AN (APPARENT) EXCEPTION IN THE ARISTOTELIAN NATURAL PHILOSOPHY: ANTIPERISTASIS AS ACTION ON CONTRARY QUALITIES AND ITS INTERPRETATION IN THE MEDIEVAL PHILOSOPHICAL AND MEDICAL COMMENTARY TRADITION

UNA (APARENTE) EXCEPCIÓN EN LA FILOSOFÍA NATURAL ARISTOTÉLICA: ANTIPERÍSTASIS COMO ACCIÓN EN LAS CUALIDADES CONTRARIAS Y SU INTERPRETACIÓN EN LA TRADICIÓN DEL COMENTARIO MÉDICO Y FILOSÓFICO MEDIEVAL

Aurora Panzica

University of Fribourg (Swiss National Science Foundation)

Abstract

This paper explores the scholastic debate about *antiperistasis*, a mechanism in Aristotle's dynamics described in the first book of *Meteorology* as an intensification of a quality caused by the action of the contrary one. After having distinguished this process from a homonymous, but totally different, principle concerning the dynamics of fluids that Aristotle describes in his *Physics*, I focus on the medieval reception of the former. Scholastic commentators oriented their exegetical effort in elaborating a consistent explanation of an apparently paradoxical process like the intensification of a quality by the opposite one. From the fourteenth century onwards, most of the commentators resorted to the theory of the multiplication of species, according to which each entity acts through the emission of *simulacra* of the objects (*species*) that spread spherically in the medium. When these rays encounter an obstacle, such as a contrary quality, they are pushed back towards their source. The reflection of the *species* determined by the surrounding and opposite quality produces a concentration of the first one, which is therefore intensified. Another distinctive feature of the scholastic interpretation of Aristotle's antiperistasis is the convergence between the discussions on inorganic and organic matter, physical and medical discourse. This convergence found its most significant expression in the adoption of the model described in the first book of Aristotle's *Meteorology* to the biological context of Hippocrates's *Aphorisms* I, 15. Following Galen's exegesis of this passage, medieval commentators established a link between physics and medicine substantially extraneous to Aristotle's theory.

Keywords

Antiperistasis; Aristotle's *Meteorology*; Aristotle's *Physics*; Multiplication of Species; Hippocratic Tradition in the Middle Ages

Resumen

Este artículo explora los debates escolásticos sobre la antiperístasis, un mecanismo en la dinámica de Aristóteles descrito en el primer libro de la *Meteorología* como una intensificación de una cualidad provocada por la acción de la cualidad contraria. Después de haber distinguido este proceso de un principio homónimo, relativo a la dinámica de los fluidos que Aristóteles describe en su *Física*, mi análisis se centra en la recepción medieval del primer proceso. Los comentaristas escolásticos orientaron su esfuerzo exegético hacia la elaboración de una explicación consistente de un proceso aparentemente paradójico como la intensificación de una cualidad por su cualidad contraria. A partir del siglo XIV, la mayoría de los comentaristas recurrió a la teoría de la multiplicación de especies, según la cual cada entidad actúa mediante la emisión de rayos virtuales (*species*) que se difunden de forma esférica en el medio. Cuando estos rayos encuentran un obstáculo, como una cualidad contraria, son empujados hacia su fuente. El reflejo de los rayos virtuales determinado por la cualidad circundante y contraria produce una concentración de la primera cualidad, que, como consecuencia, se intensifica. Otro rasgo distintivo de la interpretación escolástica de la antiperístasis de Aristóteles es la convergencia entre la reflexión sobre la materia orgánica e inorgánica, el discurso físico y médico. Esta convergencia encontró su expresión más significativa en la adopción del modelo descrito en el primer libro de la *Meteorología* de Aristóteles al contexto biológico de los *Aforismos* de Hipócrates I, 15. Siguiendo la exégesis de Galeno, los comentaristas medievales establecieron un vínculo entre la física y la medicina sustancialmente ajeno a la teoría de Aristóteles.

Palabras clave

Antiperistasis; *Meteorología* de Aristóteles; *Física* de Aristóteles; multiplicación de especies; tradición hipocrática en la Edad Media

Introduction[1]

The term *antiperistasis* (ἀντιπερίστασις) is employed in Aristotle's works with two different meanings, both related to dynamics. The first one concerns the interactions between the active qualities, hot and cold, and describes the process by which a quality surrounded by the contrary one is concentrated and intensified. The second meaning expresses a redistribution of portions of a fluid, such as air and water, in order to prevent the formation of a void. It is only in the first meaning that the process of antiperistasis can be seen as an (apparent) exception within Aristotle's natural philosophy.

If a monograph on antiperistasis is still a *desideratum*,[2] in the last years several studies have contributed to a better understanding of this process, particularly in the sense described in the *Physics*, casting light on its pre-Aristotelian history, its reception in Late Antiquity, in the Arab and in the Latin world, and its meaning for the history of science.[3] The antiperistasis in Aristotle's *Meteorology* seems to be more neglected by modern scholarship. I will therefore focus on it, and particularly on its interpretation

[1] I wish to express my gratitude to Valérie Cordonier, who made me realize the importance of this topic in Aristotle's natural philosophy, to Daniel Di Liscia, for his precious comments on a draft of this paper, to Stefania Fortuna and Alessandra Foscati, for their bibliographical suggestions concerning the medical tradition, as well as to Nicolas Weill-Parot, who kindly shared with me his recent study on medieval interpretations of antiperistasis in the commentary tradition on Aristotle's *Physics*. Research for this paper has been carried out within the project "P500PH_206632/1", financed by the Swiss National Science Foundation.

[2] Hans Strohm, *Meteorologie. Über die Welt* (Berlin: Wissenschaftliche Buchgesellschaft, 1984), 152.

[3] On the pre-Aristotelian history of this concept, see Jan Opsomer, "Antiperistasis: a Platonic theory", in *Plutarco, Platón y Aristóteles*. Actas del V Congreso Internacional de la I.P.S. Madrid-Cuenca, 4-7 de mayo de 1999, edited by A. Pérez Jiménez, J. García López, R. María Aguilar (Madrid: Ediciones Clásicas, 1999), 417-430. For some remarks on the reception of this concept in Theophrastus's *De igne*, see David Furley, "The Mechanics of Meteorologica IV. A Prolegomenon to Biology", in *Zweifelhaftes im Corpus Aristotelicum. Studien zu einigen Dubia. Akten des 9. Symposium Aristotelicum (Berlin, 7.-16. September 1981)*, edited by P. Moraux and J. Wiesner (Berlin and New York: Walter de Gruyter, 1983), 73-93, at 83, 90, which refers to Peter Steinmetz, *Die Physik des Theophrast von Eresos* (Bad Homburg, 1964). On the reception in the Arab world, see Shlomo Pines, "Quelques tendances antipéripatéticiennes de la pensée scientifique islamique", *Thalès* 4 (1937): 210-219, at 210-215; Ahmad Hasnawi, "Avicenne et le livre IV des *Météorologiques*", in *Aristoteles Chemicus. Il IV libro dei Meteorologica nella tradizione antica e medievale*, edited by C. Viano (Sankt Augustin: Academia Verlag, 2002), 133-143, at 137-139, and Nicolas Weill-Parot, "Les projectiles et les fluctuations de l'antipéristase dans les commentaires latins de la *Physique*: d'Averroès à Paul de Venise". *Studi sull'Aristotelismo medievale* 1 (2021): 263-318, at 276-280 (for Averroes's position in his *Great Commentary on the Physics*). On the meaning of this concept for the history of science, see Norwood Russell Hanson, "Aristotle (and Others) on Motion through Air". *The Review of Metaphysics* 19.1 (1965): 133-147. On the interpretations of antiperistasis in scholastic commentaries, see Weill-Parot, "Les projectiles", 265-318.

by Latin commentators on Aristotle's *Meteorology*. Before coming to them, I shall introduce what, with Michel Federspiel, we may call "Aristotle's double antiperistasis".[4]

1. Aristotle's double *antiperistasis*

The fact that Aristotle uses the term 'antiperistasis' to refer to two distinct processes, together with the absence of a clear definition and distinction of these two concepts in the Aristotelian works, led to some confusion in modern scholarship.[5] These meanings have correctly been distinguished by Henry D. P. Lee, David Furley and Michel Federspiel. The latter has reviewed, in the Aristotelian works on natural philosophy, six occurrences in which this term refers to a redistribution of fluids and seven in which it indicates an intensification by the contrary quality.[6] The process of antiperistasis is rapidly mentioned also in the *Posterior Analytics*, but this reference, which occurs in a logical context, is too general to infer which one of the two processes Aristotle had in mind.[7] Nine mentions of this term (two with the first meaning, and seven with the second one) can be found in the *Problemata*, a voluminous work which probably originated from an Aristotelian core and was enriched within the peripatetic school.[8] Leaving aside the *Problemata*, let us start with an overview of the significant *loci* in the works of assured Aristotelian paternity before coming to a closer study of some of them.

I. Antiperistasis as redistribution of fluids.

a) *Phys*. IV, 8, 215a14-17 (motion of projectiles);

b) *Phys*. VIII, 10, 266b28-267a20 (motion of projectiles);

c) *Meteor*. II, 4, 369b25 (mutual replacement of the exhalations);

d) *Meteor*. IV, 4, 382 a11-14 (definition of soft matter as something whose "surface yields, but not by displacement").

II. Antiperistasis as intensification by the contrary quality:

[4] Michel Federspiel, "Le Soleil comme movens repellens dans le *De ventis* de Théophraste et la double antipéristase", in *La météorologie dans l'Antiquité. Entre science et croyance. Actes du Colloque international interdisciplinaire de Toulouse, 2-4 mai 2002*, edited by Ch. Cusset (Saint-Etienne: Publications de l'Université de Saint-Etienne, 2003), 415-436.

[5] Federspiel mentions some examples of incorrect translations in modern editions of Aristotle's *Meteorology*: Federspiel, "L'action du soleil", 426, fn. 43.

[6] *Henry D. P. Lee, Aristotle, Meteorologica* with an *English* translation (Camdridge MA: Camdridge University Press, 1952), 82-83; Furley, "The Mechanics of Meteorologica IV", 90, particularly on the passage I (d) in our list.

[7] Aristoteles, *Analytica posteriora*, 2, 98a24; Federspiel, "L'action du soleil", 433.

[8] Federspiel, "L'action du soleil", 428, fn. 48 and 49. On the dissemination of the *Problemata* see *Aristotle's "Problemata" in Different Times and Tongues*, edited by M. Goyens and P. De Leemans (Louvain: Leuven University Press, 2006).

a) *Meteor*. I, 10, 347b6 (formation of dew in the region of the Euxine sea);

b) *Meteor*. I, 12, 348b2-15 (formation of hail);

c) *Meteor*. I, 12, 349a8 (violent rain in Arabia and Ethiopia during summer);

d) *Meteor*. II, 4, 361a1 (formation of rain);

e) *Meteor*. IV, 5, 382b10 (coldness sometimes burns by concentrating heat);

f) *De somno et vigilia*, 457b1-458a32 (sleep caused by a concentration of heat inside the body).

Of these occurrences mentioned by Federspiel,[9] I shall focus particularly on the passages from the *Physics* (I *a* and *b*), which illustrate the process of redistribution of fluids, and the passage concerning the formation of hail (II *b*), which illustrates the action on contrary qualities. But before starting with this analysis, a terminological note is necessary. Federspiel remarks that, although morphologically identical, the two meanings of the term antiperistasis employed by Aristotle are etymologically distinct, since the Greek preposition ἀντί could have two different meanings:

1. "in front of" and "against", thus expressing both proximity in the space and opposition. Aristotle uses the term antiperistasis in this sense to refer to the process of expulsion by the contrary quality.

2. "in the place of", thus expressing replacement. Aristotle uses the term antiperistasis in this sense to refer to the process of redistribution of fluids.[10]

Let us first focus on the process of redistribution of fluids. While the references in Aristotle's *Meteorology*[11] are too succinct to allow a precise characterization of this phenomenon, in the *Physics* we find a more detailed description, though not a real definition nor a systematic account of this process. The first mention of the term occurs in book IV, chapter 8. Aristotle is proving the impossibility of void, showing that it would impede on the ability for anything to move (IV, 8, 215ass). The motion of projectiles is a particular case which, according to Aristotle, confirms this impossibility, as the two explanations that have been elaborated both exclude void. The first explanation comes down to redistribution (antiperistasis). According to the second explanation, which reflects Aristotle's own position, the impulse conferred to the air by the thrower exceeds the natural tendency of a body to reach its proper place. The consequence is that, instead of falling down, a heavy body continues moving straight for a limited amount of time (215a14-18).

[9] Federspiel, "L'action du soleil", 427, fn. 46.

[10] Federspiel, "L'action du soleil", 425-426.

[11] *Meteor*. II, 4, 369b25 (mutual replacement of the exhalations); *Meteor*. IV, 4, 382 a12 (definition of soft matter as something whose "surface yields, but not by displacement").

The second passage provides a more detailed account. We are in the last chapter of the *Physics* (VIII, 10), where Aristotle addresses the problem of the transmission of motion from the first mover. Starting from the consideration that, with the exception of self-movers, every moving body is moved by something, Aristotle asks how it is possible that projectiles keep moving when they are no longer in contact with the thrower (266b26-39). He criticizes the idea that the mover A imparts its motion to the contiguous mover B, and that the latter imparts its motion on C *only because they are themselves moving*. In fact, this would imply that when A stops or is no longer in contact with B, B stops as well and no longer transfers any motion: since every member in the causal chain of motion is simultaneously mover and moved, once one element stops, the whole chain will stop (266b30-33; 267a15-18).

Aristotle remains vague on the source of the theory of redistribution of fluids (antiperistasis) that he mentions in *Phys*. IV, 215a14-16 and criticizes in VIII, 10, 267a17-20, limiting himself to ascribe it to some ἄλλοι (215a16; 267a17). This theory was employed by Plato in the *Timaeus* (79A-80C) in order to explain the process of breathing.[12] Plato maintains that the air inside the body gets heated up and exits through mouth, nostrils and the pores of the skin. Cold air is then absorbed by these orifices and interstices in order to replace the escaped air. Once the air coming from outside is heated up, it moves outwards, and the whole process is repeated. This explanation presupposes that the body is endowed with an innate heat, which causes the air to heat up, and that the heated air tends to move outwards. In this regard, Plato's conception is not too far from Aristotle's theory of natural places.[13] The simultaneity of the processes of absorption of external, cold air and expulsion of internal, warm air, prevents the formation of a void within or outside the body. Plato does not expand on other phenomena that, as he states, can be explained by the same mechanism, namely swallowing, the motion of projectiles, water currents, and the descent of thunderbolts, but limits himself to short remarks on the acoustics of harmonic sounds.[14]

In the case of projectiles, according to the antiperistasis theory criticized by Aristotle, a moving object displaces the air it is facing, causing the air to move towards the rear of the object in order to impede the formation of a void in the space left by the moving object.[15] The air gathered at the rear of the object does not only have a passive,

[12] Plato implicitly adopted this explanation in other passages of the same dialogue: 59A; D-E; 60D. Plato did not use the term *antiperistasis*, but rather περίωσις. See Francis MacDonald Cornford, *Plato's Cosmology. The* Timaeus *of Plato* (Indianapolis and Cambridge: Hackett Publishing Company, 1997), 315-316.

[13] Opsomer, "Antiperistasis", 427.

[14] Plato, *Timaeus*, 1004 DE. As shown in detail by Jan Opsomer, in the seventh of his *Platonic Questions* Plutarch elaborates an explanation of these processes consistent with Plato's thought: Opsomer, "Antiperistasis", 424.

[15] On Aristotle's antiperistasis in the *Physics*, see also Pierre Duhem, *Le système du monde* (Paris: A. Hermann, 1913-1959), vol. 1, 371-374; Anneliese Maier, *Zwei Grundprobleme der Scholastischen Naturphilosophie. Das Problem der Intensiven Grösse. Die Impetustheorie* (Roma: Edizioni di Storia e

filling function: it also has an active, propulsive purpose, which, for a limited time, pushes the mover in its direction.

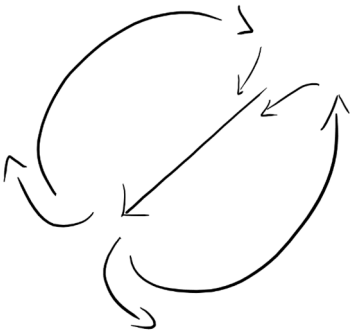

Figure 1. The theory of antiperistasis rejected by Aristotle in Phys. VIII, 10, 266b27-267a21.

