

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, Transformations 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 quantification⁷ 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 Jesuits¹⁵ – 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 logic²⁰ 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 $\xi\xi\iota\varsigma$ as *forma* by Michael Scot in his Arabic-Latin version of Aristotle's *Physica*. Rughetti, moving from the meaning of $\xi\xi\iota\varsigma$ 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 $\upsilon\lambda\eta$ 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 $\xi\xi\iota\varsigma$ /*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 concurrence), 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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