei cieli oltre che sulla loro animalità, ovvero del ruolo e natura dell'anima e dell'intelletto dei corpi celesti, per motivi che riguardano non solo la fisica celeste ma anche la polemica alessandrista sull'immortalità ovvero mortalità delle anime.[91] Nifo, in *De intellectu* (1503), nel capitolo II 22, sostenne che i cieli sono provvisti di anime, da lui dette *animae animalium coelestium*, distinte da altri due generi d'anima, che sono: la forma degli elementi, inferiore ed inseparabile dalla materia, e l'anima umana, superiore in quanto funge da collegamento tra la temporalità e l'eternità.[92] Anche per Cremonini, nel secolo successivo, il tutto è un animale in quanto composto di parti eterogenee e funzionali in movimento. Il principio per lui è chiaro: "Arguere ab organizatione ad animationem est arguere ab eo, quod est maxime Aristotelicum".[93] Prima di lui, il filosofo e medico peripatetico di vocazione platonica Fracastoro, aveva sostenuto che il mondo è

[86] Ivi, p. 280.
[87] Ivi, p. 238. Sulla recezione della dottrina averroistica della causalità celeste nel Rinascimento si veda Holland (2010).
[88] Averroè (2015) p. 217 (corpi celesti animali) e p. 241 (sfera celeste come animale macrocosmico).
[89] Galluzzi (2014) pp. 185-90.
[90] Cremonini (1613) p. 87: "Coelum est animatum et habet motus principium. Sunt verba Aristotelis 2. De Coelo, textu 13". Cfr. Lagalla (1622) f. *2*r*: "iudicio et censura virorum gravissimorum".
[91] Garin (1966) pp. 526-7.
[92] Niphus (2011).
[93] Cremonini (1616) p. 77.

vivificato dall'*anima mundi*. Nel *De anima* (postumo, 1555), distingueva tre generi di corpi organici, dotati di anima: il mondo nella sua totalità, i corpi celesti e, in terzo luogo, piante e animali:

Tria autem corporum organicorum videntur genera. Primum est universum ipsum, quem mundum dicimus: aliud vero coelestes orbes; tertium plantae, et animalia. Quod enim mundus ipse organicum quoddam corpus existat, manifestum est ex eius partibus [...]. Quare et hoc universum, tanquam animal quoddam perfectissimum, vivere, et anima sua regi, atque agitari maiores nostri omnes fere dixere: ac multa quidem de mundi anima theologizantes academici tradidere. [...] quod vero et coelestes orbes organica quoque sint corpora, manifestum est, quoniam idipsa dissimilaribus constant partibus, aliis quidem densioribus, aliis rarioribus, et magnitudine, et ordine, et situ differentibus: vero consensu tanto, tam mira virtute ad certos fines, et operationes constitutis, ut omnia, quae in universo sunt, corpora inde gubernentur. Quae vero eos orbes agitat, et regit, Anima ipsorum est, quam Philosophi intelligentiam et mentem vocant. Non est autem haec mens, mundi anima, sed particularis quaedam natura, quae et esse, et virtutem recipit a mundi anima, operatur autem secundum illam, quam recepit, virtutem.[94]

La concezione di Bruno pare debitrice nei confronti di una simile impostazione. Non a caso egli sviluppa la tesi dei pianeti quali animali celesti, con riferimento al *Timeo* platonico, nel secondo dialogo del *De la causa*, dedicato all'anima quale principio vivificatore dell'universo che agisce in esso al contempo come causa efficiente, formale e finale.[95] Ma la visione animale dei corpi celesti non è per lui prerogativa platonica, bensì ampiamente condivisa dai filosofi di differenti scuole. Sulla base di quanto sin qui discusso, non sorprenderà dunque leggere in Bruno quanto segue:

Non è filosofo di qualche riputazione, anco tra Peripatetici, che non voglia il mondo e le sue sfere essere in qualche modo animate.[96]

Viva è per Bruno la realtà nella sua interezza, l'universo infinito, ovunque agitato *dall'anima mundi*. Come si legge nel secondo dialogo del *De l'infinito*:

[94] Fracastoro (1574) ff. 149*v*-150*r*.
[95] Bruno (2002) I, pp. 659 e 662-4.
[96] Ivi, p. 658.

Oltre dico, che questo infinito et inmenso è uno animale, benché non abia determinata figura, e senso che si referisca a cose esteriori: perché lui ha tutta l'anima in sé, e tutto lo animato comprende, et è tutto quello.[97]

## *6. Conclusioni*

In questo saggio ho evidenziato la presenza di temi averroistici in un ambito che non ha ancora ricevuto sufficiente attenzione: le tesi cosmologiche di pensatori rinascimentali i quali, attribuendo un rilievo senza precedenti alla materia, difendendo l'eternità del mondo e la sua animazione intrinseca, mettevano in causa capisaldi della religione rivelata, a partire dall'idea di creazione dal nulla. Accogliendo l'invito di Bloch ho considerato tali concezioni quali momenti di una più ampia storia del materialismo cosmologico, soffermandomi sulla figura centrale di Giordano Bruno nel suo rapporto con le suddette tematiche aristotelico-averroistiche.

Se l'eternità del mondo è tesi prettamente averroistica, quella della sua infinità spaziale è piuttosto tesi in rotta con Averroè, che però viene discussa in negativo nella polemica con al-Ghazali della *Destructio destructionum*. Questi aveva infatti equiparato l'argomento di una temporalità mondana senza principio né fine alla concezione infinitistica dello spazio. Bruno elogia e, al contempo, si distacca da entrambi i filosofi arabici, promuovendo una nuova concezione del cosmo post-copernicano che assume l'eternità e necessità dell'universo assieme alla sua estensione e vitalità sconfinata. Nel suo pensiero si tinge inoltre di platonismo l'idea, diffusa tra gli averroisti, dell'animalità dei pianeti e dell'universo tutto, permeato dall'*anima mundi*. La materia acquista preminenza eccezionale quale sostanza eterna, fonte inesauribile di forme, sostrato di tutti gli enti, potenzialità sempre attuata estensivamente. Se è legittimo inserire questa filosofia e cosmologia, incluse le sue radici arabiche, nel solco di una vasta storia del materialismo, alcuni caveat sono stati necessari. Il pensiero di Bruno ha il carattere di un immanentismo dell'unità nella sua articolazione diadica, materiale e formale, piuttosto che di un materialismo in senso compiuto. L'uno non coincide mai per lui con l'universo anche se l'eternità e l'infinità dell'uno si specchia nell'altro.

[97] Bruno (2002) II, p. 85.

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ENRICO PASINI

# ARISTOTE RENCONTRE L'INFINI


## Abstract

In the Aristotelian tradition, the relationship with Aristotle's treatment of infinity has always been ambiguous for reasons connected to theology, creation, and natural philosophy. Scholastic philosophy generally rejects the existence of real infinities in the created world, while recognising potential infinities in the doctrine of the continuum, in line with Aristotle's views on this matter. According to this view, there is no infinite power or greatness in the world. Nevertheless, notable developments emerge in which this orthodoxy is questioned, and the possibility that God could produce an actual infinity in terms of quantity, number, or intensity becomes widespread among later scholastics – such infinist approaches sometimes drawing on highly interpretative readings of Aristotle's own thinking. Alongside these examples of internal development, the concept of the natural infinite – the presence of infinity in nature – becomes a source of tension between the new philosophy and Aristotelianism at the beginning of the modern era, even when a general framework or vocabulary of Aristotelian descent is maintained. Such a multifaceted subject could not be exhausted in a few pages, so we will only discuss two emblematic examples: a 16th-century literary celebrity and a 17th-century mathematician and philosopher. Despite being as different as possible, they are both signs of an interesting dependence on Aristotelian concepts and terminology, even while moving away from and fundamentally distorting the framework they were cast in.