Aristotle rejects this theory for the motion of projectiles and for breathing (*De inspiratione et respiratione*, 472b6-473a2), and proposes his own explanation (*Phys*. VIII, 10, 267a2-12), according to which the mover does not just move a consecutive body, but also communicates a motive force to the medium, be it air or water.[16] This means that the mover A of the causal chain imparts together motion *and* the property of causing motion to something that is contiguous to it (B), and this in turn does the same to what is contiguous to it (C). The motive force decreases when each consecutive member of the chain has less force to cause motion, and the movement stops when the impulse imparted to a member of the chain (let us say, by A to B), is only capable of making B move, but not of making B capable of moving C. Aristotle stresses the fact that, despite their appearance, these movements are not continuous, but successive, as they do not involve a single mover, but a number of discrete movers (267a12-16).

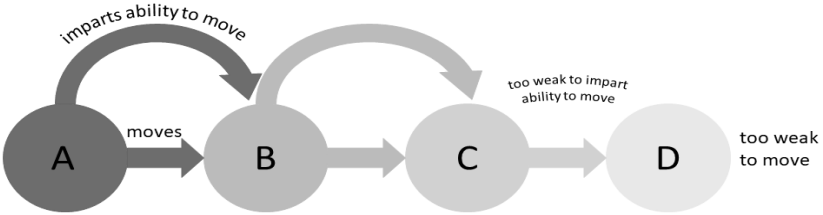

Figure 2. Aristotle's theory of motion in Phys. VIII, 10, 267a2-12.

letteratura, 1968), 117, fn 6; Opsomer, "Antiperistasis", 419; Jean De Groot, *Aristotle's Empiricism: Experience and Mechanics in the 4th century BC* (Las Vegas, Zurich and Athens: Parmenides, 2014), 256-259; Weill-Parot, "Les projectiles", 265-267.

[16] Aristotle discards Plato's theory because it is only applicable to land animals, and does not account for respiration in other species. Following Plato's text, Aristotle uses here the term περίωσις, and not antiperistasis.

This theory, which is applicable not only to the motion of projectiles, but also to magnetic attraction and the suction of fluids, was already criticized by Late-Ancient philosophers, such as John Philoponus (490-570).[17] A recent survey of these discussions in medieval commentaries on Aristotle's *Physics* has illuminated an interesting and still partly unexplored chapter in the history of dynamics.[18]

In this paper, I will instead focus on the independent medieval history of the other sense of the Aristotelian term antipersitasis, the sense used mainly in Aristotle's *Meteorology* to refer to the dynamics of hot and cold. Also in this case we have to start

[17] Iohannes Philoponus, *In Aristotelis Physicorum libros quinque posteriores commentaria*, edited by H. Vitelli (Berolini: Reimer 1888), lib. IV, ch. VIII, 639-642.

[18] Weill-Parot, "Les projectiles". In the Greek-Latin translation of the *Physics* (*translatio vetus*) by James of Venice (dead after 1147), we do not find any transliteration of the term *antiperistasis*. In the first occurrence in the *Physics* (IV, 8, 215a14-16), the Greek term is translated by "repercussio" ("Amplius nunc quidem moventur proiecta proiecturo non tangent aut propter repercussionem, sicut quidam dicunt", *Physica. Translatio vetus*, edited by F. Bossier and J. Brams; *Translatio Vaticana*, 2 vols., edited by A. Mansion (Leiden and New York: Brill, 1990), vol. 1, 160, 10-12). In the second occurrence (VIII, 10, 267a15-18), James of Venice simply introduces the Greek form of the term: "Unde et in aere et in aqua fit huiusmodi motus, quem dicunt quidam ἀντιπερίστασιν εἶναι", vol. 1, 338,18-339,1. The Latin transliteration can be found in Moerbeke's revision of this translation: "Amplius, nunc quidem proiecta moventur, proiectore non tangente, aut propter antiparistasim, sicut quidam dicunt, aut ex eo quod pellit pulsus aer velociore motu quam latio pulsi, secundum quam fertur in proprium locum", *Phys.* IV, 8, 215a14, 215a 14, AL VII. 3 (Aristoteles Latinus database, third release), 18, 46; "Quem dicunt quidam antiperistasim esse: impossibile autem aliter opposita solvere nisi dicto modo: antiperistasis autem simul omnia moveri facit et movere: quare et quiescent", VIII, 10, 267a15-18, 452, 28-30. For a discussion of the Greek-Latin translations by James of Venise and Wilhelm of Moerbeke, as well as the Arab-Latin translation incorporated in Averroes's commentary and ascribed to Michael Scot, see Weill-Parot, "Les projectiles", 268-275. On the reception of the antiperistasis theory in the scholastic commentary tradition on Aristotle's *Physics*, see Duhem, *Le système du monde*, 8, 187 (Gilles of Rome); 202-203 (John Buridan); 216-217 (Albert of Saxony) and, more recently, Weill-Parot, "Les projectiles", 280-315, who studies in detail passages from Albert the Great, Thomas Aquinas, Richard Rufus of Corwall, Roger Bacon, John Dumbleton, John Buridan, Gilles of Rome and Paul of Venice. Discussions on antiperistasis are obviously closely linked to other problems of dynamics, namely the motion of projectiles and the acceleration of falling bodies, on which Duhem's and Maier's classical studies are still very useful: Duhem, *Le système du monde*, vol. 1, 356-398; vol. 8, 169-345; vol. 10, 57, 64-65, 84-86, 103-104, 108-110, 115-116, 164-172, 216-227, 422-435; Anneliese Maier, *Die Vorläufer Galileis im 14. Jahrhundert* (Roma: Edizioni di Storia e Letteratura, 1942), 132-154; Maier, *Zwei Grundprobleme der Scholastischen Naturphilosophie* (Roma: Edizioni di Storia e letteratura, 1951), 132-154. On this topic see also Mieczysław Markowski, "Studien zu den Krakauer mittelalterlichen Physikkommentaren. Die Impetustheorie", *Archives d'histoires doctrinale et littéraire du Moyen Âge* 43 (1968): 187-210; Michael Wolff, *Geschichte der Impetustheorie: Untersuchungen zum Ursprung der klassischen Mechanik* (Frankfurt am Main: Suhrkamp, 1978); Jürgen Sarnowski, "Concepts of Impetus and the History of Mechanics", in *Mechanics and Natural Philosophiy before the Scientific Revolution*, edited by W. Roy Laird and S. Roux (London: Dodrecht, 2008), 121-148; Daniel A. Di Liscia, "Breakings and Continuities: The Fourteenth Century and Galileo's Impetus Theory as a Complex Case of Conceptual and Historical Transmission", in *Spreading Knowledge in a Changing World*, edited by Ch. Burnett and P. Mantas España (London and Córdoba: UCO Press, 2018), 175-201.

from the Aristotelian text in order to understand the doctrinal and historical roots of the subsequent debates.

Aristotle uses the principle of antiperistasis to explain some atmospheric phenomena that seem to defy the principle of his physics. These phenomena take place in the upper atmosphere as well as in the middle region of the air, and concern hot and dry as well as cold and wet bodies. An example of the first type is the movement of shooting stars. These bodies are ejected violently downwards even though, because of their warm and light nature, they should rather move upwards. Aristotle resolves this apparent paradox by explaining that when the coldness of the air causes the middle region to condense, the pressure pushes the heat out by ejecting it downwards (*Meteor.* I, 4, 341b36-342a10). An example of the second type of phenomenon is represented by the formation of dew in the Black Sea region. Aristotle underlines that there, unlike what happens elsewhere, dew is formed by northern winds. In fact, in this cold region, the southern winds do not carry enough heat to cause the evaporation necessary for the formation of dew. Northern winds, on the other hand, determine the concentration of heat by antiperistasis, which causes an increase in evaporation (I, 10, 347a36-b11).

But the most detailed explanation devoted to the action of contrary qualities occurs in relation to the formation of another humid atmospheric phenomenon: hail. Although hail is made of frozen water, it appears in spring and summer, two hot seasons. According to Anaxagoras, this apparent paradox can be solved by admitting that hail is generated in the upper region of the air, which is cold. Aristotle refuses this explanation, claiming that hail is generated in the lower region of the air, close to the Earth's surface. This supposition seems to be confirmed by the fact that hail is often accompanied by strong thunderbolts, which would be inaudible if the clouds were not close to the Earth's surface. Moreover, hailstones are often big and have irregular shapes: facts which would be impossible if hail were formed in the upper region of the air, as in this case hailstones would wear down in the course of their descent, thus becoming round in shape and smaller in size. To explain the formation of hail close to the earth surface, Aristotle presents an analogy with what happens inside the Earth. He remarks that when the Earth's surface is hot, it is cold on the inside, and vice versa. This phenomenon is due to the fact that heat and cold that are inside the earth, when surrounded by the opposite quality, are concentrated and intensified. Similarly, during summer, cold vapor in the region of air reacts against the heat by condensing and thereby determining the formation of rain and hail. It is for this reason, continues Aristotle, that raindrops are larger and thunderstorms more violent in hot countries and in hot seasons (I, 12, 348b4-7; 349a4-8). This is also the reason why water that has been previously heated up freezes faster than cold water. To illustrate this principle, Aristotle introduces the example of the fishermen in the Black Sea region. When fishing in cold weather, they use ice to secure their fishing rods to the ground, and pour hot water around them to make them freeze faster (I, 12, 348b31-349a3).

In short, the principle of antiperistasis enables Aristotle to explain a certain number of processes determined by the condensation of hot or cold matter under the action of the opposite quality. This applies equally to phenomena that occur in the upper atmosphere, like shooting stars, in the lower part of it, like hail and winds, or below the Earth's surface, in the subterranean caves. In all of these processes, three steps can be distinguished: 1) a condensation of a quality A caused by the action of a contrary quality B; 2) a subsequent intensification of quality A; 3) the expulsion of quality A from the surrounding mass of quality B. The prevailing quality condensates the losing one, reinforces it, and expels it.

As we have seen, antiperistasis as described in *Physics* (IV, 8, 215a14-18; VIII, 10, 267b27-267a21) is a different mechanism, which consists of the replacement of some bodies moving simultaneously. If this mechanism also presupposes a local movement, it implies neither a condensation nor an intensification of the moving bodies. In both cases, we are dealing with a violent motion, namely a motion that is not caused by an internal principle of the mover. In this sense, the antiperistatic motion is not essential to the mover in the way it is essential for a stone to move downwards if nothing impedes it. Both in the *Physics* and in *Meteorology*, the antiperistatic motion can rather be described as an expulsive motion. The difference is that in *Meteorology* this motion is caused by a reaction to an opposite quality, while qualities play no role in the antipersitasis of the *Physics*.[19] In any case, the *Physics* and *Meteorology* describe, under the name *antipersitasis*, two distinct processes that should not be assimilated.[20] The process described in the *Physics* concerns the dynamics of fluids, while the process described in *Meteorology* applies to the interactions between the primary qualities.[21] In the next pages, I will focus on scholastic debates on the latter, less studied process.

2. The medieval commentators

I have already devoted some pages to scholastic discussions on antiperistasis in commentaries on Aristotle's *Meteorology*.[22] For this contribution, I shall return to some of these remarks and integrate them with the study of some sources and traditions I had not taken into account in my previous analysis. As for the commentary tradition on the *translatio vetus*, I shall consider some English commentaries, which attest the early reception of Aristotle's *Meteorology* in the Latin West. Concerning the commentary tradition on the *nova translatio*, I will explore the relations between the philosophical

[19] Or at least, they play no role in the antiperistasis as described by Aristotle in the *Physics*. In fact, we have seen that, for Plato, the opposition between hot air inside the body and cold air outside it was the starting point for "his" antiperistasis, namely the process he called περίωσις.

[20] Federspiel, "L'action du soleil", 425.

[21] Federspiel, "L'action du soleil", 415.

[22] Aurora Panzica, *De la Lune à la Terre: les débats sur le premier livre des* Météorologiques *d'Aristote au Moyen Âge latin (XII^e^-XV^e^ siècles)*, ch. 16.2, forthcoming in the series *Studia Artistarum*, Brepols.

tradition of commentaries on Aristotle's *Meteorology* and the medical tradition of commentaries on the Hippocratic corpus. The analysis of these new sources will enable me to update some of my previous considerations and conclusions.[23]

A methodological premise is necessary in order to approach the corpus of medieval commentaries on Aristotle's *Meteorology* and on Hippocrates's *Aphorisms*. Commenting on authoritative texts in medieval universities was not an individual task, but rather a collective enterprise. In this sense, we have to look at these texts more as a choral work than as single voices in the history of scientific thought. Medieval masters heavily relied on their predecessors and colleagues, to the extent that the starting point of a scholastic commentary was not only the commented text, but also its previous interpretations. Although – at least up to the end of the fourteenth century – (explicit) references to other masters were not very frequent in medieval commentaries, commentators always took into account, sometimes in a polemical way, their colleagues's positions. The same should apply to the historian of medieval philosophy in order to be faithful to the object of his inquiry.

2a. The readers of the *translatio vetus*: *antiperistasis* without the term

Aristotle's text was heavily modified in the Arabic-Latin version of *Meteorology* (*translatio vetus*), which does not translate the Aristotelian treatise directly, but rather an Arabic paraphrase of it.[24] This paraphrase maintains the substantial features of the Aristotelian explanation of antiperistasis as action on contraries qualities – a process for which, though, we find no specific name in the *vetus* –, but departs from the original text on many points.

As we have seen, the first mention of this process occurs in the passage concerning shooting stars, which are pushed downwards by the coldness of the air. This passage of the Aristotelian text, in which the process of antiperistasis is rapidly evoked without a name, is too concise to appreciate the differences between the two translations, and too marginal to serve as a basis for philosophical developments in medieval commentaries.[25] We therefore have to focus on the passages concerning humid

[23] A complete overview of scholastic discussions on antiperistasis as action on contrary qualities should take into account not only the commentary tradition on Aristotle's *Meteorology*, but also the commentary tradition on the *Parva naturalia*, in which, as we have seen above, this process appears to explain sleep as a concentration of vital warmth inside the body (*De somno et vigilia*, 457b1-458a32).

[24] Pieter L. Schoonheim, *Aristotle's* Meteorology *in the Arabico-Latin Tradition: A Critical Edition of the Texts, with Introduction and Indices* (Leiden, Boston and Köln: Brill, 2000). For information on this text, see Schoonheim's introduction and Gudrun Vuillemin-Diem's introduction to *Meteorologica. Recensio et Translatio Guillelmi de Mœrbeka*, 2 vols. (Bruxelles: Brepols, 2008), vol. 1, 6-8.

[25] Aristoteles, *Meteorologica*, translatio vetus I, 6, 28,24-30,2: "Et fit assub iterum, quando expellitur caliditas, quae est in aere, qui est sub illo loco ex frigiditate quae accidit, quare apparet assuub exiens ex eo. Verum huiusmodi assuub color est turbidus, et procedit ex aere sicut manat ignis, qui expellitur ex canna."

phenomena. The term first occurs in the explaination of the formation of dew, a passage in which the text of the Arabic version replaces the city of Corinthus in Aristotle's original with the region of the Black Sea.[26] More substantial interventions concern the formation of hail, the longest passage in Aristotle's *Meteorology* devoted to antiperistasis as action on contrary qualities. According to the *vetus*, hail is generated in hot rather than cold seasons because heat concentrates cold in the interior part of the cloud, thus freezing the vapor contained in it into hail. On the contrary, during cold seasons, cold is not concentrated in one place, but is scattered throughout the air.[27] This text is however quite vague on the process that leads cold contrite under the action of the contrary quality. Some elements of the Greek original text – and, as a consequence, of the text of Moerbeke's Greek-Latin translation, which faithfully follows it[28] – are missing in this version, such as the analogy between what happens under the ground and in the atmosphere (348b3-4); the statement that the formation of hail occurs when condensation is faster than the downwards motion of water (348b18-22); the refutation of Anaxagoras's theory, according to which hail is generated in the upper part of the atmosphere (348b13-15); as well as Aristotle's arguments showing that hail is generated in the lower part of the atmosphere, close to the Earth's surface (348a24-36). The text of the *vetus* states that hailstones which come from afar are smaller and have a rounded shape, while those which come from the lower part of the atmosphere are larger and irregular in shape, but does not state that hail, unlike rain and snow, freezes below the region of the clouds. On the contrary, we read that hail is formed in the clouds far from

[26] On the transformation of this passage, and on the questions it aroused among medieval commentators, see Joëlle Ducos, *La météorologie en français au Moyen Âge: XIII^e - XIV^e siècles* (Paris: Honoré Champion, 1998), 118-122.