## Keywords

Aristotelian Tradition, Natural Philosophy, Infinite,
Béroald de Verville, Leibniz, Buridan, John Mair



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## English Title

Aristotle Meets Infinity

« L'examen de l'infini présente des difficultés ;
à le nier et à l'affirmer on en rencontre de nombreuses »
(*Phys*. III 4.203b30-32 ; Aristote 2002, I, p. 98).

## *1. Homo fuit*

Au cours du dernier quart du XIII[e] siècle, Siger de Brabant, aristotélicien hérétique jadis militant et maintenant vieillissant, se demande comment réfuter un célèbre argument en faveur de l'unité de l'intellect (position qu'il qualifie à present d'hérétique et d'irrationnelle) et démontrer que, au contraire, « intellectum numerari et multiplicari multiplicatione humanorum corporum ».[1] Il souhaite également dissocier cette question de celle de l'éternité de l'espèce humaine, qu'il soutient en restant fidèle à Aristote sur ce point, comme il a toujours essayé de le faire.[2] Or, si l'intellect se multiplie, il y aura autant d'âmes noétiques qu'il y a d'hommes ; donc, si le genre humain est éternel, il existera une infinité d'âmes séparées.[3] Par contre, Siger lui-même est fermement convaincu que l'infini n'existe pas, ni ne peut exister dans la nature,[4] puisque Aristote rejette l'infini en acte. En craignant que ce dernier, d'un autre côté, puisse avoir soutenu l'intellect unique *ex verbis suis*,[5] il va conclure pour se dégager : « Qualitercumque autem senserit, homo fuit et errare potuit : firmiter tenendum quod hominum multiplicatione multiplicatur ».[6]

[1] « L'intellect est numeroté et multiplié par la multiplication des corps humains » (Siger 1972, q. 27, p. 112).

[2] S'il est vrai, comme l'écrivait Mandonnet (1911, p. 189), que « l'ambition de Siger était de reproduire exclusivement la pensée d'Aristote ».

[3] Parmi les nombreuses doctrines condamnées à Paris en 1270 et 1277, les plus liées à l'infini sont précisement celles de l'éternité du monde et du nombre des intelligences humaines dérivant de l'éternité de l'espèce humaine. Bien plus tard, aux XVII[e], on raisonnera au contraire à partir de l'infinitude de l'univers, des mondes et des esprits, pour démontrer l'éternité du monde, comme dans le manuscrit pseudo-Malebranchien *De l'infini créé*, où l'on s'approprie les thèses infinitistes de l'Oratorien dans le but de les subvertir (voir Del Prete 2006).

[4] Le continu ne peut pas non plus être infini ; cf. Steenberghen (1977) pp. 324-5. Par ailleurs, l'essence de l'infini est inaccessible à la compréhension : « verum est quod quantitatem aliquam contingit intelligere per privationem terminorum, et per consequens infinitum. Hoc autem est intelligere infinitum per quandam proprietatem sibi accidentem. Intellectu tamen essentiali impossibile est essentiam infiniti intelligere » (Siger 1983, II, q. 22, p. 67).

[5] Siger (1972) q. 27, p. 115. On retrouve la même remarque chez Thomas d'Aquin (*De un. int.* V), qui y propose d'ailleurs une solution différente.

[6] « Mais, quoi qu'il en pense, il était un homme et pouvait se tromper : il faut bien admettre qu'avec la multiplication des hommes, les intellects se multiplient » (*ibid.*).

Mais avant de s'enfuir ainsi, avec ce coup de coude inattendu au Stagirite, il avait courageusement essayé de montrer qu'Aristote aurait peut-être pu accepter une infinité surnaturelle :

> forte non est inconveniens apud Aristotelem quod sint infiniti actu intellectus [...] nam in tertio Physicorum cum negatur infinitum in actu, sicut ipse ibi testatur, considerationem non facit nisi in rebus sensibilibus. Si enim in separatis entibus, cuiusmodi sunt intellectus separati, sit infinitum, ad altiorem scientiam quam naturalem pertinet.[7]

C'est vrai qu'Aristote avait dit à propos de l'étude de l'infini, « qu'un tel examen convient aux physiciens », plus précisement à la science dont il s'agit dans la *Physique*.[8] C'est dans la philosophie naturelle que l'on étudie la nature du changement, du temps, du continu – et, en rapport avec toutes ces notions, la nature de l'infini (est-il substance, attribut essentiel, ou autre chose ?) ainsi que ses différentes acceptions : d'abord, « ce qui ne peut par nature être parcouru », une formule très connue, mais plus particulièrement les combinaisons variées de « ne pas pouvoir être parcouru » et d'« être sans fin ». S'y ajoute, ce qui est très important dans le cas du continu, qu'il y a infini « ou par composition ou par division », ou par les deux à la fois.[9]

Aristote précise toutefois que l'infini en acte semble ne pas exister ; un infini « séparable des choses sensibles, donc une chose en soi infinie, est impossible » (*Phys*. III 5.204a8-9 ; Aristote (2022) p. 98). Ni du point de vue logique, ni physique, il peut exister des corps ou des nombres infinis ; ni un corps simple, ni un corps composé ne peut être infini.

Quant au continu, l'infini s'y obtient par « composition » (addition, multiplication) ou « retranchement » (subtraction, division), dans les deux cas en puissance : « Que la grandeur n'est pas infinie en acte, on l'a dit ; mais elle l'est par division, car il n'est pas difficile de ruiner les lignes insécables »,

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[7] « Il n'est peut-être pas inopportun pour Aristote qu'il existe réellement des intellects infinis [...] car, au troisième livre de la Physique, lorsqu'il nie l'infini en réalité, comme il l'atteste lui-même, il ne considère rien d'autre que les choses sensibles. Car s'il y a de l'infini dans les êtres séparés, tels que les intellects séparés, cela relève d'une science supérieure à la science naturelle » (*ibid.*).

[8] *Phys*. III 4.202b36-203a1 ; Aristote (2002) p. 97.

[9] *Phys*. III 4.204a3-7 ; Aristote (2002) p. 98. Les définitions du continu « se trouvent utiliser souvent la notion de l'infini, le continu étant divisible à l'infini » (*Phys*. III 1.200b18-20 ; Aristote, 2002, p. 89).

c'est-à-dire de confuter les atomes mathématiques étendus.[10] Cette puissance ne peut pas gagner vraie existence : « l'infini n'est pas en puissance en un sens tel qu'il doive ultérieurement exister en acte à titre de réalité séparée ; mais il est en puissance pour la connaissance seulement ». Ce n'est que le fait que la division ne s'arrête jamais qui confère à l'infini une existence potentielle, mais pas une existence séparée.[11]

Le livre XI de la *Métaphysique* présente notoirement un traitement presque identique de l'infini, et c'est de la *Métaphysique* que l'on apprend qu'il y a apparemment un primat de l'infini selon la grandeur, le temps n'étant pas infini en soi, mais selon le mouvement, et le mouvement l'est selon la grandeur.[12] Mais dans le même livre on apprend qu'un des genres des sciences théoretiques est le « théologique » (K 7.1064b3) : la science de l'être séparé et immobile, qui est peut-être à son tour la première partie de la science qu'on souhaite et cherche dans cet ouvrage, décrite dans le livre IV (Γ 2.1003b10-36).

### *2. Le jeu des alternatives et des détournements*

La notion de la divinité unique chrétienne, tout-puissante créatrice du monde fini, a nécessairement un pied dans l'infini, « concept qu'en un sens Aristote a protégé de toute mathématicité, préparant ainsi qu'il soit, par les chrétiens, épinglé au seul Dieu » (Badiou 2016, 22), et particulièrement revendique l'existence de l'infini surnaturel. Mais après que les Pères des Églises chrétiennes avaient rendu Dieu infini,[13] le concept était appelé à subir une réorganisation qui permettrait toutefois de préserver la distance entre le Créateur et les créatures : « Illum infinitum et magnum excessum, quem habet Deus respectu creaturarum », comme le dit un systématiseur tel qu'Arriaga (1632, *Log*. XI, 4, p. 159).[14]

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[10] *Phys*. III 6.206a16-18 ; Aristote (2002) p. 104.
[11] *Metaph*. Θ 6.1048b14-15 ; Aristote (2000) II, p. 501.
[12] Voir *Metaph*. K 10.1067a33-36.
[13] Voir par exemple l'étude classique de Mühlenberg (1966).
[14] On peut supposer soit qu'il s'agit de délivrer l'infini de son caractère d'imperfection pour l'associer à la perfection de Dieu, soit plutôt de l'associer positivement à la plénitude de la réalité. Arbib (2009) propose pour cette dernière démarche, avant Scot ou Suarez, le nom d'Henri de Gand (voir aussi Porro 1993) ; la première, qui demande la solution du rapport

L'identification de l'infini et de la plénitude de la réalité va produire, entre autres, une différenciation entre plusieurs sens du mot :[15] d'une part, l'infini un, absolu, catégorématique, *simpliciter*, en acte ; d'autre part, des infinis qualifiés, syncatégorématiques, *secundum quid*, en puissance. Cela laisse tout de même ouvertes une foule de questions, aux sujets plus ou moins provocants,[16] dont deux sont plus déterminantes dans la transformation de cette notion. L'une insiste sur la séparation des infinités et maintient une certaine compatibilité avec le traitement classique. Si l'infini implique la grandeur, *cum infinitum quantitatem sequatur*, de quelle façon Dieu peut-il être infini ? Thomas présente plusieurs solutions, dont l'une fait intervenir, comme dans Siger, la grandeur spirituelle : celle de Dieu est infinie dans le seul sens négatif de rien lui manquer.[17] Par ailleurs, l'infini positif est *per se* singulier, en dehors de tous les autres êtres (*S. Th.* I, 7, 1).

L'autre question porte plutôt sur la continuité et s'appuie sur une notion strictement chrétienne. Si le créateur est absolument infini, la création doit-elle

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de la théologie chrétienne à la pensée grecque, remonte au moins à Bonaventure et Thomas d'Aquin (voir Gravil 2009).

[15] Le but en étant, selon une ample analyse d'Antoine Colé (2002, p. 204), d'assurer, face à l'introduction de l'infini, la consistance théologique dans quatre domaines différents : « la compatibilité de l'infini et de la simplicité », « de l'infinité et de la causalité finale de Dieu », « de l'infini et de l'être-distinct de Dieu », « de l'infinité divine et de la connaissance de soi de Dieu ». Nous nous concentrerons pourtant sur les aspects qui concernent plutôt la création et l'infini dans la nature créée – un débat suffisamment différent, qui semble aussi ne pas se développer au même rythme.

[16] La capacité infinie de l'âme à comprendre et à aimer Dieu, par exemple, qui semble être demandée par la nature infinie de Dieu comme son objet, et qui par contre la rendrait capable de subir une punition infinie et donc de se purger de ses péchés en moins d'un instant au purgatoire (voir l'article *Utrum capacitas animae sit infinita* de Richard Kilvington dans Michałowska 2021, pp. 77 suiv.). De même l'amour pour Dieu, tout comme la vision béatifique et l'espoir du fidèle, ayant un objet ou un principe infini, s'avèrent infinis, comme le discute Thomas lui-même (voir par exemple *S. Th.* II$^{a}$ II$^{ae}$, q. 17). Et les péchés rachetés par Jésus-Christ, qui a versé un sang d'une valeur infinie, se trouvent être infinis en mesure et même en nombre, comme le discute déjà Anselme dans le *Cur Deus homo*. Pour le développement historique de la thématique de l'infinité divine et de son poids philosophique, voir Davenport (1999).

[17] « Non autem sic ut infinitum privative accipiatur, sicut in quantitate dimensiva vel numerali : [...]. Sed in Deo infinitum negative tantum intelligitur : quia nullus est perfectionis suae terminus sive finis, sed est summe perfectum. Et sic Deo infinitum attribui debet » (*C. Gent.* I, 43, 3).

présenter quelques traits reflétant cette infinité ? Le caractère infini du créateur permet-il (ou demande-t-il) à la nature d'exprimer une certaine infinité ?

La question de l'infini dans la création est pourtant indissociable de celle du continu et de l'infini au sein de la finitude. Au XIV^e^ siècle, la solution canonique à ces questions dans la philosophie naturelle est peut-être celle de Jean Buridan, basée sur la distinction entre un sens catégorématique et un sens syncatégorematique de l'infini :

> Loquendo sincategorematice infinitae sunt partes in continuo, igitur similiter loquendo sincategorematice infinitus est numerus earum. Et isto modo capiendo *infinitum* exponitur *infinitae partes*, quia : non tot quin plures ; et similiter *infinitus numerus*, quia : non tantus quin maior ; igitur etc.[18]

Dans les différents domaines, l'infini syncatégorématique s'entend différemment, mais suit toujours le même schéma.[19] L'infini catégorématique, de son côté, ne produit que des paradoxes : « mihi videtur quod non sit possibile esse magnitudinem infinitam, quia sequeretur quod totum non esset maius sua parte » (Buridan 1991, q. 18 p. 52). S'il existait, un temps infini contiendrait autant des années (infinies) que des jours (également infinis) ; par conséquent, la grandeur infinie est impossible. Cela ne remet toutefois pas en cause la quantité infinie de la perfection divine, car il est ici exclusivement question de choses divisibles, c'est-à-dire de faits naturels.[20]

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[18] « En termes syncatégorématiques, il y a une infinité de parties dans le continuum ; donc, en termes syncatégorématiques, leur nombre est infini. Ainsi, en prenant l'infini de cette manière, on obtient l'infinité des parties parce qu'elles ne sont pas si nombreuses qu'elles ne puissent l'être davantage ; de même pour le nombre infini, parce qu'il n'est pas si grand qu'il ne puisse devenir majeur ; donc, etc. » (Buridan 1991, q. 17, p. 34) ; voir aussi Murdoch and Thijssen (2000). L'infini catégorématique est pour Buridan opposé au fini : aucune proposition ne peut être vraie à la fois de l'un et de l'autre. Toutefois, pris sincategorématiquement, ils ne sont pas opposés.