[27] Aristoteles, *Meteorologica*, translatio vetus I, 7, 40,18-44,7: "Dico ergo sermone aggregato quod grando non fit nisi in locis multae serenitatis nisi ex caliditate exsistente in eis, plus quam sit exsistentia eius in temporibus frigidis quae sunt in locis vehementis frigoris sempiterni in eis. Sequitur ergo illud necessario quod fit grando in temporibus calidis plus quam sit exsistentia eius et in temporibus frigidis, quoniam tempora calida similiora sunt locis in quibus fit grando quam tempora frigida. Et non fit in temporibus calidis absque temporibus frigidis nisi propterea quod calor contractus est frigori, quare recipitur frigus ad interiora nubis ex multitudine caliditatis aeris in illa hora, quare congelat quid in ea est de aqua et separat eam grandinem. In temporibus autem frigidis frigus est sparsum in aere toto, non in proprietate [the manuscript Città del Vaticano, Biblioteca Apostolica Vaticana, Urb. lat. 206, f. 218r, reads instead: "propinquitate", which seems to me to fit better in this context] nubis. Et non est illic caliditas quae possit contraria esse ei ei et [I think the lectio "et" should be corrected into "ut"] contrahatur propter eam ad interiora. Grando autem rotunda parva descendit ex locis supremis in alto. (...) Dico ergo, quia quando in aere est calor, est velocior congelatio aquae. Et demonstratio super illud est quod quando aqua calefit, deinde funditur in locis frigidis, est velocior ad frigus suum, propterea quod, quando cum contrarius fit frigori, calor est magis apparens virtuti suae et vehementius ad operationem suam quam quando non est illic contrarium. Et iterum piscatores, quando volunt permutare arundinem, qua venantur in glaciem – ut sit velocior ad submersionem suam in aqua – fundunt super eam aquam calidam, deinde ponunt eam in loco frigido. Quare congelatur super eam glacies statim propter apparitionem virtutis frigoris et vehementiam operationis eius propter contrarietatem ex calore."

[28] Aristoteles, *Meteorologica,* I, 12, 348b3-349a9; translatio nova, 32,631-33,667.

the Earth.[29] Moreover, as we have seen, the text of the *vetus* does not indicate a specific name for the process of the action on contrary qualities. Confronted with a quite elliptic text, early scholastic commentators on Aristotle's *Meteorology* had to elaborate a consistent Latin terminology to describe a phenomenon that seemed to be an exception in Aristotelian physics.

The oldest medieval commentaries on Aristotle's *Meteorology* stem from England, where this text was frequently transmitted into manuscripts containing Aristotle's treatises (and medieval commentaries on) *Physics*, *De caelo*, *De generatione et corruptione*, *De anima*, *Parva naturalia*, and some short pseudo-Aristotelian works belonging to the *corpus vetustius*, namely Costa ben Luca's *De differentia spiritus et anime*, and the pseudo-Aristotelian treatises *De mineralibus* and *De plantis*. The last two texts were translated from Arabic into Latin by Alfred of Sareshel, to whom we owe the first surviving commentary on Aristotle's *Meteorology*.[30] This commentary takes the form of glosses to particular passages. As far as the formation of hail is concerned, Alfred states that when the air is particularly hot, the cold is *chased* (fugatur) into the interior part of the cloud.[31] Alfred's terminology of flight and chase (fugare) would later be adopted by all the other commentators of the *translatio vetus*.

An important manuscript gathering all the texts mentioned above is kept at the Vatican Library under the signature Urb. lat. 206.[32] The text of the *translatio vetus* of Aristotle's *Meteorology* transmitted in this codex is accompanied, in the inferior margin, by Adam of Buckfeld's (ca. 1220-1294) literal commentary.[33] This commentator starts

[29] Aristoteles, *Meteorologica*, translatio vetus I, 7, 38,17-20: "Dico ergo quod aqua non congelatur nisi in loco in quo sunt nubes, et quia descendunt ex loco nubium tria corpora, quorum generatio et essentia est per frigus, scilicet aqua et nix et grando."

[30] James K. Otte, *Alfred of Sareshel's Commentary on the* Metheora *of Aristotle: Critical Edition, Introduction, and Notes* (Leiden, New York, Kobenhavn and Köln: Brill, 1988).

[31] Alfred of Sareshel, *Glose in Meteorologica*, 44, n. 42: "Accidit quoque cum vehemens inflammavit aerem caliditas, frigus ad nubis valde humide interiora vehementer fugari." The text of Otte's edition should be emended: instead of "fugari", Otte writes "frigari", a passive form of a quite rare verb, "frigare", attested as a seconday form of "frigerare" (to make cool) or "frigēre" (to be cold) in the *Dictionary of Medieval Latin from British Sources* (Oxford: Oxford University Press, 1975-2013), fasc. 4/5, 1009, col. b-c. I have also consulted the base manuscript used by Otte, namely ms. Durham, Chapter Library, C III 15, ff. 11v-18r, at f. 13ra, which clearly reads "fugari". The second manuscript transmitting this text, namely Oxford, Bodleian Library, Selden Supra 24, ff. 84r-109r (*in marg.*), at f. 89r (*marg. dext.*) also reads "fugari". The example of the wrong lecture "frigari" is by far not the only one in Otte's text: the necessity to correct and integrate it has recently been stressed by Henryk Anzulewicz and Philipp A.C. Anzulewicz, "Alfred von Sareshels Glossenkommentar zu den 'Meteorologica' des Aristoteles", *Przegląd Tomistyczny* 27 (2021): 7-60, esp. 18.

[32] Georges Lacombe [*et al.*], *Aristoteles Latinus, Pars posterior*, I (Bruges, Roma and Cambridge: Desclée de Brouwer, Libreria dello Stato and Cambridge University Press, 1955), 1204-1205.

[33] For information on this text and its manuscript tradition, see Olga Weijers, *Le travail intellectuel à la Faculté des arts de Paris: textes et maîtres (ca. 1200-1500)*, I. *Répertoire des noms commençant par A-B* (Turnhout: Brepols, 1994), 24-30, at 29; Charles Lohr, *Latin Aristotle Commentaries, I.1 Medieval Authors* A-L, 2 vols. (Firenze: Olschki, 2010-2013), vol. 1, 3-9, at 6. For easier identification of Adam's *Sententia*

with a close rendering of Aristotle's text. He explains that in hot seasons, the heat of the air surrounding the coldness of the vapor chases it into the interior part of the cloud, where it is strongly compressed, thus condensing the vapor and freezing it. Hail is the result of this process.[34] Then Adam provides a second explanation, according to which, when the vapor that constitutes the material cause of hail is hot enough, it is intensified by its contrary: the cold. This happens because the cold, perceiving its contrary, is reinforced and acts strongly against it, as if it were aimed at its conservation (*salus*) and at the destruction of its contrary. In this sense, we can say that hail is generated from humid vapor in a hot place, or from hot matter in a cold place.[35] Some

on Aristotle's *Meteorology*, I have transcribed the incipits and the explicits of each of its four books from ms. Roma, Biblioteca del Collegio di San Isidoro, I/10, which I was able to inspect personally: I, ff. 135ra-143rb: "*Postquam precessit etc*. Intentio est in hoc libro de corpore mobili contracto ad corpus mobile generabile et corruptibile compositum et generatum ex vapore ascendente ex terra et aqua et ad compositum generatum ex ventre terre. Cum enim subiectum totius naturalis philosophie sit corpus mobile ...X... non manent loca illorum fluminum in eadem dispositione, immo transmutantur a fertilitate in sterilitatem. Et sic terminatur primus liber secundum Alvredum"; II, ff. 143rb-147ra: "<U>*t iam complevimus*. Hic intendit de mari, et differt hec determinatio a determinatione predicta de mari, quia in parte precedenti determinatum est de mari in quantum est aqua ...X... et propter illam distantiam secundum eos habet illam tortuositatem. Et in hoc completur liber secundus"; III, ff. 147ra-151ra: "<Q>*uia ergo iam diximus ventos*. Postquam actum est in duobus libris precedentibus <de hiis> que fiunt in loco alto, non tamen ex vapore, de hiis autem impressionibus que primo et principaliter generantur ex vapore tam humido quam sicco ...X... hoc enim fit per irradiationem Solis in nube, adhuc hoc solum apparet de die; ista autem de nocte, etc. Et sic finitur sententia tertii libri Metheororum"; IV, ff. 151rb-161rb: "<Q>*uia ergo iam diximinus operatione*. In tribus libris precedentibus actum est sufficienter de hiis que generantur ex vapore ascendente terra. In isto quarto est intentio de hiis que generantur ex vapore incluso in ventre terre ...X... sciret ex omnibus facere aurum, et dicunt istam abstractionem per artificium esse possibilem. Et sic terminatur sententia totius libri Metheororum"; colophon: "Finitur sententia quarti libri Metheororum de Magistro A. de Bockfeld." The reference to Alfred of Sareshel we find at the end of book II is far for being the only one: Adam frequently refers to this commentator, as noticed by Otte, *Alfred's commentary on the Meteora*, 28.

[34] Adam of Buckfeld, *Sententia in Meteorologica*, ms. Città del Vaticano, BAV, Urb. lat. 206, f. 218rb, *marg. inf.*: "Dat causam propter quam in temporibus calidis fit grando, et est propter contrarietatem caliditatis ad frigiditatem. Propter hoc est <quod>, cum tempus fuerit calidum, calidum circumstans frigidum aeris in loco generationis grandinis fugat ipsum frigidum et facit ipsum comprimi vehementer in profundum nubis, qui quidem frigus ex vehementi fuga comprimit vaporem aqueum in profundo nubis repertum et congelat in grandinem."

[35] Adam of Buckfeld, *Sententia in Meteorologica*, ms. Città del Vaticano, BAV, Urb. lat. 206, f. 218rb, *marg. inf.*: "Vel posset dici quod, <cum> causa materialis grandinis elevatur, si fuerit multum calida, cum obviaverit suo contrario, quod est frigus, ipsum frigus ex perceptione sui contrarii vigoratur et fortiter agit in ipsum, ipsum vincendo, quare intendens salutem propriam et remotionem contrarii fugat et expellit calorem ab illa materia et excitatum a suo contrario vehementer comprimit ipsam in grandinem. Unde potest sic dici grandinem generari ex vapore humido prius existente in loco generationis grandinis, calidum [*ms.:* calido] temporis supervinciendo, vel ex materia calida elevata frigore loci ex suo contrario excitato vincente. Sic generatur grando in temporibus calidis. In temporibus autem frigidis non fit, ymo frigus aeris est sparsum per totum aera et non concurrit tantum in profundum nubis propter hoc quod non est ibi calor contrarius excitans ipsum ut

important concepts in Adam's explanation were to later establish themselves in medieval discussion on antiperistasis. The most important idea is that each entity, be it animated or inanimate matter, aims at its conservation ("intendit salutem propriam"). It is this tendency which leads the cold to escape the heat of the surrounding air and the heat of the air to push the cold and let it concentrate in the interior part of the cloud. The distinction between animated and inanimate matter seems moreover less rigid in a description that, like Adam's, employs the verb "intendere" to express the natural tendency to conservation, and which states that cold is reinforced by the *perception* of its contrary ("frigus ex perceptione sui contrarii vigoratur"). Adam's rendering of the process of antiperistasis seems to therefore attribute faculties of the animated world, such as perception and intentionality, to the elementary qualities, hot and cold. The semantic field of chase and flight ("fugare, fugari") somehow reinforces this impression. However, it should be noticed that the verb "intendere", when applied to inanimate bodies, simply indicates a natural tendency, inherent to the moving body.

This terminology can be found in a set of anonymous English questions on Aristotle's *Meteorology* stemming from the same period. Just like Adam's commentary in codex Urb. lat. 206, this text, contained in ms. Firenze, Biblioteca Nazionale Centrale, Conv. Sopp. G 3 464, ff. 28ra-41rb, is accompanied by commentaries on *De anima*, *De vegetabilibus*, *De mineralibus* and *Parva naturalia*.[36] A similar combination of texts can be found in another thirteenth-century manuscript of English origin, kept in an Italian library: Siena, Biblioteca comunale degli Intronati, L III 21. The commentary transmitted at ff. 196r-234v of this codex applies an important distinction of Aristotelian physics to the process of antiperistasis: the one between essential and accidental qualities. The anonymous commentator caracterizes the cold required to the formation of hail as accidental with respect to the heat of the air in the seasons when hail is generated.[37]

contrahatur vigorando se ad interiora nubis nec etiam ut excitetur ad fortiter agendum in materiam elevatam suum contrarium expellendo, propter quod tunc non generatur grando."

[36] Anonymus, *Scriptum super libros Meteororum*, Firenze, Biblioteca Nazionale Centrale, Conv. Sopp. G 3 464, ff. 28ra-41rb, at f. 31ra: "Grando magis generatur in locis calidis quam in frigidis, non tamen generatur in temporibus summe calidis, sed quibus admiscetur aliquid de frigiditate, ut calor fuget frigus et comprimat ipsum in locum unum. Per calorem enim fugatur frigus ad interiora nubis ut [*ms.*: et] comprimatur ibi et comprimat quod e<s>t de aqua in nube in grandinem, quod non fit in absentia caloris." For a description of this manuscript, see *Catalogo dei manoscritti filosofici nelle biblioteche italiane*, vol. 3, edited by G. C. Garfagnini, M. R. Pagnoni Sturlese, G. Pomaro and S. Zamponi (Firenze: Olschki, 1982), 68-70.

[37] Anonymus, *Questiones in Meteorologica*, ms. Siena, Biblioteca comunale degli Intronati, L III 21, An fuerit frigus in medio interstitio aeris potens congregare et congelare nubem, f. 214rb: "Contraria invicem approximata fortius agent, ideo, cum fugatur ista frigiditas per calorem exteriorem et excitatur per ipsum, fortius agent congelando vaporem ibi repertam in impressione, et ideo vult Aristoteles quod grando non generatur nisi in temporibus calidis et in locis similiter, quando scilicet est vehemens calidum potens fugare frigiditatem accidentalem aeris ad interius nubium." According to Giancarlo Fioravanti, this commentary can be dated between 1255 and 1270, as it

A copy of Adam of Buckfeld's commentary is transmitted in manuscript I/10 of the library of St. Isidore's College in Rome (ff. 58ra-79rb), a codex which contains several texts on natural philosophy and which has been copied by different English hands of the first half of the thirteenth century. At ff. 113ra-134v, this manuscript transmits a set of questions on Aristotle's *Meteorology* that should probably be ascribed to Roger Bacon.[38] This commentary addresses the process of antiperistasis in two questions devoted to hail. The first one concerns the season of generation of hail. Our commentator explains that the vapor in the clouds does not freeze in winter because, in this season, the cold is distributed homogeneously in the air; now the formation of hail requires a more intense cold than the other atmospheric phenomena, and should therefore take place when cold is less dispersed. This condition does not happen in winter, but in the intermediary seasons: spring and autumn.[39] The following question inquires about the efficient cause of hail, and particularly whether or not heat is necessary to the generation of this phenomenon. The starting point of this explanation is that when hot and cold happen to be in the same place, their action is mutually reinforced. In the generation of hail, this means that hot chases away ("fugat") cold, thereby reinforcing it. In this sense, hot can be considered as an accidental cause of hail, while cold is its essential cause.[40] The dichotomy essential/accidental that we have found in the Siena commentary is thus inverted. The reason is that in the commentary

mentions book XII of Aristotle's *Metaphysics* as XI (I.14, An elementa in suis speris sint continua an contigua: "Habent res duplicem ordinem, scilicet inter se et ad ipsum Primum, et primus ordo non est nisi propter secundum sicut in famulis vel in exercitu. Ab unitate autem istius ordinis ad ipsum Primum quod est unum et simplex dicitur universum esse unum. Hec verba Aristotilis in XI", f. 204ra, quoted in Giancarlo Fioravanti, "I *Meteorologica*, Alberto e oltre", *Cosmogonie e cosmologie nel Medioevo*, edited by C. Martello, Ch. Militello and A. Vella (Louvain-la-Neuve: Brepols, 2008): 68-76, at 68.