[19] « notandum est quod diversis modis solet exponi illud nomen *infinitum* sincategorematice sumptum. Uno modo in magnitudinibus, quia : aliquantum et non tantum quin maius, et in multitudine, quia : aliquota et non tot quin plura. Et [...] sic de infinito secundum velocitatem vel tarditatem vel parvitatem etc. Et intendo idem per infinitum secundum longitudinem et per infinite longum et in infinitum longum » (Buridan 1991, q. 18, p. 54).

[20] « tempus infinitum, si esset, contineret annos infinitos secundum multitudinem, ideo non contineret plures dies quam annos [...] ex hoc concluditur quod impossibile est esse magnitudinem infinitam vel etiam tempus infinitum, sumendo *infinitum* categorematice, quamvis etiam concederemus eternaliter fuisse tempus et infinitum fuisse tempus, sumendo

On sait bien que la tradition scolastique, dans son aspect le plus courant, rejette l'existence d'infinis réels dans le monde créé.[21] En revanche, concernant la doctrine du continu et les paradoxes de Zénon, elle reconnaît les infinis potentiels, suivant l'approche d'Aristote sur ce point. Cependant, il n'y a pas de puissance ou de grandeur infinie, car elles seraient incompatibles avec l'action dans le temps. Néanmoins, il existe des développements particuliers notables où cette orthodoxie est remise en question. C'est notamment John Major, ou Jean Mair, maître parisien, qui, au début du XVI[e] siècle, entreprend la démonstration de l'existence de l'infini actuel.[22] Il s'occupe de l'infini extensif et intensif, soit catégorématique, soit syncatégorématique, dans la grandeur et le nombre, et examine si Dieu peut produire sans contradiction l'infini.[23]

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*infinitum* sincategorematice ; nam impossibile est ad quod sequuntur contradictoria. Et tamen ad esse magnitudinem infinitam vel tempus infinitum sequuntur contradictoria. Nec propter hoc est neganda perfectio Dei infinita, quia nos non loquimur hic nisi de finitate vel infinitate quantorum divisibilium » (*ibid*., p. 51).

[21] Il est vrai que Grosseteste considère déjà qu'il est possible d'avoir une quelque science de l'infini, c'est-à-dire de savoir ce que c'est, en en donnant la définition: « licet infinitum non habeat quid rei, cum nulla talis res sit, habet tamen quid nominis, id est definitionem communiter dictam » (*In III Phys. Summa* ; Grosseteste 1573, p. 280). Il peut notamment raisonner en toute liberté chez lui sur l'infinité des nombres et l'utiliser comme modèle pour la multiplication infinie de la lumière ; mais le résultat (l'entité naturelle) est néanmoins fini. La lumière, qui est le simple en soi, lorsqu'elle est infiniment multipliée, doit nécessairement étirer la matière, semblablement simple, dans des dimensions de grandeur finie: « Atque simplex a simplici non exceditur in infinitum, sed solum quantum finitum in infinitum excedit simplex. [...] Lux igitur, quae in se simplex est, infinities multiplicata materiam similiter simplicem in dimensiones finitae magnitudinis necesse est extendere », comme on lit dans Grosseteste (2011) p. 77. On peut se représenter cette multiplication, en considérant les infinités des nombres et les proportions de toute « aggregatio numeri infinita ad aggregationem infinitam in omni numerali », qui sont traitées par Grosseteste de façon très libre et même rapportées « etiam in omni non numerali » (p. 78). Voir aussi McEvoy (1986) pp. 151-4 ; (2000) pp. 88-95. Mais les représenter ne signifie pas les comprendre entièrement: « conclusiones [mathematicarum] scientiarum sunt infinitae, et non comprehenduntur omnes actu ab intellectu creato potentiae finitae, sed solum ab intellectu increato potentiae infinitae » (*Comm. Post*. I, 11; Grosseteste 1981, p. 187).

[22] Sur lui voir Biard (1986) ; sur la relation de Giordano Bruno au traité de Jean Mair, voir Gatti (2002) pp. 109-11.

[23] « Circa materiam de infinito sic procedam. Primo quaeram an sit aliquid infinitum extensive vel intensive. Secundo an implicet contradictionem Deum infinitum posse producere. [...] Nota quod infinitum capitur sincathegoreumatice et cathegoreumatice, attribuitur magnitudini et multitudini » (Major 1938, p. 2).

Sa définition de l'infini catégorématique ne diffère pas beaucoup, en apparence, de l'infini syncatégorematique de Buridan : « valet sicut multitudo cuius consequenter numerando non est dabilis ultima unitas », c'est-à-dire qu'en additionnant successivement on n'atteint pas une unité ultime ; mais il en conclut que « sic in quolibet continuo datur infinita multitudo cathegoreumatice », précisément une multitude infinie de parties proportionnelles.[24] Il démontre également qu'il existe une infinité de parties proportionnelles dans le continu, car dans la division, il n'y a jamais la dernière.[25] Finalement, il explique le rapport entre sa position et la doctrine d'Aristote :

> aliquid dicitur esse ens in actu bifariam : primo modo quando est actualiter in rerum natura ; secundo modo capitur pro ente separato et isto modo pars continui dicitur esse in potentia non quin realiter sit. Ex isto patet quomodo Aristoteles intelligendus est negans infinitam multitudinem actu. Intelligit enim secundo modo.[26]

Un résultat remarquable de sa réhabilitation de l'infini dans la philosophie naturelle concerne la multiplicité infinie des mondes,[27] où Major oppose ouvertement Démocrite[28] à Aristote :

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[24] *Ibid*., p. 4.

[25] « Probatur : multitudo partium proportionalium est cuius non est dabilis ultima unitas. Quod probatur : vel illa est divisibilis vel indivisibilis ; non secundum, quia nulla talis est pars continui ; nec primum, quia medietas eius est ultra illam ; et per consequens illa non est ultima » (*ibid*., p. 6).

[26] « On dit qu'une chose est un être en acte de deux manières : d'abord, lorsqu'elle est en acte dans la nature des choses ; ensuite, lorsqu'elle est considérée comme un être séparé, et ainsi, une partie d'un continuum est dite en puissance, tout en étant effectivement. On comprend ainsi comment Aristote peut être interprété comme niant la multitude infinie en acte. En effet, il la comprend de la seconde manière » (*ibid*.).

[27] Major représente apparemment un moment important de passage, à une époque où l'on se confronte, comme on le sait, à plusieurs théories de l'infini temporel ou spatial de l'univers. Si certaines sont anti-aristotéliciennes (l'atomisme classique, Cuse, Bruno), d'autres sont aristotéliciennes ou quasi, comme dans les œuvres d'Avicenne et d'Averroès (voir les textes dans Gierens 1933, nº 30 et l'article d'Omodeo dans cette collection). Sur l'infini cosmologique, voir Seidengart (2010) ; sur l'infini entre philosophie naturelle, âge classique et science moderne, Grant (2010).

[28] C'est notable qu'on retrouve à l'age classique des interpretations finitistes de l'atomisme, par exemple dans la *Physiologia Epicuro-Gassendo-Charletoniana* (Charleton 1658). Dans l'antiquité, l'infinité des atomes et des mondes avait servi de prémisse à plusieurs arguments contre l'intervention divine dans l'univers et en faveur de la formation fortuite des mondes (cf. Bakker 2018).

Naturaliter loquendo sunt infiniti mundi, nulla ratio convincit oppositum. Ratio Aristotelis quod terra unius moveretur ad medium alterius facile diluitur et quaelibet alia ratio ut apparet. Et haec erat Democriti scientia philosophi insignis quem apprime laudat Aristoteles.[29]

Si l'on se remet à Arriaga,[30] la possibilité pour Dieu de produire un infini actuel, en quantité, nombre ou intensité (*multitudine, magnitudine, et intensione*), devient une opinion répandue chez les derniers scolastiques, en raison du fait que, comme il le dit lui-même, une infinité d'anges, par exemple, ou même de mondes est naturellement possible.[31]

Restons un peu avec Arriaga. Bien que l'infini potentiel n'implique l'infinité actuelle de l'entité qui le produit (1632, *Phys*. II, 11, p. 269), pour lui il y a des infinis majeurs et mineurs : par exemple, s'il y a une infinité d'hommes, il y aura deux fois plus d'yeux.[32] Encore, un infini peut être renfermé entre deux bornes :

dices : Si infinitum habere ultimum, iam non est infinitum, cum claudatur terminis, et habeat finem. Respondeo, infinitum non excludere proprie ultimum [...] nam praecise in eo, quod ex uno termino ad alium successive perveniri nequeat, consistit essentia infiniti, ut in exemplo [...] de infinitis speciebus entis, inter hominem, et lapidem inclusis, manifeste cernitur. Adverte tamen, illud punctum ultimum non dicendum proprie terminum ; [...] solum est dicendum, dari duo puncta vel duo individua, inter quae tota magnitudo aut multitudo infinita claudatur.[33]

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[29] « Du point de vue de la philosophie naturelle, il existe une infinité de mondes et aucune raison ne prouve le contraire. La théorie d'Aristote selon laquelle la Terre de l'un se déplacerait au milieu d'un autre est évidemment facile à réfuter, comme toute autre raison. Et c'était la théorie de Démocrite, le célèbre philosophe qu'Aristote encensait » (Major 1938, p. 58 ; voir pp. 60-2 pour le développement de cet argument).

[30] Dans la section 4 du livre XIII de la partie physique, *Potest Deus producere infinitum in multitudine, magnitudine, et intensione*. « In hanc sententiam inclinat P. Vasquez [...] & est communis inter modernos, probaturque facilè ex solutione argumentorum quæ in contrarium possunt adduci » (Arriaga 1632, *Phys*. XIII, 4, p. 369).

[31] « Imo ex hac ratione [...] concludam, etiam naturaliter infinitos Angelos, mundos, &c. esse possibiles, quia nihil est, nec naturaliter, quod petat ne producantur. Quod a fortiori certe de possibilitate divinitus loquendo urget » (*ibid*., p. 417).

[32] C'est peut-être le seul Grégoire de Rimini qui, au seuil de l'ère moderne, « soutient qu'un infini peut faire partie d'un autre infini, mais que l'infini qui en fait partie est néanmoins égal à l'infini dont il fait partie » (Grant 2010, p. 300), abandonnant entièrement l'approche qu'on a pu voir chez Buridan dans sa version orthodoxe, ou même l'approche hétérodoxe qu'on trouvait dans le *De Luce* (voir Grosseteste 2011, pp. 77-9).

[33] « Mais vous direz : Si l'infini a un ultime, il n'est plus infini, puisqu'il est clos par des termes et a une fin. Je réponds que l'infini n'exclut pas proprement l'ultime, car c'est précisément en

Si quelqu'un soutient que l'infini syncategorematique n'est qu'un fini *simpliciter*, il leur donne raison ; mais, avec un judo spéculatif *ad hominem*, il démontre alors, à partir de là, que les parties du continu sont infinies « categorematice et absolute [...] ratione earum quas actu in se habet », car ils existent en acte dans le continu.[34] Ces démarches infinitistes s'appuient hardiment sur la pensée même d'Aristote, car elles sont présentées comme une implication potentielle de sa théorie de la divisibilité infinie du continu :

> Primo arguunt ex Aristotele id negante. Respondeo, Aristotelem docentem, continuum quodlibet, quantumvis minimum, v. g. atomum, componi de facto ex infinitis partibus & punctis, admittere etiam de facto infinitum : quoad possibile verò divinitus non mirum si negetur ab ipso, qui Deum docet operari ex necessitate naturæ, in quo errat in Fide.[35]

On vise ainsi non seulement à préserver la toute-puissance divine, mais tout autant à franchir les limites qu'Aristote a posées à la présence de l'infini dans la nature. Il s'agit peut-être d'un modèle pour la transformation de certaines notions aristotéliciennes durant la première âge moderne, avec des progressions et, bien évidemment, des points d'attrition.

### *3. L'infini au naturel*

À côté de ces derniers exemples de développement apparemment pacifique, le domaine de l'infini naturel, ou la présence de l'infini dans la nature, est, au commencement de l'époque moderne, une source de tension inévitable entre la nouvelle philosophie et l'aristotélisme même dans les cas où, à la différence

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cela qu'il est impossible de passer successivement d'un terme à l'autre que consiste l'essence de l'infini, comme le montre clairement l'exemple des espèces infinies d'êtres compris entre l'homme et la pierre. Notez cependant que ce point ultime ne doit pas être appelé terme proprement ; on peut seulement dire qu'il y a deux points ou deux individus entre lesquels toute la grandeur ou multitude infinie est close » (Arriaga 1632, *Phys*. XIII, 1, p. 413-4).

[34] *Ibid*., XVI, 3, p. 408. Il convient de noter que cette thèse n'est pas nouvelle : voir notamment Guidi (2022) sur la doctrine du continu chez Antonio Rubio. Comme déjà signalé, l'intérêt d'Arriaga réside pour nous spécialement dans sa fonction de systématiseur.

[35] « Premièrement, ils argumentent à partir d'Aristote qui affirme le contraire. Je réponds qu'Aristote enseigne que toute chose, aussi petite soit-elle (par exemple un atome), est composée d'une infinité de parties et de points, et admet ainsi, de fait, l'infinité. Mais lorsqu'il s'agit de ce qui est divinement possible, il n'est pas étonnant que ce soit nié par celui qui enseigne que Dieu agit en vertu de la nécessité de la nature, dans laquelle il erre dans la foi » (Arriaga 1632, *Phys*. XVI, s. III, p. 408).

de Nicolas de Cuse ou Giordano Bruno,[36] on maintient un cadre général ou un vocabulaire d'ascendance aristotélicienne. Il va de soi qu'il ne serait pas possible d'épuiser en quelques pages un sujet aussi vaste et multiforme. Ainsi, nous n'aborderons que deux exemples emblématiques : une célébrité littéraire du XVI[e] siècle et un mathématicien et philosophe du XVII[e], aussi différents que possible.