[38] On the attribution to Bacon, see Roger Bacon, *Questiones supra libros octo Physicorum Aristotelis* in *Opera hactenus inedita Rogeri Baconi*, edited by R. Steele and F. M. Delorme, 16 vol. (Oxford: Clarendon, 1909-1940), vol. 13 (1935), 31. The attribution of this commentary to Bacon is presented as doubtful in Weijers's and Lohr's inventories: *Le travail intellectuel à la Faculté des arts de Paris: textes et maîtres (ca. 1200-1500), VIII. Répertoire des noms commençant par R*, vol. 8, edited by O. Weijers and M. Calma (Turnhout: Brepols, 2010), 220-252, at 239; and Lohr, *Latin Aristotle Commentaries*, vol. 2, 141-145, at 144.

[39] Anonymus (Roger Bacon?), *Questiones super libros Meteororum*, ms. Roma, Collegio di San Isidoro, I/10, f. 120ra: "Maxima congelatio nubium non fit in yeme propter dispercionem frigoris per totum aerem, unde maius frigus exigitur ad grandinem quam ad aliquam aliam huiusmodi impressionem. Oportet ergo quod generetur in illo tempore in quo virtus frigoris magis unitur et minus dispergitur. Hoc autem est in vere et autumpno, non autem in yeme."

[40] Anonymus (Roger Bacon?), *Questiones super libros Meteororum*, ms. Roma, Collegio di San Isidoro, I/10, f. 120rb: "Dicendum quod, si calidum et frigidum sunt in eodem loco, per excellentiam unum semper distruit [*sic pro* destruit] alterum, si in diversis non. Sed utrumque veementius [*sic*] agit propter presentiam alterius, et sic est calor causa per accidens grandinis, quia fugit frigidum, et ad talem fugam sequitur veemens operatio frigi [*sic*]. Et per hoc patet ad secundum. Ad primum dicendum quod duplex est causa infrigidationis: causa per se et causa per accidens. Per se, ut frigus, per accidens, ut calor."

ascribed to Roger Bacon the focus is on the freezing process, for which hot can only be an accidental cause. As we will see, the notion of accident will be an important feature of scholastic discussions on the formation of hail and, more generally, on the process of antipersistasis, among the commentators of the *nova translatio*.

2b. The readers of the *nova translatio* and their dialogue with the physicians: from a deeper understanding of the Aristotelian theory to a new model of antiperistasis

With Wilhelm of Moerbeke's literal translations of the Greek Aristotelian originals and their Greek commentators, prepared between 1260 and 1270, a new term enriched the Latin philosophical thesaurus: *antiperistasis* (also frequently spelled *antiparistasis*), a transliteration from the Greek.[41] This term, absent in Latin classical texts, appears in Moerbeke's revisions of James of Venice's translations of the *Posterior Analytics*[42] and of the *Physics*,[43] in Moerbeke's translations of Aristotle's *Meteorology*[44] and the

[41] In order to contextualize Moerbeke's activity in the wider process of translating philosophical (and particularly Aristotelian) texts into Latin, see the useful overview provided by Valérie Cordonier, Peter De Leemans, and Carlos Steel, "Die Zusammenstellung des *corpus aristotelicum* und die Kommentartradition", in *Grundriss der Geschichte der Philosophie begründet von Friedrich Ueberweg. Völlig neu bearbeitete Ausgabe herausgegeben von Helmut Holzhey*, *Die Philosophie des Mittelalters*, Bd 4: 13. Jahrhundert, edited by A. Brungs, V. Murdoch and P. Schulthess (Basel: Schwabe, 2017), 149-161. The term "antiperístasis" is absent in Charles du Fresne Du Cange, *Glossarium Mediae et infimae latinitatis* (Paris: L. Favre, 1883-1887; reprint Graz: Akademische Druck-U. Verlagsanstalt, 1954), vol. 1, and in the *Mittellateinisches Wörterbuch*. The *Dictionnary of Medieval Latin from British Sources*, contains an entry in which the term is spelled *antiperistasis* (fasc I, 95), although in the text it quotes it is spelled *antiparistasis*. This process is described as an "interchange" and a "reciprocal replacement", a definition that corresponds to the treatment of this concept in in Aristotle's *Physics*, despite the fact that both texts quoted to exemplify this process refer to the intensification caused by the contrary quality, namely the process Aristotle describes in *Meteorology*. More complete and precise information is contained in the *Lexicon Latinitatis Nederlandicae Medii Aevi*, edited by J. W. Fuchs † and O. Weijers, vol. 1 (Leiden: Brill, 1977), 269-270, which mentions many concurrent spellings (*antiparastasis*; *-istasis*; - *istesis*; *-istisis*; *antipharistasis*) and provides examples for both meanings: the one of *Physics* and the one of *Meteorology*. The latter is treated in more detail, which correctly accounts for a larger use of this meaning by medieval authors. The plurality of medieval spellings is also attested in the *Latinitatis medii aevi Lexicon Bohemorum*, vol. 1, edited by L. Varcl and J. Martínek (Pragae: Academia, 1987), 202, which however mentions only the sense of this term used in *Meteorology*, namely the fortification by the contrary quality.

[42] Aristoteles, *Analytica posteriora. Translationes Iacobi, Anonymi sive 'Ioannis', Gerardi et Recensio Guillelmi de Moerbeka*, edited by L. Minio-Paluello and B. G. Dod (Bruges and Paris: Desclée De Brouwer, 1968), II, 15, 98a24, 338, 23.

[43] Aristoteles, *Physica*, *Recensio Guillelmi de Morbeka*, IV, 8, 215a14, 215a 14, AL VII.3 (Aristoteles Latinus database, third release), 18, 46.

[44] Aristoteles, *Meteorologica*, translatio nova, 347b6 (29,566); 348b3 (32,632); 348b6 (32,635); 348b16 (32,644); 349a8 (33,666); 360b25 (61,458-9). The form I encountered the most in medieval commentators on Aristotle's *Meteorology* is *antiparistasis*, spelled with *a*. Vuillemin Diem's edition of

corresponding commentary by Alexander of Aphrodisias,[45] as well as in Moerbeke's translation of Simplicius's Commentary on Aristotle's *De caelo*.[46] The introduction of a new, polysemantic term did not come without some confusion, particularly in the first generations of commentators. For instance, the Cistercian friar Humbert from Preuilly seems to mix the two senses of Aristotle's antiperistasis in his commentary on the *Metaphysics*, where he refers to the eighth book of Aristotle's *Physics* for the principle according to which fire cools down by accident, namely "because of a certain antiperistasis".[47] Now we have seen that the antiperistatic process described in Aristotle's *Physics* applies to the dynamics of fluids, and not to the action of contrary qualities.

This action was explored in great depth by the commentators of the Greek-Latin translation of Aristotle's *Meteorology*, who continued and deepened the exegetical effort of their predecessors.[48] Their aim was to elaborate a consistent explanation of the

Moerebeke's Greek-Latin translation of Aristotle's *Meteorology* adopts instead the reading *antiperistasis*, spelled with *e* (Index graeco-latinus, 155a). The apparatus however mentions the concurrent form *antiparistasis*. It is indeed very difficult for an editor of scholastic texts who does not follow an autograph or a base text to make a decision regarding this point, as the scribes are often inconsistent in the spelling of this transliteration from the Greek. Moreover, the prefixes *per* and *par* have sometimes the same appearence in the Gothic system of abbreviations, namely a *p* with a horizontal stroke intersecting its leg.

[45] Alexander Aphrodisiensis, *Commentarium in Meteorologica*, recensio Guillemi de Moerbeka, in *Commentaire sur les Météores d'Aristote. Traduction de Guillaume de Mœrbeke*, edited by A. J. Smet (Leuven and Paris: Publications Universitaires de Louvain and Éditions Béatrice-Nauwelaerts, 1968), I, 10 (75, 57; 76, 68-69), 11 (81, 69-70); 12 (83, 17; 84, 53); II, 4 (145, 75; 146, 90); II, 8 (192, 67).

[46] Simplicius, *Commentarium in De caelo*, in *Commentaire sur le Traité du ciel d'Aristote. Traduction de Guillaume de Mœrbeke*, vol. 1, edited by F. Bossier † (Leuven: Leuven University Press, 2004), I, 3 (102,78; 103,23; 215,26; 372,51).

[47] Humbertus de Prulliaco, Sententia super librum Metaphisice Aristotelis. Liber I-V, edited by M. Brînzei and N. Wicki † (Turnhout: Brepols, 2013), lib. 5, lect. 3, 487, 317: "Primo dividit causam penes per se et per accidens, sicut ignis per se calefacit, per accidens autem frigefacit, scilicet per quandam antiperistasim, ut dicitur in VIII Phisicorum." The variant apparatus does not mention alternative spellings for the form "antiperistasim". "Primo dividit causam penes per se et per accidens, sicut ignis per se calefacit, per accidens autem frigefacit, scilicet per quandam antiperistasim, ut dicitur in VIII *Phisicorum.*" The variant apparatus does not mention alternative spellings for the form "antiperistasim".

[48] In this paper I will limit myself to the Latin commentary tradition, without addressing the vernacular translations of Aristotle's *Meteorology*. It should however be noticed that the process of antiperistasis stimulated interesting developments also in this vernaculare literature, as stressed by Joëlle Ducos, who pointed out that the Norman philosopher Mahieu le Vilain, author of a French reworking of the Aristotelian text, mentions many possible applications of this principle. According to Mahieu le Vilain, antiperistasis allows to explain why plants happen to burn due to intense cold, why fricating the fingers in winter further cools them, and even why a corpse bleeds when it is placed close to its murderer. See Joëlle Ducos, "Progrès scientifique et autorité: l'exemple de la météorologie médiévale au XIII^{e} siècle", in *Progrès, réaction, décadence dans l'Occident médiéval*, edited by E. Baumgartner and L. Harf-Lancner (Genève: Librairie Droz, 2003), 184-197, at 191. The passage

Aristotelian theory of antiperistasis as action on contrary qualities which could be reconciled with experience. A first difficulty, of exclusively exegetical nature, was the discordance between the two available translations of Aristotle's *Meteorology*, particularly concerning the place of generation of hail. As we have seen, according to the Greek text, hail is generated in the lowest part of the atmosphere, close to the Earth's surface, while reading the Arabic-Latin translation it seems that hail comes from the upper part of the atmosphere. Now, this is not a minor detail, as it may appear at first glance, because the place of generation of hail clearly affects its process of generation, and therefore the theory used to explain this phenomenon. The commentators of the *nova translatio*, which literally followed the Greek text, should therefore reconcile the two versions of the Aristotelian treatise, as well as the authority of the exegetical tradition related to them. This is the reason why Radulphus Brito ascribed the theory according to which hail is generated in the region of the clouds to the old translation and to Albert the Great, who commented on it, and the idea that it is generated close to the Earth's surface to the new translation.[49] Brito holds that both explanations are correct: hail is generated in the region of the clouds because of cold, and close to the Earth's surface because of antiperistasis. The second process requires hot temperatures, which cause the cold in the clouds to concentrate and intensify.[50] This conciliatory solution will be generally adopted by the commentators of the *nova translatio*, interested in finding exegetical solutions that would not invalidate the authority of one of the translations – and of the interpretative tradition – of the Aristotelian text.[51] The notion of accident will help the commentators achieve this

on antiperistasis can be found in Mahieu le Vilain, *Les metheores d'Aristote*, traduction du XIII[e] siècle, edited by R. Edgren (Uppsala, Dissertation Thesis, 1945), 55-56.

[49] Radulphus Brito, *Questiones in Meteorologica* I, 39 *Utrum grando generetur in loco nubium propinquiori vel remotiori*, ed. A. Panyzica, in preparation: "Albertus autem et Philosophus secundum antiquam translationem videntur velle quod locus medius aeris sit locum generationis grandinis. Verumptamen Philosophus in nova translatione videtur sentire contrarium, unde secundum novam translationem hic Philosophus videtur dicere quod grando generatur in loco nubium propinquo terre."

[50] Radulphus Brito, *Questiones in Meteorologica* I, 39 *Utrum grando generetur in loco nubium propinquiori vel remotiori,* ed. A. Panzica in preparation: "Unde propter hoc duo dico. Primo, quod grando potest generari in medio interstitii; etiam secundo, quod potest generari in loco propinquo terre. Primum patet, quia ibi potest grando generari ubi est materia et efficiens grandinis; sed in loco medio aeris possibile est reperiri materia et efficiens grandinis, quod est frigidum congelans, eo quod ille locus est eccellenter frigidus, et etiam cum vapor qui est materia grandinis possit elevari usque ad illum locum et ideo ibi potest converti in aquam et cito etiam in grandinem congelari. Dico autem secundo quod grando potest congelari in loco aeris propinquo prope terram, quia cum aliquando nubes frigida, si incidit circa terram, maxime in tempore calido, propter antiperistasim comprimitur et fortificatur frigiditas in ipsa, et tunc ab illa frigiditate intensa partes nubis possunt congelari. Et sic patet quare in loco nubis propinquo terre potest grando congelari, quia ibi potest esse causa efficiens et materia grandinis, ut ostensum est, et grando sic generata habet fieri in vere et autumno magis quam aliis temporibus."

[51] The case of the Milky Way represents a serious defeat to this attitude. According to the Arabic-Latin translation, this phenomenon results from the light of a group of stars, and belongs therefore

conciliation by weakening the assertive force of the commented text and give nuance to their own explanation. This notion allowed, moreover, some flexibility. While, according to Albert the Great, the proper place for the generation of hail – that is, the place where hail is generated most of the time – is the region of clouds, the commentators of the *nova translatio* hold on the contrary that hail is generated more frequently in the lowest part of the atmosphere and only rarely and accidentally in the region of clouds.[52]

But let us return to Brito's explanation. As far as action on contrary qualities is concerned, he first remarks that the same cause cannot produce contrary effects. Cold causes cold, but not cold *and* hot. In the ordinary course of nature, a quality cannot in itself (*per se*) reinforce the contrary one. This happens only by accident, due to some circumstances that interfere with the ordinary interactions between the qualities.[53] This remark clearly qualifies the antiperistatic action as an accidental one: the intensification by the contrary quality is the exception, and not the rule.

Brito explains that two conditions are required for a quality A to strengthen the opposite quality B: first, A should not be much stronger than B, otherwise A would destroy B. Secondly, A must surround B, otherwise B would just be pushed away from

to the celestial sphere; on the contrary, according to the new translation – and to the original Greek text – the Milky Way is located in the terrestrial region and is caused by the inflammation of the dry exhalation. None of the commentators I have consulted aims at – or even tries to – combine these opposite explanations.

[52] Albertus Magnus, *Meteora*, lib. II, tract. 1, ch. 24, edited by P. Hossfeld (Münster in Westfalien: Aschendorff, 2003), 59,42-59. As an example of the attitude of the commentators of the *nova translatio*, see Nicole Oresme, *Questiones in Meteorologica de prima lectura* I, 27, edited by A. Panzica (Leiden and Boston: Brill, forthcoming): "Probatur primo quia non fit in montibus multum altis, ut patet in littera nove translationis, et ideo signum est quod magis basse generatur quam nix et pluvia, que inveniuntur in illis montibus et fiunt in media regione. Secundo patet alio signo, quia aliquando in nube ex qua venit grando auditur sonus terribilis, et ideo signum est quod illa nubes non est nimis longe nec alte. Tertio, sepe fit grando figure cornute, et non rotunde; modo, si veniret a multum alto, tunc isti anguli et coni destruerentur et ex confricatione cum aere esset quasi rotunda. Quantum ad primum, duplex est opinio. Una est moderna, que ponitur in nova translatione, quod grando generatur satis prope, sub media regione et in loco calido (...). Alia est opinio que videtur trahi ex antiqua translatione, quam ponit Albertus, quod duo sunt loca generationis grandinis; unde quandoque et ut in pluribus generatur bene sursum in media regione, et hoc est sibi essentiale (...). Comparando ista ad invicem, dicendum est quod ut in pluribus grando basse generatur propter signa prius dicta. Etiam aliquando homines de montibus altis videbant sub se nubem ex qua veniebat grando."

[53] Radulphus Brito, *Questiones in Meteorologica* I, 38, ed. A. Panzica, in preparation: "Dico duo. Primo, quod unum contrarium non habet per se fortificare alterum, quia idem non potest esse causa per se contrariorum (...) Secundo dico quod unum contrarium fortificat alterum per accidens." See Radulphus Brito, *Questiones super Analytica Priora*, II, 5, edited by G. A. Wilson (Leuven: Leuven University Press, 2016), 461,40: "Ad aliam, cum dicitur 'oppositum non est causa sui oppositi', verum est per se, sed per accidens bene potest esse causa sicut frigidum additum calido per antiperistasim est causa fortitudinis suae."