On commence donc par Béroald de Verville,[37] célèbre collectionneur d'anecdotes paillardes, grand mélangeur de savoir et d'imagination dans ses récits romanesques en vers et prose, nourrissant le désir de présenter, dans ses *Appréhensions spirituelles*,[38] des secrets naturels sous le déguisement d'intrigues amoureuses. Le texte s'ouvre météorologiquement, à peu près comme l'*Homme sans qualités* : « Le Soleil ayant tout le long du iour selon son deuoir accoustumé, esclairé la terre, et s'estant eschaufé à la course de sa carriere », le sommeil étendit ses ailes sur les yeux de l'auteur et se glissa dans son cerveau.[39] Béroald fait alors une sorte de rêve lucide, et son esprit s'applique librement à ses vrais objets :

> les objets veritables non meslés par la vanité des incertains images qui se forment en la fantaisie, [...] les effaits certains des espris separés de leurs corps, se presenterent à moy : et me fut avis que ie voyois comme premierement l'eternel creoit le monde.[40]

La question dont il s'agit tout d'abord est : « comme *premierement* l'eternel creoit le monde »,[41] c'est-à-dire quand, pendant la création, le caractère

[36] En général, on ne va pas suivre ici ces discussions des côtés des anti-aristotéliciens : par exemple, la discussion sur l'espace infini entre Descartes, More et les cartésiens, sur laquelle voir Schwartz (2014). De même on peut dire avec Spinoza que l'infini n'a rien hors de soi ; et chez Aristote on trouve précisement que l'infini n'est pas « ce en dehors de quoi il n'y a rien, mais ce hors de quoi il y a toujours quelque chose, voilà l'infini » (*Phys*. III 6.207a1-2 ; Aristote 2000, p. 106). Mais Spinoza, bien qu'il parle de substance, n'a aucun intérêt à préserver l'héritage d'Aristote.

[37] François Broüard dit Béroalde de Verville, auteur du famigeré *Moyen de parvenir* (voir Crescenzo 2019, Renner 2020), traducteur du *Songe de Polyphile*, très fécond polymathe (voir Kenny 1991, Bamforth 1996, Adam 2014).

[38] Béroald de Verville (1583). Le livre eu une nouvelle impression en 1584. Sur les *Appréhensions* cf. Bamforth (1994), Kahn (2004).

[39] Béroald de Verville (1583) f. 1*r*.

[40] *Ibid*., f. 1*v*-2*r*.

[41] *Ibid*., f. 2*r* ; mon italique.

infini du créateur doit se réfléchir dans l'univers fini créé. Dans un instant, avant le déroulement du temps, au sein de la « boule » du chaos primigène une vraie infinité de choses passent l'une dans l'autre[42] et il en résulte une masse, infinie à son tour mais encore dépourvue de corporalité et de forme :

> Ceste masse estoit la matiere infinie de tout le monde, qui allors fut creée corps ; car paravant estant en Dieu elle estoit incorporelle, & sans forme, sensuele, ne pouvant patir, d'autant, qu'estant dans l'infini, elle demeure tellement en son infinité que ce qui est conduit sous certains termes, ne luy peut ny convenir ny la contraindre : mais par l'admirable puissance de l'eterne ayant receu le corps, et [...] à cause de l'impuissance où il l'a ordonnée pour avoir puissance de pouvoir, luy a fait avoir forme.[43]

Alors la matière et la forme, dans un sursaut de platonisme, « s'entrayment à cause que leur estre est par l'un et l'autre »[44]. Soit-il plutot un amalgame fascinant ou une incroyable mixture, on doit se demander quel est le rôle des ingrédients aristotéliciens dans cette potion : dans quelle mesure ne s'agit-il que d'un ensemble de mots empruntés, ou d'une solution de facilité à la difficulté de s'élaborer un langage même pseudo-philosophique. Mais en nous épargnant d'autres reécritures de la Genèse, telles que « le crystal de la matiere non encores distingué » et la « retraicte de l'ombre »,[45] allons directement au resumé final de cette section :

> Voila comment i'appercevois l'univers estre crée, par l'eternel en l'infini, qui est bien plus, & qui tout en soy mesme [...] retient ce qui se peut entendre par ce qui se dit tout, estant tel qu'il a en soy tout, [...] et combien que le monde soit en l'infini, s'il n'est-il pas infini.[46]

À la fin du XVII[e] siècle, la pression pour intégrer l'infini à la structure des êtres naturels est encore plus forte, bien qu'ils soient conçus de façon mécanique : un infini microscopique (pensez à Malebranche), des machines infiniment petites (pensez à Malpighi). Toujours désireux de réconcilier l'inconciliable, mais un peu plus sérieux, naturellement, que Béroald, Leibniz porte

[42] « C'estoit une grande boule où infinies d'une mesme grandeur, et beauté tenant mesme lieu, se passoient l'une en l'autre, tant que cessa ce meslange, qui ne dura qu'un instant, car le temps encor tendre, ne pouvoit en esclorre, mais peut a peu se formoit en son enceinte » (*ibid.*).
[43] *Ibid*.
[44] *Ibid*., f. 2*v*.
[45] *Ibid*., f. 3*r-v*.
[46] *Ibid*, f. 3*v*.

cette position à l'intérieur d'une théorie de la substance s'inspirant de la tradition aristotélicienne : son programme est en fait la reprise des « formes substantielles ».[47]

Dans le but de caractériser l'attitude de Leibniz envers l'infini, il est commun d'évoquer la lettre qu'il adressa en 1693 au philosophe français sceptique Simon Foucher. Dans cette lettre, Leibniz exprime sa conception positive et réaliste de l'infini[48] en ces termes fameux :

> Je suis tellement pour l'*infini actuel*, qu'au lieu d'admettre que la nature l'abhorre, comme l'on dit vulgairement, je tiens qu'elle l'affecte partout, pour mieux marquer les perfections de son auteur. Ainsi je crois qu'il n'y a aucune partie de la matiere, qui ne soit, je ne dis pas divisible mais actuellement divisée, et par consequent la moindre particelle doit estre considerée comme un monde plein d'une infinité de creatures differentes.[49]

Lorsqu'on combat l'infini à l'aide d'Aristote, par conséquent, ce dernier est vite sacrifié. On prétend par exemple (nous avons déjà rencontré cette problématique) que la durée du genre humain, l'immortalité des âmes et le refus de la métempsychose amèneraient à admettre l'infinité actuelle des âmes, ce qui est impossible selon Aristote : les âmes doivent donc périr avec les corps. « Il n'y avoit rien de plus foible, » déclare Leibniz, « que cette pretendue Demonstration : il ne se trouve point qu'Aristole ait bien refuté la Metempsychose, ny qu'il ait prouvé l'eternité du genre humain ; et apres tout, il est tres faux qu'un infini actuel soit impossible ».[50]

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[47] « On sera surpris que je pretends rehabiliter en quelque façon la philosophie de l'ecole [...] et que j'entreprend de fournir de quoy expliquer intelligiblement Aristote, St. Thomas et les Scholastiques » (*Système nouveau*, ébauche, 1695 ; GP 4, 471-2). Je vais faire usage des abréviations des *Studia Leibnitiana*.

[48] Laerke (2018) a souligné l'importance de sa lecture de la « Lettre sur l'infini » de Spinoza (1676), où il aurait trouvé un allié dans la réhabilitation de l'infini réel, dont la notion avait déjà été adoptée par l'anti-aristotélicien juif Chasdaï Crescas contre Maïmonide et, par l'intermédiaire de Crescas, également par Spinoza. Voir aussi Wolfson (1971).

[49] Leibniz à Foucher, juin 1693 ; A II, 2, 713. Sur l'infini chez Leibniz comme caractère de l'existant, voir Nachtomy (2011) ; en tant que pilier de l'anti-monisme leibnizien, voir Antognazza (2024). Pour une approche différente de celle qui sera présentée ici, voir Ugaglia (2022). Sur Foucher voir Alexandrescu (2015).

[50] *Théod*., Disc. Prel. §§7-8 ; GP 6, 54.