A and would move towards the opposite direction, thus escaping A.[54] These two requisites for the process of antiperistasis – a certain balance in the intensity of the contrary qualities, and a particular position they should occupy in order for one to reinforce the other – are clearly stated in other Parisian commentaries on Aristotle's *Meteorology* from the third quarter of the thirteenth century, namely the *Questions* transmitted in ms. Paris, Bibliothèque Nationale de France, latin 14698, ff. 62va-82vb and the *Questions* transmitted in ms. Paris, Bibliothèque Mazarine, 3493, ff. 143ra-190rb, both of them anonymous.[55] The latter commentary further clarifies a notion only implied in the other two texts, namely the concept of resistance: the surrounding quality should not be much stronger than the surrounded one in order to allow the latter to exert some resistance. Antiperistasis is the result of this resistance.

In order to explain how a quality reinforces the contrary one, Brito and his Parisian colleagues adopt the physical model of the multiplication of species, according to which each entity acts through the emission of virtual rays (species), which propagate in the medium and produce different effects according to the nature of the receiving object. The commentators explain that as these rays encounter an obstacle, they are reflected towards the body which emitted them and, therefore, are concentrated and strengthened. The intensification results from the fact that the reflected force is added to the one newly produced by the agent. According to the commentators, this principle explains the overheating of ovens and chimneys, where the flame of the fire encounters an obstacle and is pushed back.[56]

[54] Radulphus Brito, *Questiones in Meteorologica* I, 38 38, ed. A. Panzica, in preparation: "Ad cuius evidentiam sciendum quod ad hoc quod unum contrarium fortificet alterum duo requiruntur. Primum est quod unum contrarium non multum excellat alterum, quia tunc corrumperet ipsum, et per consequens non fortificaret. Secundum est quod unum illorum circumdet alterum, quia si unum non circumdaret alterum, tunc prius compelleret ipsum quam fortificaret."

[55] Anonymus, *Questiones in Meteorologica*, ms. Paris, Bibliothèque Nationale de France, latin 14698, I, 48, f. 78va: "Primo requiritur quod istud contrarium quod fortificatur non sit ita debile quod statim a contrario corrumpatur; secundo requiritur quod illud contrarium sit inclusum, ita quod contrarium ad ipsum non posset undique attingere. Istis duobus concurrentibus, contingit quod contrarium fortificat suum contrarium, et hoc per hanc viam, quia contrarium circumstans sic suum contrarium ipsum adiuvat et non permittit ipsum dispergi"; Anonymus, *Questiones in Meteorologica*, ms. Paris, Bibliothèque Mazarine, 3493, f. 159rb: "Dico tunc quod per accidens unum contarium fortificat reliquum; tamen due condiciones requiruntur ad hoc. Prima est quod contrarium quod debet confortari non <sit> nimis [*ms.*: minus] debile, ita quod aliqualiter possit resistere. Secunda est quod includatur totaliter in alio, ita quod nullo modo possit exire. For information on the manuscript transmission, dating and content of these two commentaries, see the Appendix in Panzica, *De la Lune à la Terre*, forthcoming. A critical edition of the anonymous commentary transmitted in ms. Paris, BnF, latin 14698 is in preparation by Iacopo Costa.

[56] Radulphus Brito, *Questiones in Meteorologica* I, 38, ed. A. Panzica, in preparation: "Unum contrarium circumdatum ab alio reflectitur super se ipsum, sicut nos videmus de igne si sit in fornace vel in aliquo concavo quod per reflexionem flamme et caloris corroboratur et fortificatur, et sic est in contrario quod, si unum si unum circumdat alterum et obstruatur ab ipso, tunc reflectitur supra se ipsum, et per consequens fortificatur et colliditur in se"; Anonymus, *Questiones*

This explanation of the process of antiperistasis would later be adopted by most of the fourteenth and fifteenth-century commentators on Aristotle's *Meteorology*. The analysis of John Buridan and Nicole Oresme, both active at the Paris Arts Faculty, would serve as a reference for many other later commentators. Buridan further develops the concept of balance between the two acting qualities and resistance opposed by the surrounded quality. He distinguishes between two kinds of contraries: a penetrating (*penetrans*) quality is much stronger than the surrounded one, and therefore destroys it, while a surrounding (*circumdans*) quality does not corrupt the contrary quality, but fortifies it by concentration: this is known as antiperistasis. This process, as Buridan explains, happens especially in the body of men and animals. When the exterior cold is intense (*penetrans*) and the natural heat of the body cannot escape it or oppose enough resistance, the latter is weakened and destroyed. On the contrary, if the coldness of the air is moderate and the interior natural heat is stronger, the latter can resist the cold and, in this process, get reinforced.[57] This happens because, in winter, the coldness of the air closes the pores on the surface of the skin; as a consequence, the vital warmth, which cannot exit throughout the skin, is reinforced within the body.[58] The application

in Meteorologica, ms. Paris, Bibliothèque Nationale de France, latin 14698, f. 78va: "Istis duobus concurrentibus, contingit quod contrarium fortificat suum contrarium, et hoc per hanc viam, quia contrarium circumstans sic suum contrarium ipsum adiuvat et non permittit ipsum dispergi. Unde etiam simile est <quando> nos videmus quod ignis in camino, quia non potest agere ad oppositum, reflectitur ad aliam partem et in se ipsum, propter quod ille ignis calidior est quam si non haberet obstaculum"; Anonymus, *Questiones in Meteorologica*, ms. Paris, Bibliothèque Mazarine, 3493, f. 159rb: "Contrarium sic inclusum nititur penetrare frigidum aliquando, et ideo reducitur in se ipsum et fortificatur. Sic maxime patet de igne in camino vel in furno; quare, etc."; Sigerus de Brabantia (?), *Questiones in Meteorologica*, ms. München, Bayerische Staatsbibliothek, Clm 9559, f. 61rb: "Intelligendum autem quod unum contrarium per se non fortificat alterum (...). Per accidens tamen contingit. Omnis enim forma naturalis generativa est sui ipsius in materia susceptiva ipsius. Forme enim, secundum quod forma, est agere; et ideo, cum non agat nisi per suam virtutem, necesse est quod in illud in quod agit diffundat virtutem eius. Quando ergo contingit quod repellatur, tunc virtus eius refrangitur in subiectum suum, ita quod ista virtus que extendebatur in aliud, refrangitur in ipsam, sicut est videre in motu proiectionis. Cum enim aliquid proicitur usque ad aliquod obstaculum, refrangitur, et ita contingit esse in alteratione luminis et refractione radiorum. Et ideo, cum aliquid agit in aliud et contingat quod virtus eius repellatur ab alio, tunc refrangitur in se ipsam et fortificatur. Sic autem est cum unum contrarium approximatur alteri contrario." On the ascription of this anonymous commentary to Siger of Brabant, see the Appendix in Panzica, *De la Lune à la Terre*, forthcoming.

[57] Iohannes Buridanus, *Questiones in Meteorologica* I, 7, edited by S. Bages, in *Les Questiones super tres libros Metheororum Aristotelis de Jean Buridan: étude suivie de l'édition du livre I*, 2 vols. (Thèse de Doctorat de l'École des Chartes, 1986), vol. 2, 111: "Et de hoc ponunt medici aliqui quamdam distinctionem rationabilem, scilicet quod aliquando est contrarium circumdans non penetrans, et aliquando, ex nimia eius fortitudine, est penetrans, vel etiam ex debili resistentia passivi. Dicunt ergo quod in nobis et animalibus frigidum circumdans non penetrans debilitat ipsum vel corrumpit."

[58] Iohannes Buridanus, *Questiones in Meteorologica* I, 7, vol. 2, 112: "sed tunc dicitur non penetrans si non obtineat sed fortificatur interius quia spiritus calidi a corde missi ad singula membra non multum possunt exalari nec exire, tum quia pori exteriores sunt magis clausi, tum quia frigus

of the process of antiperistasis to organic matter is particularly evident in Blasius of Parma's commentary. Referring to Aristotle's *Politics*, Blasius asks why men born in cold places are more courageous than men born in warm places. He explains that at the moment of their generation, the vital warmth of men born in cold places is compressed in the innermost part of the body in order not to be destroyed by the cold air. This compression determines the intensification of the vital warmth and, as a consequence, the strengthening of the natural complexion of these men, who become more courageous than others. In warm places, on the contrary, the similarity of temperature between the air and the inside of the body spreads the vital warmth throughout the whole body and often dissolves it. That is the reason why these men have a weak natural complexion and are fainthearted.[59]

Buridan, just like many other medieval commentators on Aristotle's *Meteorology*, ascribes this explanation of the process of antiperistasis to some physicians (*medici*). Buridan does not justify his assertion, for which I therefore tried to provide some historical and doctrinal foundation. A preliminary analysis led me to find a possible answer in the medieval Hippocratic tradition.[60] In fact, in the first book of Hippocrates's *Aphorisms*, we read that in winter and in spring, the belly is naturally warmer, and that

obvians et circumdans repellit eos ad interiora. Et hec dicta quodam speciali modo pertinent ad corpora humana vel animalium, de quibus etiam medici magis in speciali considerant."

[59] Blasius de Parma, *Questiones in Meteorologica* I, 5, ms. Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 2160, f. 72ra: "Et iuxta hoc Philosophus, libro *Politicorum*, proponit tale problemata: propter quid est quod homines generati in locis frigidis sunt animosiores hominibus generatis in locis calidis? Ratio est una et eadem. Primo, quia in nativitate istorum propter frigiditatem aeris calor naturalis ad intra revocatur, per quam revocationem multum fortiter intenditur. Et ad eius intensionem fortificatur naturalis complexio ipsorum et habitudo ipsorum, et fiunt magis animosiores aliis, quia in aliis, propter similitudinem continentis, calor naturalis expanditur per totum corpus et sepe dissolvitur, et tales fiunt pusilanimes et debiliores complexionis." On Blasius of Parma's *problemata*, to which this extract from his *Questions on Meteorology* belongs, see the footnote in Graziella Federici-Vescovini, *Astrologia e scienza. La crisi dell'aristotelismo sul cadere del Trecento e Biagio Pelacani da Parma* (Firenze: Vallechi, 1979), 48-49, which is only concerned with the appearance of *problemata* in Blasius's *Questions on the Physics*, leaving aside the *Questions on Meteorology*. Research on Blasius's *problemata* is in preparation by Sabine Rommevaux and Aurora Panzica. On the scholastic academic practice of problemata, see Alfonso Maierù, *University Training in Medieval Europe* (Leiden: Brill, 1993), 130-131; Olga Weijers "*Problema*. Une enquête", in *Etudes sur la Faculté des arts dans les universités médiévales* (Turnhout: Brepols, 2011), 58-76.

[60] A first, highly incomplete inventory of Greek and Latin manuscripts transmitting medical texts was compiled by Hermann Alexander Diels, *Die Handschriften der antiken Ärzte. I. Hippokrates und Galenos. II. Die übrigen griechischen Ärzte. III. Nachtrag* (Leipzig: Abhandlungen der Preußischen Akad. der Wiss., philosophisch-historische Klasse, 1905-1907; reprint Leipzig-Amsterdam: Zentralantiquariat der Deutschen Demokratischen Republik Hakkert, 1970). Corrections and additions were published by Richard Jasper Durling, "Corrigenda and Addenda to Diels' Galenica. I. Codices Vaticani", *Traditio* 23 (1967): 461-476; "Corrigenda and Addenda to Diels' Galenica. II. Codices Miscellanei", *Traditio* 37 (1981): 373-81, and Stefania Fortuna and Anna Maria Raia, "Corrigenda and Addenda to Diels' Galenica by Richard J. Durling. III. Manuscripts and Editions", *Traditio* 61 (2006): 1-30.

the innate heat is more abundant than in the other seasons.[61] In his commentary on the *Aphorisms*, Galen of Pergamum (129-216 AD) explains this phenomenon by the process of antiperistasis. While the term antiperistasis does not appear in Galen's text, the description he provides clearly corresponds to the one in Aristotle's *Meteorology*, to which Galen explicitly refers.[62]

Galen's commentary was translated from Ḥunayn Ibn Isḥāq's Arabic version into Latin by Constantinus Africanus († 1093). This translation had a wide dissemination in the Salernitan milieu and was included in a medicine handbook compiled in the twelfth century at the Salernitan School and soon adopted in other European universities, the *Ars parva* or *Articella*, as it was called in incunabula printings.[63] Soon, Constantinus's translation was no longer the only one available to the Latin public. Burgundius of Pisa (c. 1110-1193) translated the first four books from Greek into Latin, based on a lost

[61] *Œuvres complètes d'Hippocrate*, 10 vols., edited by É. Littré (Paris: Baillière, 1839-1861), vol. 4, 466-467. A modern critical edition of this aphorism can be found in *Hippocrates, Histoire du texte et édition critique, traduite et commentée, des Aphorismes d'Hippocrate, I–III*, edited by C. Magdelaine, Thèse pour le Doctorat Nouveau Régime, soutenue à l'Université de Paris Sorbonne, Paris 1994.

[62] No critical edition of Galen's commentary on Hippocrates's *Aphorisms* is available yet. Christina Savino prepared the critical edition of book VI: Galeno, *Commento agli Aforismi di Ippocrate. Libro VI*, edited by Ch. Savino (Berlin: De Gruyter, 2020). For the remaining books, we still have to refer to Galen's *Opera omnia* published in the ninenteenth century: *Claudii Galeni Opera omnia*, 20 vols., edited by C. Gottlob Kühn (Leipzig: K. Knobloch, 1821-1833), vol. 17, *In Hippocratis Aphorismos commentarius* I, 15, 415-425, at 416: "Sed cur is calor hieme augeatur etiam Aristoteles explicuit, quia in profundum extrinsecus circumstante frigore refugiat, quemadmodum contra aestate ad congenerem calorem externum protenditur. Atque ita contingit discuti quidem ac dissipari ejus substantiam per aestatem; contineri vero et coërceri ac in profundum secedere per hiemem." The Latin text published by Kühn is drawn from the Greek-Latin edition of Hippocrates and Galen's works by the French physician René Chartier (Paris, 1679, 13 vols.), who in turn relies, for the *Aphorisms* (vol. 9), on the edition by the Humanist physician Nicolò Leoniceno (1428-1524). On the Latin sources of Chartier see, Stefania Fortuna, "René Chartier e le edizioni latine di Galeno", in *René Chartier, 1572-1654: éditeur et traducteur d'Hippocrate et Galien. Actes du colloque international de Paris, 7 et 8 octobre 2010*, edited by V. Boudon-Millot, G. Cobolet, and J. Jouanna (Paris: De Boccard, 2012), 303-324. The Appendix (317-324) presents a list of Chartier's Latin sources, particular relevant to our purpose because Kühn reproduced Chartier's text.

[63] On the constitution of this corpus see Paul Oskar Kristeller, "The School of Salerno: Its Development and Its Contribution to the History of Learning", *Bulletin of the History of Medicine* 17 (1945): 138-194 and Tiziana Presenti, "Arti e medicina: la formazione del curriculum medico", in *Luoghi e metodi di insegnamento nell'Italia Medioevale (secoli XII-XIV). Atti del Convegno Internazionale di studi Lecce-Otranto 6-8 ottobre 1986*, edited by L. Gargan and O. Limone (Galatina: Congedo Editore, 1989), 153-178. A chronological list of medieval commentaries on the *Articella* has been established by Paul Oskar Kristeller, "Bartholomaeus, Musandinus and Maurus of Salerno and Other Early Commentators of the *Articella*, with a Tentative List of Texts and Manuscripts, *Italia medioevale e umanistica* 19 (1976): 57-87; Italian translation, with corrections and additions: Paul Oskar Kristeller, *Studi sulla scuola medica salernitana* (Napoli: Istituto italiano per gli studi filosofici, 1986), 97-151. On the *Articella* see also Faith Wallis, "The *Articella* commentaries of Bartholomaeus of Salerno", in *La scuola medica salernitana. Gli autori e i testi*, edited by D. Jacquart and A. Paravicini Bagliani (Firenze: Sismel – Edizioni del Galluzzo, 2007), 125-164, and the bibliography listed there.

Greek manuscript; his translation was completed by Niccolò da Regio (1280-1350), a Greek physician active at the Salernitan school.[64] By means of this tradition, Galen's "Aristotelian" interpretation of Hippocrates's aphorism I,15 established itself among scholastic masters. The *Aphorisms*, which was in fact the most widespread Hippocratic writing, was included, together with Galen's commentary, in the curricula of the faculties of medicine.[65]

A systematical examination of the commentary tradition on Hippocrates's *Aphorisms* I, 15 clearly lies beyond the scope of this study. A first, selective survey can, however, give us a glimpse at the main lines of development of the medieval commentary tradition on *Aphorisms* I, 15 and his connection with the first book of Aristotle's *Meteorology*, in order to understand why Buridan and his colleagues refer to the physicians dealing with antipersitasis.

Maurus of Salerno (ca. 1130-1214), whose commentary on the *Aphorisms* precedes the assimilation of Aristotle's *Meteorology* in the Latin West, begins his exegesis of I, 15 with a terminological clarification. He explains that the Ancients divided the interior organs in two sections: the first one, comprised between the chest and the genitals, was called belly (*venter*). This part was in turn divided into two parts: the upper one, situated above the diaphragm, was called spiritual (*spiritualia*); the lower one, beneath it, was called nutritive (*nutritiva*). This latter part is meant by Hippocrates in *Aphorisms* I, 15. Maurus explains that, in winter, this part of the body is warmer than in summer because the coldness of the air closes the pores at the surface of the skin, thus preventing the vital warmth to exit the body. The spirits and the vital warmth are therefore multiplied inside the body.[66]

[64] On Burgundius, see Peter Classen, *Burgundio von Pisa, Richter, Gesandter, Übersetzer* (Heidelberg: C. Winter Universitätsverlag, 1974). On Niccolò da Regio's translations see Lynn Thorndike, "Translations of Works of Galen from the Greek by Niccolò da Reggio (c. 1308-1345)", *Byzantina Metabyzantina* 1 (1946): 213-235, and Roberto Weiss, "The Translators from the Greek of the Angevin court of Naples", *Rinascimento* 1 (1950): 195-226, esp. 216-225.

[65] An inventory of medieval Latin manuscripts transmitting Hippocrates's and Galen's works and commentaries on them was compiled by Pearl Kibre under the title "Hippocrates latinus. Repertorium of Hippocratic Writings in the Latin Middle Ages", and was published in a series of issues of *Traditio* 31 (1975): 99-126; 32 (1976): 257-292; 33 (1977): 253-295; 34 (1978): 371-412. A revised version was published in 1985 (New York: Fordham University Press). My quotations are from the original version. On the early medieval dissemination of Hippocrates's *Aphorisms* and on an early medieval commentary on it, see Pearl Kibre, "Hippocratic Writings in the Middle Ages", *Bulletin of the History of Medicine* 18 (1945): 371-412; Augusto Beccaria, "Sulle trace di un antico canone latino di Ippocrate e di Galeno", *Italia Medioevale e umanistica* 2 (1959): 1-56; 4 (1961): 1-75; 14 (1971): 1-23; Kibre, "Hippocrates Latinus II", 259-260, 262-268.

[66] Maurus Salernitanus, *Commentarium de Articella*, *In Aphorismos*, in *Collectio Salernitana ossia Documenti inediti e trattati di medicina appartenenti alla Scuola medica salernitana*, 5 vols., edited by S. De Renzi, vol. 4 (Napoli: Tipografia del Filiatre-Sebezio, 1856), 532. I have added some punctuation in the nineteenth-century edition, which I have also corrected with three thirteenth-century manuscripts: Paris, Bibliothèque Nationale de France, lat. 18499, f. 62ra-b (*P1*), and, secondarily, lat.

The closure of the pores at the surface of the skin as a cause of the strengthening of the vital warmth in winter, is also invoked in the commentary by master Cardinalis, active at the University of Montpellier around 1240.[67] Our master accompanies this practical consideration to the theoretical principle according to which a given quality is stronger when it is united than when it is dispersed.[68] This principle, which is mentioned in the neoplatonic *Liber de causis* and included in the florilegium of the

6956, f. 77va-b (*P2*) and Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4477, f. 5rb (*V*): "Sciendum vero quod antiqui membrorum interiorum [membrorum interiorum *om. ed*.] dispositionem humani corporis perscrutantes eam in duo diviserunt; unam a furcula pectoris inferius usque ad genitalia, et eam ventrem vocaverunt. Ipsumque in duas partes diviserunt: unam a diafragmate superius, et eam spiritualia vocaverunt [a diafragmate superius, et eam spiritualia vocaverunt aliam *om. ed*.]; aliam a diafragmate inferius et eam nutritivam nuncupaverunt. Et per ventrem hic intelligimus regionem continentem nutritivam et ideo potius discit de ventre tanquam de centro totius corporis. Frigidi igitur [*ed.*: nam] aeris inspiratione pori diafragmatis cohartantur [*ed.*: cohartantis] et constringuntur, quare calor naturalis et spiritus per poros ipsius nequeunt evaporare, frigiditate etiam [*ed.*: et sic per frigidi !] ipsius aeris continentis pori corporis superficiales constringuntur [*ed.*: constringentur], unde per poros constrictos calor et spiritus evaporare non possunt. Retenti ergo in nutritiva multiplicantur, et quia ver in maiori parte immitatur natura hyemis, in frigiditate scilicet ratione predicta caloris et spirituum multiplicatio fit in nutritivis." On Maurus of Salerno's life, works and influence, see Morris Harold Saffron, *Maurus of Salerno. Twelfth-century Optimus Physicus. With his Commentary on the Prognostics of Hippocrates* (Philadelphia: Transactions of the American Philosophical Society, 1972), 5-140, at 5-17. On the twelfth-century dissemination of the Aristotelian writings in Salerno, see Danielle Jacquart, "Aristotelian Thought in Salerno", in *A History of Twelfth-Century Western Philosophy*, edited by P. Dronke (Cambridge, New York, New Rochelle, Melbourne and Sydney: Cambridge University Press, 1988), 407-428, who updates the hypotheses on the relationships between medical and philosophical thought presented by Alexander Birkenmajer, "Le rôle joué par les médecins et les naturalistes dans la réception d'Aristote au XII^{e} et XIII^{e} siècle", in *La Pologne au VI^{e} Congrès International des Sciences Historiques*, Oslo 1928 (Warsaw, 1930), 1-15, reprinted in Alexander Birkenmajer, *Études d'histoire des sciences et de la philosophie du Moyen Âge* (Wrocław, Warsaw and Cracow: Zaklad Narodowy Imienia Ossolinskich and Wydawnictwo Polskiej Akademii Nauk, 1970), 73-87.

[67] On this master, see Kibre, "Hippocrates Latinus", III, 263; Ernest Wickersheimer, *Dictionnaire biographique des médecins en France au Moyen Âge*, 2 vols. (Genève: Libraire Droz, 1979) 1, 74; Geneviève Dumas, *Santé et société à Montpellier à la fin du Moyen Âge* (Leiden: Brill, 2014), 34, 36, 41, 50, 147, 210; *L'Université de Médecine de Montpellier et son rayonnement (XIII^{e}-XV^{e} siècles)*. Actes du colloque international de Montpellier organisé par le Centre historique de recherches et d'études médiévales sur la Méditerranée occidentale (Université Paul Valéry – Montpellier III), 17-19 mai 2001, edited by D. Le Blévec (Turnhout: Brepols, 2004), 17, 67, 72, 137.

[68] Cardinalis, *Commentarium in Aphorismos Hippocratis*, Paris, Bibliothèque Nationale de France, lat. 6847, ff. 1ra-79rb, f. 5vb: "Causa autem quare ventres sunt calidissimi in vere et hyeme est quia a frigiditate exteriori, scilicet continentis, clauduntur pori corporis, et sic calor coadiuvatur in interioribus et fortificatur. Calor enim coaddunatus maior est se ipso disperso, et ita ventres hyeme et vere, scilicet in principio veris, calidissimi sunt, et etiam in toto vere, quando simile est hyemi. Hoc autem non est intelligendum generaliter, sed in illis in quibus calor fortis est (...). Nam enim calor esset debilis et ipsi essent exdenuati [*sic*], frigus continentis penetraret ad interiora et postea [*conieci*: potius?] diminuetur calor quam augmentaret."

Auctoritates Aristotelis,[69] is almost universally quoted in scholastic explanations of the process of antiperistasis in commentaries on the first book of *Meteorology*. The Montpellier commentary also contains a third feature that will help us understand the evolution within the debates in *Meteorology* commentaries, namely the assertion that the strengthening of vital warmth in winter does not concern every body, but only those in which the vital warmth is strong enough. In fact, if the vital warmth is weak, the coldness of the air penetrates the body, further weakening the vital warmth instead of reinforcing it. This remark clearly corresponds to the distinction between penetrating (*penetrans*) and non-penetrating (*non penetrans*) cold, presented by Buridan and by the masters who follow him.

Buridan stresses the limits of the explanation of antiperistasis he ascribes to the physicians: according to him, in most of the cases the amount of cold or heat which is generated by antiperistasis is such that it cannot be explained only by a concentration of preexisting heat or cold. That is why Buridan resorts to the theory of the multiplication of species, which shows that the intensification of a quality that takes place in the antiperistatic process cannot be reduced to the concentration of a preexisting quality, but implies the generation of a new one.[70]

It seems that, at least starting from the second half of the fourteenth century, the physicians also adopted this model. The Italian physicians Iacopo da Forlì, Ugo Benzi, and Giovanni Sermoneta, for instance, all resort to this theory for their exegesis of *Aphorisms* I, 15. Iacopo da Forlì (1364-1414)[71] mentions two ways in which a quality can intensify the opposite one. First, by concentrating its parts, which therefore become stronger in acting and resisting. Iacopo explains that this fortification results from the fact that a concentrated quality acts through shorter – and therefore stronger – lines of action. A further, accidental cause of fortification comes from the better disposition (*melior applicatio*) of these parts. It is for these reasons, Iacopo explains, that a concentrated virtue is stronger than a dispersed one.[72] According to the second

[69] *Les* Auctoritates Aristotelis*: un florilège médiéval. Étude historique et édition critique*, edited by J. Hamesse (Louvain-la-Neuve and Paris: Béatrice-Nauwelaerts, 1974), 232, n. 13; *Liber de causis*, edited by A. Pattin in "Le Liber de causis. Edition établie à l'aide de 90 manuscrits avec introduction et notes", *Tijdschrift voor filosofie* 28 (1966): 138, 15-16.

[70] Iohannes Buridanus, *Questiones in Meteorologica* I, 7, vol. 2, 113.

[71] On Iacopo da Forlì, see *Dizionario biografico degli Italiani* (Roma: Istituto della Enciclopedia italiana, 1960-2021), vol. 37, 555-558.

[72] Iacopo da Forlì, *In Hippocratis Aphorismos et Galeni super eisdem commentarios, expositio et quaestiones* (Venetiis: Iuncta, 1547), *Utrum ventres et corpora humana sunt calidiora tempore hyemis quam tempore aestatis vel autumni*, f. 126vb: "Quantum ad primum erunt notata et conclusiones. Primo praemitto. Dupliciter imaginari possumus unum contrarium alterum vigorare et fortificare. Primo uniendo et congregando partes eius, quare ipse redduntur potentiores ad agendum et resistendum quam prius. Ipsis enim ad invicem melius applicatis unaqueque melius aliam conservat. Ipse etiam melius se iuvant ad agendum, tum quia agunt per breviores lineas, tum etiam quia melius sunt applicatae fit maius in actione accidentale iuvamentum. Ex quo patet quare virtus unita fortior est seipsa dispersa."

explanation mentioned by Iacopo, a quality can intensify the opposite one by strengthening its form. Iacopo's favorite explanation is the second one. According to him, the intensification of one of the first qualities requires the participation of an agent that immediately produces it. As a consequence, a first quality cannot be produced by the sole concentration of its parts.[73] Iacopo admits that a quality can intensify a contrary one, but only by accident. This happens when this quality surrounds the first one and strengthens its substantial form, as in the processes of formation of hail and freezing of hot water mentioned in the first book of Aristotle's *Meteorology*.[74] Having established that the essential cause of these phenomena cannot be the simple concentration of a quality, Iacopo resorts to the theory of multiplication of species, which we have already found to explain the process of antiperistasis in commentaries on Aristotle's *Meteorology*. According to Iacopo's rendering of this theory, the first qualities act through the emission of insensible qualities, the species. Although the species have a different form of being in the medium, such as the *lumen* that results in the medium from light (*lux*), they vehiculate the first qualities and are capable of producing them in other bodies. When the species encounter a contrary quality, they are reflected back towards the body which emitted them, in the same way that light is reflected by a mirror. This reflection causes a concentration, and, as a consequence, an

[73] Iacopo da Forlì, *In Hippocratis Aphorismos*, f. 126vb: "Secundo imaginari possumus unum contrarium aliud fortificare quia ipsum intendit in forma, quod qualiter sit possibile declarabitur. Secundo principaliter praemittendum est: non posse in aliquo subiecto intendi caliditatem vel qualitatem aliquam de primis nisi ad illius intensionem vel productionem per se concurrat aliquod agens immediate illam intendens vel producens. Ex quo patet non esse possibile per solam subiecti partium aggregationem vel unionem fieri alicuius qualitatum primarum de novo productionem."

[74] Iacopo da Forlì, *In Hippocratis Aphorismos*, f. 126vb: "Tertio praemittendum est quod numquam unum contrarium per se et immediate concurrit ad alterius contrarii productionem. Patet, quia quodlibet contrarium intendit aliud contrarium naturaliter corrumpere; ergo etc. Patet consequentia cum antecedente. Quarto est praemittendum quod possibile est unum contrarium ab alio contrario circumdatum fieri in forma qua illi contrariatur intensius quam prius erat. Patet hoc grandine et similibus. Aqua etiam praecalefacta ad maiorem reducitur frigiditatem quam si non praecalefiat, ut primo *Metheororum*, capitulo quarto, quia magis passibilis est a contrario circumdante propter eius raritatem. Confert autem ad hoc ac ad caliditatem congelationis praecalefactam esse aquam, primo *Metheororum*, capitulo quarto." Iacopo's wording (almost) literally reproduces Moerbeke's *nova translatio*, I, 12, 348 b 30-32. The text established by Gudrun Vuillemin-Diem reads: "Confert autem adhuc ad celeritatem coagulationis et precalefactam esse aquam", vol. 1, 33, 656-657. The variant apparatus does not mention any variant corresponding to Iacopo's quotation according to the Venice edition, whose text is probably faulty. In fact, the copy of Iacopo's commentary contained in manuscript Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 2464, transmits a version of the Aristotelian passage more similar to that printed in Vuillemin-Diem's edition: "Confert adhuc ad celeritatem coagulationis aquam precalefactam esse", f. 109vb. The reference to the fourth chapter of Aristotle's *Meteorology* in the Venice edition does not correspond either to the division of the text in the *nova translatio*, in which the chapter on hail is the twelfth (ed. Vuillemin-Diem, 1, 412; 2, 30), or to the division of the *vetus*, in which hail is discussed in the seventh chapter. This reference to the fourth chapter is missing in the manuscript Vat. lat. 2464.

intensification of the quality.[75] According to Iacopo, this theory allows for the explanation of many problems related to meteorological phenomena, namely why caves and subterranean waters are warmer in winter and colder in summer; why hail is generated in spring, summer and autumn, rather than in winter; and why the coldness of the region of clouds (called by the scholastic masters "middle region of the air") is more intense in summer than in winter.[76]

The same theory is put forward in the commentary on Hippocrates's *Aphorisms* by Ugo Benzi (Siena, 1360-Ferrara, 1439). Ugo studied in Florence and Bologna, and taught in Pavia before moving to Ferrara, where he was appointed personal physician of the duke, Niccolò III d'Este.[77] It is to the said duke that his commentary, probably completed

[75] Iacopo da Forlì, *In Hippocratis Aphorismos*, f. 126vb: "Prima conclusio. Ad salvandum intensionem unius contrarii ab altero in corporibus simplicibus necesse est praeter qualitates primas in corporibus simplicibus repertas poni aliam vel alias qualitates ad huius intensionem effective concurrentes. Patet, quia oportet poni aliquam qualitatem per se intensionis illius effectivam, sed illa non potest esse qualitas prima, quia una non est per se alterius productiva; igitur etc. Patet consequentia et assumptum similiter intelligenti. Item talis intensio non fit per se et immediate a sibi contrario, per tertiam suppositionem, nec per solam partium unionem, per primam, nec a qualitate quae est in passo [*ed.*: passio], quia pono ipsum totum uniforme. Et patet nullam partem posse agere in aliam nec in se per qualitatem per quam ipsa est uniformis. Relinquitur igitur aliud vel aliam qualitatem per se et immediate ad hoc concurrere effective. Secunda conclusio sequitur. Huiusmodi qualitas talis qualitatis productiva est species vel radius a qualitate subiective in corpore cuius qualitas intenditur existente decisus vel productus. Patet, quia non est aliqua qualitatum in istis corporibus existentium, igitur necessario est aliquid ab istis vel ab aliquo istorum causatum vel productum, sed non apparet aliud quam radius vel species alicuius istarum qualitatum; igitur. Imaginandum est enim quod, sicut color [*ed.*: calor] est sui speciei multiplicativus in medio, ita calor et frigiditas, et quod, sicut caliditas est qualitas magis activa quam color [*ed.*: calor] et odor, ita et eius species. Est enim immutativa non solum specialiter, sed etiam est talis qualitatis quale est obiectum a quo deciditur productiva. Imaginandum ulterius quod, sicut ab opaco vel a speculo reflectitur lumen et species coloris, ita a frigido species caloris, et a calido frigiditatis. Ex quo patet modus quod unum contrarium ab alio circumdante intenditur et e contra, quia a calido circumdante multiplicatur radius ad frigidum, qui reflexus ad calidum in subiecto a quo fuit decisus producit caliditatem, et sic de aliis." I have corrected the edition with manuscripts Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. Lat. 2464, f. 109vb and 2466, f. 72ra.