Quand son corréspondant Des Bosses, professeur jésuite au Gymnase de Hildesheim, lui propose l'axiome « Il n'y a pas d'infini réel dans la nature », Leibniz repond avec fermeté :

> Infinitum actu in natura dari non dubito, positaque plenitudine mundi, et aequabili divisibilitate materiae, sequitur ex legibus motus varii, quodvis punctum moveri motu diverso a quovis alio assignabili puncto. Sed nec aliter sibi pulchritudo rerum ordoque constaret.[51]

Il existe selon lui au moins trois types d'infini distincts : l'infini potentiel, l'infini réel et l'infini absolu (ou l'Absolu). « Les arguments contre l'infini en acte supposent que, dès qu'il est admis, le nombre infini existe et que tous les infinis sont égaux. Mais il faut savoir qu'en vérité, un agrégat infini n'est pas entier, ni doté de grandeur, ni constitué d'un nombre ». Comme déjà Buridan :

> Au lieu du nombre infini, il faut dire, plus exactement, qu'il y en a plus qu'il n'est possible d'exprimer par un nombre quelconque ; ou, au lieu de la ligne droite infinie, qu'une ligne droite est produite au-delà de toute magnitude que l'on peut assigner [...] Ainsi, même si le monde était infini en grandeur, il ne serait pas un tout [...] et n'aurait donc pas d'unité plus que verbale.[52]

Il n'existe donc absolument aucun nombre, aucune grandeur ou quantité réelle positivement infinie, ni aucune entité infiniment petite. L'imagination peut fournir des idées d'entités infinies ou infiniment petites, à proprement parler irréelles, qui peuvent néanmoins s'avérer utiles, voire indispensables en mathématiques.

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[51] « Je ne doute nullement de l'existence d'une infinité réelle dans la nature ; et en admettant la plénitude du monde et la divisibilité uniforme de la matière, il s'ensuit des lois du mouvement variable que tout point quel qu'il soit est animé d'un mouvement différent de celui de tout autre point assignable. Mais sans cela, la beauté et l'ordre des choses ne sauraient subsister » (Leibniz à Des Bosses, 1706 ; A II, 4, 403).

[52] « Argumenta contra infinitum actu supponunt : hoc admisso dari Numerum infinitum, item infinita omnia esse aequalia. Sed sciendum, revera aggregatum infinitum neque esse unum totum aut magnitudine praeditum, neque numero constare. Accurateque loquendo loco numeri infiniti dicendum est plura adesse, quam numero ullo exprimi possint ; aut loco lineae Rectae infinitae, productam esse rectam ultra quamvis magnitudinem, quae assignari potest, ita ut semper major et major recta adsit. [...] Hinc etsi magnitudine infinitus esset mundus, unum totum non esset [...] neque adeo nisi verbalem haberet unitatem » (à des Bosses, 11/03/1706 ; A II, 4, 427).

Les entités mathématiques régulières, en revanche, qui trouvent leur origine dans une combinaison d'expérience du monde et de dispositions innées du sens commun, ne sont infinies qu'en puissance : autrement dit, par la possibilité d'une division ou d'une multiplication sans fin. L'infini mathématique est toujours « syncatégorématique » ; il n'existe pas d'infini catégorématique ni dans les mathématiques, ni dans le monde, c'est-à-dire un objet ou un tout actuellement infini (Dieu est infini dans un sens « hypercatégorématique »), et l'infini actuel du monde crée existe « per modum totius distributivi, non collectivi ».[53]

Chez Leibniz, on trouve souvent des éléments doctrinaires, ou des doctrines entières d'héritage aristotélicien, spécialement dans la philosophie pratique. Concernant le continu, il distingue entre le continu mathématique, qui est une entité imaginaire infiniment divisible en puissance, selon une conception strictement aristotélicienne, et le continu physique, qui est fondé au moins indirectement dans la réalité métaphysique et, comme nous allons le voir, est strictement leeuwenhoekien.[54]

Pascal voit notamment l'homme comme étant pris entre deux infinis (une grandeur infinie au-dessus et une extrême petitesse au-dessous de lui), ce qui suscite l'intérêt de Leibniz, dans la mesure où cette notion, se dit-il, « n'est qu'une entrée dans mon système ».[55] Leibniz propose au public un *Système nouveau de la nature et de la communication des substances* en 1695.

Pour Leibniz, en vérité, la matière et le mouvement proprement dits n'existent pas au sens strict du mot, ni aucun autre continuum apparemment « réel ». L'espace et les temps sont des système des relations entre les choses.[56] Mais les choses sensibles elles-mêmes ne sont que des agrégats

[53] À Des Bosses, 01/09/1706 ; A II, 4, 464. Voir Arthur (2019), Katz *et al.* (2024) ; sur les nombres infinis, se référer à Brown (2000), Arthur (2001), Harmer (2014).

[54] « Il n'y a pas d'atomes, en effet aucun corps n'est si petit qu'il ne puisse être divisé, car il subit l'influence de tous les autres corps de l'univers entier ; il conserve même toutes les impressions passées et contient à l'avance celles à venir. [...] Il s'ensuit que chaque particule de l'univers contient un monde de créatures infinies » (*Principia Logico-Metaphysica* [Primae veritates], A VI 4, 1648). L'existence omniprésente de ces créatures vivantes ubiquitaires est démontrée, aux yeux de Leibniz, précisément par les observations microscopiques d'Antoni van Leeuwenhoek. Voir Andrault (2006-2007), Becchi (2017).

[55] Grua, 553 ; cf. aussi Naërt (1985), De Buzon (2010). Sur le théories de l'infini dans ce siècle, voir Nachtomy and Winegar (2018), North (1983).

[56] Sur la théorie de l'espace et des continus chez Leibniz, se référer à De Risi (2025).

manquant d'une unité métaphysiquement réelle. Seules des substances inétendues, qui soient des principes de vraie unité et des forces vivantes, peuvent exister pleinement. Son monde est donc composé de « points métaphysiques »,[57] c'est-à-dire de substances qui servent de principes d'unité et de vie. Ces substances sont aussi des *automates spirituels*, dont le développement suit, de manière très célèbre, une *harmonie préétablie*.

Chez Leibniz, la réalité (telle qu'elle a été créée) est apparemment infinie sous tous les angles. Mais le point majeur de croisement de cette infinité avec les notions aristotéliciennes réside spécifiquement dans sa doctrine des substances : « la notion parfaite de chaque substance, quoyque indivisible, enveloppe l'infini »,[58] soit dans sa notion complète, soit dans ses rapports à l'univers dont elle fait partie.

La « matière », qui n'est qu'un *phaenomenon bene fundatum*, « un pur phenomene ou apparence bien fondée »,[59] se subdivise à l'infini (non pas potentiellement, mais réellement) en parties qui, selon Leibniz, sont soit mécaniques, soit animées et vivantes, et qui ont pour cette raison un degré de réalité supérieur à celui des phénomènes physiques ; il sont aussi infiniment complèxes : « les Machines de la nature ont un nombre d'organes veritablement infini ».[60]

Le nombre de substances simples entrant dans une masse de matière, aussi petite soit-elle, est actuellement infini, y compris (ou mieux : surtout) dans le cas de la matière vivante : en dehors de l'âme qui, selon Leibniz, constitue l'unité réelle de l'animal, le corps est actuellement subdivisé, c'est-à-dire qu'il est encore une agrégation d'animaux ou de plantes invisibles, qui sont à leur tour également composés, et qui ont de même une substance simple particulière qui en fait l'unité réelle. En effet, bien qu'en fin de compte tout se résume à ces unités immatérielles (le reste, ou le résultat, n'étant que des

[57] *Système nouveau*, 1695 ; GP 4, 482.
[58] *Système nouveau*, ébauche, 1695 ; GP 4, 475.
[59] Lettre à Arnauld, 1687 ; A II, 2, 249.
[60] *Système nouveau*, 1695 ; GP 4, 482. Sur les machines de la nature je renvoie à Fichant (2003), Smith and Nachtomy (2011).

phénomènes bien fondés), on va également à l'infini dans le domaine naturel, et à un infini réel, c'est-à-dire à une pluralité infinie au sens strict.[61]

Le monde physique est donc rempli de substances corporelles, résultant d'agrégats mutables de substances simples, l'une d'entre elles jouant le rôle de porteur d'identité ou âme (et donc principe d'unité). À la multitude d'animaux microscopiques qui structure la réalité physique, correspondent donc une infinité de substances individuelles immatérielles (appelées finalement, comme on le sait bien, « monades »), dont les harmoniques représentations sont le fondement réel de la nature physique. Chaque monade a une composante passive et une composante active (la substance est dynamique mais finie), qui correspondent respectivement à l'opposition de force et d'inertie, ainsi que de forme et de matière.

Leibniz se détourne souvent du nom de « substance » : il commence à utiliser « monade » déjà à la fin de l'an 1695, à l'époque où entre autres il acquiert un exemplaire des écrits latins de Bruno (1591)[62] ; il affectionne particulièrement le terme « entelechie ».[63] Toutefois, Leibniz veut faire revivre les « formes substantielles, que les Atomistes et Cartesiens pretendent d'avoir exterminees » (A II, 1, 754) et donc, de façon implicite, se propose de ressusciter Aristote à l'époque cartésienne.[64] Cependant, le fondement de sa notion de substance n'est pas son entité ou *ousia*, mais une loi fondamentale de développement qui s'exprime comme une force.[65] Cette substance,

[61] Cette infinie complexité permet à Leibniz de résoudre le problème de la contingence des événements sur lesquels s'exerce la liberté humaine. « Une vérité contingente est celle qui implique des raisons infinies » (A VI, 4, 1662), c'est-à-dire qu'elle requiert une analyse infinie, à l'instar des proportions entre quantités incommensurables. Autrement dit, elle nécessite une procédure infinie pour exposer son explication causale, laquelle ne peut donc pas avoir valeur démonstrative (puisqu'une démonstration infinie n'est pas possible), et la vérité de telle sorte ne peut dès lors pas être nécessaire.

[62] Voir Feller (1718) p. 142 ; A VI, 5, VE n. 2835.

[63] Dont il est également prêt à revendiquer une sorte d'orthodoxie : « cum Thomistis sentio omnes Entelechias primitivas indivisibiles esse, seu quod appello Monades » (à Des Bosses, 1706 ; A II, 4, 464).

[64] Pour Descartes, comme on le sait, l'âme n'est pas une forme unie à la matière, tel que le concevait la tradition aristotélicienne ; de plus, des trois fonctions que cette dernière lui attribuait, végétative et appétitive sont perdues.

[65] *De primae philosophiae emendatione*, 1694 ; GP 4, 469. Cette « force primitive » correspond proprement à la forme substantielle dans la première présentation publique du système de Leibniz (*Système nouveau*, 1695 ; GP 4, 473 e 479).

qui ressemble à une âme, a pourtant une matière et une forme qui lui sont propres ; cela est bien peu orthodoxe du point de vue de la tradition aristotélicienne.[66]

Comme on l'a dit, chaque agrégat de monades, s'il s'agit d'une chose durable et animée, aura une forme, en tant qu'il y a une âme, et une matière, en tant qu'il s'agit d'une substance corporelle. Cela semble contredire le caractère non réel et seulement « bien fondé » de la nature physique, déjà mentionné : Leibniz répond que le corps physique n'est pas une substance, mais un *substantiatum*, c'est à dire que le corps de la substance corporelle, et la substance corporelle même en tant que l'union d'une monade dominante et d'un corps, reçoivent leur substantialité de l'essaim de monades qui y entrent.[67]

Généralement, pour mieux l'expliquer, Leibniz envisage une composition ascendante des deux éléments de cette substance pseudo-aristotélicienne, à savoir la matière et la forme, des infinies substances (soit les corporelles plus petites, soit les respectives monades dominantes et non dominantes) qui sont à chaque moment comprises dans une particulière substance corporelle, en plus de la matière et de la forme de la monade dominante. Parfois, cela fonctionne, ou semble fonctionner. Mais cette composition est irrémédiablement compliquée, faisant plutôt exploser la substance, ou au moins sa théorie, et ne parvenant pas à pallier l'absence du *synolon* de la tradition. Ainsi, Leibniz va de plus en plus s'en tenir, autant que possible, à la simple et directe combinaison des perceptions des substances dans l'harmonie préétablie.

En résumé : dans chaque substance corporelle entre une infinité de substances elles-mêmes corporelles, toutes basées sur des principes immatériels d'unité analogues aux âmes. L'infinité est donc bien réelle : dans chaque partie infinitième de matière il existe réellement, selon cette doctrine si caractéristique de Leibniz, un monde entier de créatures vivantes, et ainsi à l'infini. Ceci

[66] On peut évoquer le jugement sans appel d'Oviedo : « Sit prima conclusio ; Anima rationalis non est composita ex partibus essentialibus, materia videlicet & forma : assentiunt omnes Doctores, & ex nostris conclusionem probat Hurtadus [...] Ratio sit : Anima rationalis est forma respiciens subiectum, cum quo totum componit : ergo ipsa subiectum non habet, neque ex illo componitur » (Oviedo 1640, *De an*. c. I, V, §3 ; II, p. 20).

[67] La matière et les corps vivants sont constitués d'un flux perpétuel (« in perpetuo fluxu », à Bierling, 1711 ; GP 7, p. 502).

est décidément incompatible avec les théories, aussi bien cartésienne qu'aristotélicienne, de la substance. Plus précisément, l'infinité réelle de la composition des substances corporelles franchit les limites à la fois de la substance aristotélicienne et de la substance cartésienne. Qu'importe cette dernière, mais Leibniz avait un intérêt authentique pour récupérer certains traits de la conception de la substance héritée de la tradition aristotélicienne. Encore une fois, le rôle de l'element aristotélicien va mis et se met en question ; la terminologie aristotélicienne est soumise à des contraintes qui la conduisent à revêtir des formes insolites et exogènes, évoquant la souffrance des buis qu'on taille de manière fantastique dans les jardins princiers de l'époque.

### *4. La morale de l'histoire : substance et substance*

On peut penser que, dans une certaine mesure, pour les philosophes de cette époque la « substance » ne soit qu'un mot emprunté, une solution, en quelque sorte, « faute de mieux ». D'un autre côté, on ne peut pas nier que ces auteurs souhaitent réellement *conserver* certains intégrants conceptuels aristotéliciens, qui s'éloignent ainsi de plus en plus de leur origine, tout en conservant une organisation lexicale toujours familière. Le lexique aristotélicien est non seulement une référence incontournable de la pensée philosophique au XVII$^{e}$ siècle, mais aussi un outil linguistique dont ces philosophes dépendent : on peut dire paradoxalement que c'est l'opium ou le fentanyl de la métaphysique de cette époque. On pourrait, en tant que morale de l'histoire, se demander d'où vienne la douleur et pourquoi l'addiction, mais on ne peut nier la puissance de la « substance » – dans tous sens.

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