[76] Iacopo da Forlì, *In Hippocratis Aphorismos*, f. 126vb: "Ex quo solvi possunt probleumata multa. Primum, quare in cavernis terrae profundis in [127ra] hyeme reperitur intensa caliditas, aestate vero intensa frigiditas. Et per idem aquae puteales in hyeme sunt calidae, aestate vero multum frigidae. Similiter quare in hyeme non generantur grandines, in vere autem et aestate, sic etiam in autumno. Et multa alia. Et quare frigiditas intensior est in media regione aeris in aestate quam in hyeme. Et quo modo intensior potest in aestate esse frigiditas generans grandinem quam frigiditas generans nivem tempore hyemis, etc. Patet enim ad haec omnia responsio ex fundamento iam dicto."

[77] On Ugo Benzi, see Dean Putnam Lockwood, *Ugo Benzi. Medieval Philosopher and Physician (1376-1439)* (Chicago: The University of Chicago Press, 1951), esp. 35-43 for his commentaries on medical works. The preface of Ugo Benzi's commentary on Galen was published by Lockwood, *Ugo Benzi*, 212-213. Ugo Benzi also commented on Aristotle's *De somno et vigilia*: Ugo Benzi, *Scriptum De somno et vigilia*, edited by G. Fioravanti and A. Idato (Siena: La Nuova Italia, 1991). I could not find any mention

in 1414, is dedicated.[78] In his exegesis of *Aphorisms* I, 15, Ugo Benzi states that, in some circumstances, one quality can strengthen the contrary one. The examples he gives to illustrate this principle are directly taken from the first book of Aristotle's *Meteorology*, to which he explicitly refers. Ugo explains that, in summer, when vapor rises in the atmosphere, it condensates into hail. This strong condensation does not happen when the air is not warm enough, in which case the vapor only condensates into water. In the same way, ground waters are colder in summer and warmer in winter, because of the contrast with the outside temperature.[79] Similarly to Iacopo, Ugo provides two explanations of the fortification by the contrary quality. According to the first one, when a quality is completely surrounded by the contrary one, it tends to escape its contrary by concentrating towards its own center. Since a concentrated virtue is stronger than a dispersed one, the surrounded quality gets reinforced. Ugo stresses that this process does not happen in every kind of body, but in gaseous matter, such as vapor, which gives rise to the precipitations, and exhalation, which gives rise to winds, rather than in solid matter. He then redirects his reader to Aristotle's *Meteorology* for further details.[80] According to the second explanation provided by Ugo, the surrounding quality strengthens the surrounded one by letting its parts mix. As the weakest parts are intensified by the stronger ones and tend to be assimilated by them, by the end of the process all the parts of the surrounded quality are reinforced. This explanation applies particularly to heterogeneous bodies, in which some parts are stronger than others, but does not seem to fit for uniform bodies.[81] To explain how the

of the process of antiperistasis corresponding to the passage where Aristotle explains sleep as a concentration of heat within the body (457b2, 458a27).

[78] For his commentary, see Kibre, "Hippocrates latinus III", 266-267.

[79] Ugo Benzi, *Expositio super Aphorismos Hippocratis et super Galeni commentum* (Venetiis: Ottaviano Scoto, 1498), f. 25va: "Nota tertio quod per contrarii iuxtapositionem quandoque aliud contrarium fortificatur, ut experientia [docet et] notat quod vapor ascendens in aere tempore estatis convertitur et fit glacies cum fit grando. Qui tamen vapor, cum medium non est vehementer calidum, non ita in glacie convertitur, sed fit pluvia. Hoc idem videmus quia aque puteales sunt estate frigidiores [*ed.*: frigidioris], hyeme vero calidiores, et talem fortificationem dicit Aristotelem fieri per antiperistasim, id est contrarii iuxtapositionem." I have corrected the text of this edition (on which see Lockwood, *Ugo Benzi*, 387) with the manuscripts Paris, Bibliothèque Nationale de France, lat. 6848, ff. 1r-222va, at f. 37v; Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. Lat. 2471, ff. 61r-151r, at 88v and 2489, ff. 1r-133r, at f. 40r.

[80] Ugo Benzi, *Expositio super Aphorismos*, f. 25va: "Notandum quarto quod hec contrarii fortificatio duobus modis contingit: unus est <quod> contrarium circumdatum a contrario undique ab illo fugiens secundum omnes suas partes petit centrum, et ita uniuntur sue partes, et ita unaqueque ab alia recipit maius iuvamentum aliis partibus quam prius. Et hoc modo dicitur quod virtus unita est fortior seipsa dispersa. Hec autem fortificatio fit a natura talium corporum que refugiunt iuxtaposito contrario. Talis autem natura maxime in corporibus vaporosis invenitur, nam ferrum et lapides aut talia non videntur hanc habere virtutem, sed vapores et venti videntur, et res vaporose subtiles, et hoc est magis in libro *Metheororum* videndum."

[81] Ugo Benzi, *Expositio super Aphorismos*, f. 25va: "Secundus modus fortitudinis est quia non solum partes magis uniuntur, sed qualitas contraria qualitati circumdanti fortius intendatur quam si contrarium non approximaretur, et tunc illud in rebus difformibus facilem habet causam, quia

intensification by the contrary quality also happens in homogeneous bodies, Ugo therefore resorts to a more general explanation, which he ascribes to some *quidam*. This is the theory of the multiplication of species, which Ugo presents in a very similar way to Iacopo.[82]

Iacopo's explanation, and even wording, can also be found in the commentary by another Italian physician, Giovanni Sermoneta, active between 1411 and 1444.[83] Interestingly, both Iacopo da Forlì and Giovanni Sermoneta, who probably follows him, state that this explanation of the concentration of vital warmth in winter is more philosophical than medical.[84] Just like Buridan ascribed to the physicians the distinction between penetrating and non-penetrating cold, as well as the view according to which the body is warmer in winter because of the closure of the pores at the surface of the skin, the physicians ascribe to the philosophers the explanation of *Aphorism* I, 15 based on the theory of the multiplication of species. This double movement clearly shows the interrelations between medical and physical discourse on the subject of antiperistasis, a feature that seems to be a peculiarity of scholastic debates. In fact, Aristotle only

partes minus intense partibus intensioribus appropinquantur et ab eis assimilantur et intenduntur, ita quod totum redditur intensius quam prius esset."

[82] Ugo Benzi, *Expositio super Aphorismos*, f. 25va: "Sed supposito vapore uniformi frigido, videre [*ed.*: videtur] quomodo per antiparistasim intendatur non est tam facile. Quidam tamen imaginantur hunc modum quod qualitates prime agunt sibi similes qualitates per species spirituales que sunt alie a qualitatibus primis, sicut lumen a luce, habent tamen virtutes generandi similes illis a quibus deciduntur. Imaginantur secundo quod quemadmodum species visibilis reflectitur a speculo denso et opaco, ita species caliditatis et frigiditatis et aliarum qualitatum reflectuntur a corpore contrario qualitate forti informato. Et ideo ille species supra subiectum suum reflexe talia corpora intendunt."

[83] Giovanni Sermoneta, *Quaestiones super Aphorismos Hippocratis* (Venetiis: Bonetus Locatellus, 1498) I, 17, *Utrum corpora humana sint calidiora tempore hyemis quam estatis vel autumni*, f. 17va: "Tertio est notandum quod dupliciter possumus imaginari unum contrarium alterum vigorare et fortificare. Primo uniendo et aggregando partes, que redduntur potentiores ad agendum et resistendum quam prius, ipsis ad invicem melius applicatis; tunc enim unaqueque istarum partium melius conservat alteram. Melius etiam iuvat alteram ad agendum, tum quia fit actio per breviores lineas, tum etiam quia ipsis melius applicatis fit in actione iuvamentum accidentale maius. Et propter hoc dixerunt quod virtus unita fortior est seipsa dispersa. Secundo imaginari possumus unum contrarium fortificare aliud quia ipsum intendat in forma." It may be remarked that the text almost literally corresponds to that of Iacopo, quoted above at fns. 72 and 73. On Giovanni Sermoneta, see *Dizionario biografico degli Italiani* (Roma: Istituto della Enciclopedia italiana, 1960-2021), vol. 92, 161.

[84] Iacopo da Forlì, *In Hippocratis Aphorismos*, f. 126va: "Respondendo ad istam quaestionem, primo tangetur quidam probabilis modus respondendi, et magis naturalis quam medicinalis." And again, after having exposed this theory: "Et secundum haec dicta consequenter non solum dicendum Hippocratem dixisse ventres esse calidiores propter maiorem spirituum multitudinem, sed etiam quia gradualiter spiritus sunt calidiores et adhuc membra. Haec autem responsio est magis physica quam medicinalis, ideo philosophis dimittatur", f. 127ra. Giovanni Sermoneta, *Quaestiones super Aphorismos Hippocratis*, f. 17va: "fuit opinio quorundam magis philosophantium quam medicinaliter loquentium, dicentium quod corpora humana sunt intensive calidiora tempore hyemis quam estatis, quorum fundamentum est quia unum contrarium ab alio circumdatum intenditur."

rapidly proposes an application of antiperistasis to organic matter in the treatise *De somno*, but not in *Meteorology*. On the contrary, it seems that among scholastic masters this interaction was current also beyond the tradition of commenting on Aristotle's *Meteorology*. Thomas Bradwardine's *De causa Dei contra Pelagium* provides a significant example of the medical application of antiperistasis. In order to exemplify God's providential action, which only tolerates evil as a means for emphasizing good, Bradwardine introduces the example of the drugs prepared by the physicians, which act by antiperistasis, stimulating a contrary reaction.[85] Bradwardine does not expand on this analogy, which should therefore have been evident to his readers.

As shown by the texts of Ugo Benzi and Iacopo da Forlì, the main reason that seems to have led the philosophers and the physicians to resort to the theory of the multiplication of species is the idea that a new quality cannot be produced by the simple concentration of a preexisting one. Now, if we assimilate the fortification of a quality by antiperstasis to the production of the same quality, and if we admit that these processes cannot be caused immediately by the contrary quality, we have to postulate a positive, essential cause of antiperistasis – namely, for our masters, the multiplication of species.

The question as to whether the intensification caused by the process of antiperistasis implies the generation of a new quality was indeed rather controversial. Some commentators, including Blasius of Parma (1355-1416) and Nicolaus Theoderici from Amsterdam († before 1456), pointed out that the strengthening of a quality cannot be caused by its simple reflection towards the interior part of the body. In fact, this assertion would imply that an accident (the quality in question) passes from one subject (the extremities of the body affected by antiperistasis) to another (the central parts of this body), a possibility excluded by the Aristotelian natural philosophy (*De gener. et corrupt*. I, 10, 327b22).[86] This is why Blasius concludes that, when a quality is intensified by antiperistasis, one must admit that a new quality is generated in the course of this process.[87] Nicole Oresme solves this problem differently. According to him, it is not

[85] Thomas Bradwardine, *De causa Dei contra Pelagium et de virtute causarum ad suos Mertonenses libri tres*, ch. 34, edited by H. Savile (London: apud Ioannem Billium, 1618; reprint Frankfurt am Main: Minerva, 1964), 301 B: "[Deus] Non enim vult peccatum nisi forsan sicut Medicus in medicamentibus suis vult venenum, in quantum scilicet valet ad exercitium bonorum, ad punitionem malorum, ad pulchritudinem universi per antiparistasin contemplandam."

[86] On this principle, see Silvia Donati, "*Utrum accidens possit existere sine subiecto*. Aristotelische Metaphysik und christliche Theologie in den Physikkommentaren des 13. Jahrhunderts", in *Nach der Verurteilung von 1277. Philosophie und Theologie an der Universität von Paris im letzten Viertel des 13. Jahrhunderts*, edited by J. A. Aertsen, K. Emery and A. Speer (Berlin and New York: Walter de Gruyter, 2001), 377-617.

[87] Blasius de Parma, *Questiones in Meteorologica* I, 5, ms. Città del Vaticano, BAV, lat. 2160, f. 72vb: "Queratur an huiusmodi intensio fiat per renovationem an per novam generationem, quod volo dicere. Verum est quod aliqui ponunt talem modum quod frigiditas intendit caliditatem revocando ipsam a partibus circumferentialibus ad centrum, et sic dicunt medici quod humana corpora fiunt calidiora in yeme per revocationem caloris ad intra. Dicamus ergo ad hanc dubitationem duo.

necessary to postulate the generation of a new quality in the process of antiperistasis. In fact, Oresme does not consider the quality itself to move from the extremities of a body towards its center, but the parts of said body to move in this way, carrying along the quality in question.[88]

The movement of a body involved in the process of antiperistasis was in itself a problematic question to be solved within the Aristotelian theory of motion. Aristotle distinguishes two kinds of movements: natural movements, which result from a principle intrinsic to the moving body, and violent ones, which are caused by a principle external to it. Each simple body has only one natural movement, which takes it to its natural place. The natural motion of fire, for instance, raises it towards the sphere of fire, located above the sphere of air, but underneath the celestial sphere. This is why the flame of a candle moves upwards. Starting from this principle, it seems that the motion of lightning, which has a fiery nature, but moves downwards to escape the coldness of the clouds, should be considered violent. Yet this movement, just like the other ones that are caused by a process of antiperistasis, results from the natural and intrinsic principle of self-conservation, which leads a body to escape from another with contrary qualities, in order not to be destroyed by it. For this reason, scholastic commentators commonly considered the antiperistatic motion as natural.[89] This qualification is rather problematic, as Aristotle maintains that a natural body only has

Primum est: unum contrarium non intendit aliud per revocationem talis qualitatis a circumferentia versus centrum. Patet, quia si ille modus est verus, oportet concedere accidens transire de subiecto ad subiectum, quod quilibet naturalis negat [73ra]. Secunda propositio: unum contrarium fortificat et intendit aliud per novam generationem talis qualitatis. Et modus iste est, unde declarando in uno proposito aque puteales in yeme calefiunt et corpora humana, pro tanto quia corpus humanum, cum sit ex se calidum, difundit [*sic*] a se caliditatem, que caliditas sic difusa [*sic*] per continens reflectitur a suo contario, et in hac reflexione fit nova generatio caliditatis in proprium subiectum, sicut patet cum radii solar[i]es flectuntur ad unam partem, generant magnam caliditatem et ignem consequenter. Notice the reference to the physicians (*medici*).

[88] Nicole Oresme, *Questiones in Meteorologica* I, 10, in *Questiones in Meteorologica de ultima lectura, recensio parisiensis. Study of the Manuscript Tradition and Critical Edition of Books I-II.10*, edited by A. Panzica (Leiden and Boston: Brill, 2021), 175: "Ad quintam: sequitur quod accidentia migrarent de subiecto, etc., dico negando consequentiam, quia non solum caliditas que est in partibus extremalibus movetur versus partes centrales, verum etiam partes extreme in quibus est ipsa caliditas."

[89] Iohannes Buridanus, *Questiones in Meteorologica* I, 7, vol. 2, 114; Nicole Oresme, *Questiones in Meteorologica de ultima lectura* I, 10, 172; Blasius de Parma, *Questiones in Meteorologica* I, 5, ms. Città del Vaticano, BAV, lat. 2160, f. 72va: "Prima difficultas sit de motu quo unum contrarium fugit ab alio, et queratur an iste motus sit naturalis an violentus. Quod sit violentus patet, quia fit a principio extrinseco suo contrario. Quod sit naturalis patet, quia quodlibet ens diliget permanere; ideo naturaliter unum contrarium fugit ab altero. Et ad hanc respondeo quod iste motus est naturalis, et hoc propter rationem adductam (...). Ad rationem in contrarium, cum dicitur: 'iste motus fit a principio extrinseco', negatur hoc; unde non est ymaginandum quod unum contrarium repellet a se suum contrarium, sed unum contrarium propter conservationem sui ipsius movetur a principio intrinseco fugiendo a suo contrario."

one natural motion (*De caelo*, I, 2, 268b30-269a2). If the fire of the exhalation within lightning has a natural tendency to move upwards, it can not have another, contrary, natural tendency to move downwards. Some fifteenth-century commentators solve this problem by ascribing the antiperistatic motion to the common nature (*natura communis*), a universal principle which can lead the bodies to move against their natural tendency in order to preserve the general order of nature and to avoid inadmissible consequences (at least within Aristotle's physics), such as the formation of a void.[90]

Interestingly, the difficulty of describing the antiperistatic motion within the Aristotelian dichotomy between natural and violent motions was perceived also in the medical tradition. The Italian thirteenth-century physician Taddeo Alderotti (1215-1295), for instance, tried to describe the intensification caused in the process of antiperistasis – for which he does not use a proper name – in light of the Aristotelian distinctions of motion. In his commentary on the *Aphorisms*, Taddeo explains that the augmentation of heat in the inside of the body in winter is partly natural, because of the increased intake of food during this time of the year, and partly violent, because of the exterior cold. Taddeo stresses the fact that even though the origin of this intensification is a violent one, the intensification itself may be said to be natural, because it results from the subject that is intensified and from its goal, which is its natural activity (*operatio*). In fact, this accidental intensification makes the natural activity of the subject stronger. Now, everything that makes the natural activity of a subject stronger should be considered natural to it.[91] Differently from the

[90] This is the case for the Parisian master Iohannes Versoris, whose lectures on the Aristotelian corpus date back from the '40s and the '50s of the fifteenth century: "Et si queratur an naturaliter et a principio intrinseco unum contrarium moveat fugiendo reliquum, respondetur quod fit secundum naturam communem et non secundum naturam propriam", *Questiones in libros I–IV Meteororum* (Köln: Konrad Welker, 1488), f. 4ra. Outside Paris, this position was adopted, for instance, by an anonymous German master whose commentary is transmitted in ms. Frankfurt (Main), Stadt- und Universitätsbibliothek, Ms. Barth. 146: "Tertio dubitatur utrum motus localis quo partes extremales aque moventur versus partes centrales (...) sit naturalis vel violentus. Et videtur quod sit naturalis simpliciter, quia fit a principio intrinseco passo (...). In oppositum arguitur, quia tunc eidem corpori simplici convenirent plures motus simplices, quod est contra Philosophum primo *Celi*. Respondetur quod talis motus aque est simpliciter naturalis, non tamen secundum naturam propriam, recte sicut motus aque sursum ad replendum vacuum, et ita talis motus est aque naturalis secundum naturam communem, et per consequens posset dici motus preter naturam", ff. 333v-334r. On the common nature, see Nicolas Weill-Parot, *Points aveugles de la nature. La rationalité scientifique médiévale face à l'occulte, l'attraction magnétique et l'horreur du vide (XIII^e^-milieu du XV^e^ siècle)* (Paris: Les Belles Lettres, 2013), 271-339.

[91] Taddeo Alderotti, *In Aphorismos Hippocratis Expositio*, ms. Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4465, f. 7vb: "Preterea dicitur quod venter yeme est calidum violenter, quia frigus aeris violenter facit calorem fortiorem. Preterea, augmentatio caloris fit a frigore per accidens, eo quod unum contrariorum auget aliud per accidens et non per se, ergo non augetur calor naturaliter, sed potius accidentaliter. Ad primum dico quod augmentum quod recipitur calor in yeme dupliciter fit, scilicet partim violenter a frigore aeris et partim naturaliter ab augmentatione nutrimenti, tamen principium illius augmenti est solum a frigore. Sed licet augmentum eius factum

commentators on Aristotle's *Meteorology* we have just reviewed, Taddeo is not interested in the local motion caused in the process of antiperistasis, but in the passage from a certain degree of a quality to a superior one. Be it in its local or in its quantitative sense, the antiperistatic motion did not stop raising questions among the philosophers and the physicians permeated by the peripatetic concept of motion.

Conclusions and research perspectives

Let us now sum up the main results of this inquiry. Differently from the antipersitasis to which Aristotle refers in the *Physics*, which is a principle of the dynamics of fluids, the antipersitasis described in *Meteorology* applies to the dynamics of the primary active qualities, hot and cold. If the redistribution of fluids caused by a violent motion expresses a constant in Aristotle's physics, the intensification by the contrary quality is the exception, and not the rule.[92] This second kind of antiperistasis can be described as the result of a resistive effort which leads a quality surrounded by the contrary one to concentrate in order not to be corrupted. This mechanism represents thus a particular application of the general law according to which each entity aims at its preservation. In spite of this, Aristotle applies this process mainly to inorganic matter, as he makes abundant use of this explanation in a treatise devoted to inanimate matter, as *Meteorology* is, and only a pretty spare use of it in his biological treatises. The rapid mention in the treatise *On respiration*, in which Aristotle expresses criticism on Plato's theory, concerns the process of antiperistasis described in the *Physics*. Thus, the only explicit reference to antiperistasis as action on contrary qualities in Aristotle's biological works seems to be that in the treatise *De somno*, where Aristotle states that sleep is caused by a concentration of the vital warmth within the body (457b2, 458a27). Contrary to the Aristotelian treatment of antipersistasis, medieval analyses in commentaries on *Meteorology* would later develop a link between physics and biology, in an implicit as well as in an explicit way. On the one side, scholastic masters ascribed ascribed to the inorganic agents of the process of antiperistasis, hot and cold, features of the animate matter, like the perception of its contrary and the tendency of escaping it. On the other side, medieval commentators on Aristotle's *Meteorology* explicitly borrowed distinctions (such as the one between penetrating and

sit a violentia, nichilominus dicitur tale 'natura', quia recipit denominationem a subiecto cui fit aditio [*sic pro* additio, *ut semper*] et a fine, que est sua operatio, nam operatio naturalis efficitur per eum fortius et melius quam primo, licet aditio <sit> facta violenter ratione qualitatis caloris que fugit suum contrarium. Ad secundum dico quod patet solutio per hec omnia que dixi iam, nam calor ille sic augmentatus non dicitur 'naturalis' propter modum secundum quem est augmentatum per causam exteriorem, sed propter utilitatem et bonitatem sue actionis, nam omnia opera natura bene agit."

[92] Nicolaus Oresme, *Questiones super Physicam*, II, 11, edited by S. Caroti, J. Celeyrette, S. Kirschner and E. Mazet (Leiden and Boston: Brill, 2013), 249, 52-250, 53: "sicut ignis determinatur ad calefaciendum et non frigefaciendum nisi raro et per accidens, sicut in antiperistasi."

non-penetrating cold) and explanations (such as the intensification of vital warmth due to the closure of the pores at the surface of the skin) from the physicians. Moreover, the medieval commentators (both on Aristotle's *Meteorology* and on Hippocrates's *Aphorisms*) applied the model of antiperistasis to organic matter, particularly to land animals and even to men, whose complexion they explained based on the climate, as we have seen in Blasius of Parma's commentary. The references to the medical tradition in medieval discussions on antiperistasis can be traced back to a remark in Galen's commentary to Hippocrates's *Aphorisms* I, 15, where Galen explains that the belly is warmer in winter than in summer because of the antiperistasis exerted by the cold air on the vital warmth of the body. This interpretation was adopted and further developed by medieval commentators on the *Aphorisms*. Following Galen's path, many of them explicitly applied the model of antiperistasis described in the first book of Aristotle's *Meteorology* to a biological context, thus establishing a link between physics and medicine substantially extraneous to Aristotle's theory.

The medieval commentators also tried to reinsert an apparent exception in Aristotle's natural philosophy, as the intensification due to the contrary quality was, in a coherent model of physical causation. In order to achieve this goal, they had to clarify some key notions in this process, such as the resistance exerted by the surrounded quality. Starting from the mid fourteenth century, they explained antiperistasis in the light of the model of the multiplication of species, according to which the strengthening caused by antiperistasis is due to the reflection of the virtual rays of a quality against the surrounding contrary quality. Yet even within this model, the antiperistatic motion remained somehow problematic: first, because it was difficult to determine the exact conditions for antiperistasis to take place, since in most cases a quality is weakened, and not reinforced, by the contrary quality; secondly, because this notion seemed to escape to the Aristotelian opposition between natural and violent movements. I consider that the interest of studying medieval discussion on antiperistasis lies exactly in this (partial) incompatibility with the categories of Aristotelian physics, which the medieval commentators tried to deepen, and also to adapt, in order to include the apparent paradoxical phenomena for which Aristotle elaborated this explanation.

Mentions of the process of antiperistasis in later authors and outside the commentary tradition on Aristotle's *Meteorology* show that it more frequently indicated the fortification of a quality caused by the contrary one than the redistribution of fluids described in the *Physics*. As the example of Bradwardine's *De causa Dei* has shown, the process of antiperistasis was sometimes mentioned in this sense in theological contexts. This is also the case for John Gerson (1363-1429), who mentions antiperistasis in a rhetorical enumeration illustrating the tribulations endured by the soul in its path towards contemplation. The image of a "spiritual antiperistasis, which reinforces its contrary", is evoked by Gerson to illustrate the purification of the soul together with other examples taken from physical processes, such as sharpening of iron with a stone, souring of children with wormwood, stretching with hammers, polishing with a file,

purifying gold in a furnace.[93] It seems moreover that the concept of antiperistasis as action on contrary qualities remained familiar to the readers of scholarly texts in Latin, if in his *De dignitate et augmentis scientiarum*, a text published in 1623, a fiery opponent to Aristotelism and Scholasticism like Francis Bacon, resorts to the example of antiperistasis to explain that desire increases when resistance and prohibitions oppose it, in the same way that cold increases vapor exhaled by plants.[94] Some thirty years after Bacon, Thomas Hobbes mocks the vacuity and multiplicity of scholastic concepts employed to explain natural phenomena. In the *Leviathan* (1651), Hobbes mentions antiperistasis as part of a philosophical arsenal encompassing species, potency, substantial form, incorporeal substance, instinct of nature, sympathy and antipathy, occult and specific qualities, chance and fortune: all concepts that, according to Hobbes, merely serve to hide the ignorance of their proponents.[95] Despite Hobbes's criticism,

[93] Iohannes Gerson, *De mystica theologia practica*, consideratio 9, in Jean Gerson, *Œuvres complètes*, edited by P. Glorieux, vol. 8, *L'œuvre spirituelle et pastorale (399-422)* (Paris: Desclée & Cie, 1971), 38: "Haec est antiperistasis quaedam spiritualis quae contrarium fortificat; haec est cos ferrum exacuens, haec absinthium pueros ablactans avellens que ab uberibus; hoc malleus dilatans et extendens sicut psalmista inquit: in tribulatione dilatasti mihi; haec lima poliens, mundans, eruginans eruginans et clarificans; haec fornax quae aurum purgat ut rutilet; haec est virga quae percussos erigit ab inferno ut dicat tribulatus conformans se perceptae gratiae: Domine, si sic vivitur et in talibus vita spiritus mei, corripies me et vivificabis me, ecce in pace amaritudo mea amarissima; illud quoque: Ingrediatur putredo in ossibus meis et subter me scateat, ut requiescam in die tribulationis et ascendam ad populum accinctum, civium videlicet supernorum." A second reference to the antiperistasis described in Aristotle's *Meteorology* as the fortification of a quality caused by the contrary one can be found in another theological work by Gerson, the *Collectorium super Magnificat*, which evokes the distinction between "penetrating" (*penetrans*) and "not penetrating" (*non penetrans*) contrary that we have found in Buridan's *Questions on Meteorology* and in the commentaries influenced by it: Iohannes Gerson, *Collectorium super Magnificat*, pars 2, tract. 9, in Jean Gerson, *Œuvres complètes*, edited by P. Glorieux, vol. 8, 430: "Habet virtus suam antiperistasim; coadunatur in se ex circumstante, non penetrante, contrario ac perinde fortificatur. Sed et Job percussus ulcere pessimo, sedet in sterquilinio ubi velut in throno regio concionatur."

[94] Francis Bacon, *De dignitate et augmentis scientiarum*, lib. II, ch. XIII, in *The Works of Francis Bacon*, vol. 2, edited by J. Spedding, R. Leslie Ellis and D. Denon Heath (New York: Hurd and Houghton, 1864), 249: "Quod ad primum enim attinet, omnis cupiditas per renitentiam et vetitum et tanquam antiperistasin (veluti per frigora brumae hedera) virescit, ac vigorem acquirit." Another example of the same metaphorical use of the concept of antiperistasis in moral matters can be found in book III, ch. I, 255: "*Augetur vis agentis per antiperistasin contrarii*, regula est in Physicis. Eadem mira præstat in Politicis; cum omnis factio, ex contraria ingruente, vehementer irritetur."

[95] Thomas Hobbes, *Leviathan*, pars IV: Of the Kindome of Darknesse, ch. 46, 3 vols., edited by N. Malcolm (Oxford: Clarendon Press, 2012), vol. 3, 1088-1090 (Latin translation, 1089-1091): "And in many occasions they put for cause of Naturall events, their own Ignorance; but disguised in other words: As when they say, Fortune is the cause of things contingent; that is, of things whereof they know no cause: And as when they attribute many Effects to *occult qualities*; that is, qualities not known to them; and therefore also (as they thinke) to no Man else. And to *Sympathy*, *Antipathy*, *Antiperistasis*, *Specificall Qualities*, and other like Termes, which signifie neither the Agent that produceth them, nor the Operation by which they are produced. If such *Metaphysiques* and *Physiques*

however, antiperistasis still remained for a while in the repertorium of Western philosophical terms and concepts, as shown by Johannes Micraelius's and Étienne Chavin's lexica.[96]

These rapid mentions show that a survey of physical and metaphorical uses of the concept of antiperistasis in modern authors would not be without interest for retracing the history of this neglected Aristotelian theory. This is a task for further investigation on a tradition that still remains unexplored. If the weight of the medical tradition in medieval discussions on antiperistasis should be studied in greater detail, the subsequent Latin reception of this concept in Renaissance and Early modern commentaries, as well as a wider contextualization within the Greek and Arabic exegetic tradition of Aristotle's *Meteorology*, need to be taken into account.

Aurora Panzica

aurora.panzica@gmail.com

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as this, be not Vain Philosophy, there was never any; nor needed St. Paul to give us warning to avoid it."

[96] Micraelius remarks that antiperistasis explains the causes of many meteorological phenomena, such as lightning and thunderbolts, as well as many diseases, thus confirming the link between meteorology and medicine on this topic: "Antiperistasis, Circumobsistentia est circumstantia contrariae qualitatis: unde fit, ut inclusa qualitas vim suam intra se uniat, et fortius deinde erumpat, juxta illud: *Vis unita fortificat.* Sic cum frigida circumstant calorem, ille intus occlusus vires suas intra se cogit. Idem faciunt frigida, si circumstat calor. Et per ἀντιπερίστασιν causae redduntur plurium meteororum, et imprimis fulminis et tonitrui; apud medicos etiam plurium morborum. Dicitur etiam *compressio et cohibitio mutua*", Johannes Micraelius, *Lexicon philosophicum terminorum philosophis usitatorum* (Stetini: Mamphrasius, 1661, second edition corrected by the author), vol. 1, col. 139. The link between meteorology and medicine is also evident in the long article dedicated to antiperistasis in Chauvin's lexicon, which mentions Hippocrates's principle according to which the belly is warmer in winter than in summer as an example of antiperistasis and refers to the explanation of the multiplication of species: Étienne Chauvin, *Lexicon Rationale, sive Thesaurus Philosophicus* (Rotterdam, 1692; new augmented edition: Leeuwarden, 1713), f. 2v.

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