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On Democritean *Rhysmos*

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Abstract: In *Metaphysics* A.4 (985b4-19 [DK67 A6]), Aristotle provides crucial information about fundamental aspects of the chemistry and microphysics of the atomic theory of Leucippus and Democritus of Abdera. Besides the plenum and the void, which he identifies as the elements of the atomic theory, he presents what he himself names as *differences*. These fundamental differences are named so because they ought to be responsible for the emergence of all other differences in the physical world, and especially the ones that hit our senses. Aristotle provides a list of three differences both

in what is recognized as autochthonous terminology from Leucippus and Democritus, and in a translation to terms apparently more intelligible to Aristotelian listeners. Among those differences there is one in particular that is harder to comprehend than the other ones: *rhysmos*. Aristotle's translation of *rhysmos* into *schēma* has led most interpreters to acknowledge that it referred solely to atoms individually, while the other two differences would refer to relations between atoms. In this paper, I want to propose an interpretation in which *rhysmos* actually refers to several aspects of the chemistry and microphysics of the atomic theory.

Keywords: ancient atomism, ancient chemistry, Democritus, *rhysmos*, configuration, motility.

I

In his historical summit of *Metaphysics* A, Aristotle summarizes the atomic doctrine of Leucippus and Democritus thus:

> (1) Leucippus and his companion Democritus state that the plenum and the void are elements, (2) saying that one is such as what-is and the other as what-is-not; from these, the plenum and solid as what-is, and the void [*and rare*] as what-is-not (which is why they say that what-is is no more than what-is-not, because body is no more than void); and [say] that these are the causes of the things that are as matter. (3) And just as those who make the underlying essence as one and generate everything else by its affections, positing the rare and the dense as principles of the affections, they too, in the same way, say that the differences are the causes of the other things. (4) Yet they say that these <differences> are three: shape, array, and position.[1]

[1] I adopt the suggestion of Mourelatos (2005, p. 39, n. 2), who translates τάξις into 'array' to avoid usual choices such as 'arrangement' or 'order'. However, even though I understand his reasons for translating θέσις into 'posture', I would rather keep 'position', because this word seems to me to be closer to the verb τίθημι. I am not completely sure that the "semantic component of orientation or (geometric)

> For they say that what-is differs in "*rhysmos*", "*diathigē*", [2] and "*tropē*" only. (5) From these, "*rhysmos*" is shape, "*diathigē*" array, and "*tropē*" position; for A differs from N in shape, AN from NA in array, and Z from N in position. (6) As regards motion, however, namely, whence and how it occurs in the things that are, this they blithely neglected, just like the others. (985b4-21 [DK67 A6])[3]

This summary is very rich and dense with information about Leucippus and Democritus' atomism. It starts with what Aristotle would recognize as having the function of elements in the atomic doctrine – the plenum and the void – and hints to the ontological status of these things relating them to *what-is* and *what-is-not*, terms

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attitude" that Mourelatos wants to recover is fully implied in θέσις. Rather, it seems to me that Aristotle adds it to θέσις with his example two sentences further.

[2] Laks & Most (2016), however, choose the variant διαθηγῇ (and διαθηγή in the next sentence), which they translate as 'disposition'. It is not clear to me the reason for this choice, whether, for instance, they are assuming διαθηγή as being related to θήγω instead of θιγγάνω as is usually taken regarding διαθηγῇ. Θήγειν means 'to sharpen' or 'to whet', and has also the metaphorical sense of 'to excite', which may lead to a certain type of *disposition*. It could make sense with Democritean microphysical dynamics, but it seems too far from Aristotle's translation into τάξις, whereas διαθιγὴ seems to work better both with the translation and with the example. Another problem with διαθηγὴ is that it could also mean 'thoroughly sharpen', which does not make much sense. What would it mean for an atom or a compound to be utterly sharpen? Some additional aspect of shape, perhaps? Finally, I wonder why they would not accept the manuscript versions that have διαθιγή, when in LM27 R47 (at *GC* I.9 327a18) they do find διαθιγή (there translated as 'contact', not 'disposition').

[3] My translation, with borrowings from Taylor, 1999; Mourelatos, 2005; Angioni, 2008; and Laks & Most, 2016 (LM27 D31); based on the Greek text edited by Primavesi (2012): Λεύκιππος δὲ καὶ ὁ ἑταῖρος αὐτοῦ Δημόκριτος στοιχεῖα μὲν τὸ πλῆρες καὶ τὸ κενὸν εἶναί φασι, λέγοντες οἷον τὸ μὲν ὂν τὸ δὲ μὴ ὄν, τούτων δὲ τὸ μὲν πλῆρες καὶ στερεὸν τὸ ὄν, τὸ δὲ κενόν [*τε καὶ μανὸν*][3] τὸ μὴ ὄν (διὸ καὶ οὐθὲν μᾶλλον τὸ ὂν τοῦ μὴ ὄντος εἶναί φασιν, ὅτι οὐδὲ τοῦ κενοῦ τὸ σῶμα), αἴτια δὲ τῶν ὄντων ταῦτα ὡς ὕλην. Καὶ καθάπερ οἱ ἓν ποιοῦντες τὴν ὑποκειμένην οὐσίαν τἆλλα τοῖς πάθεσιν αὐτῆς γεννῶσι, τὸ μανὸν καὶ τὸ πυκνὸν ἀρχὰς τιθέμενοι τῶν παθημάτων, τὸν αὐτὸν τρόπον καὶ οὗτοι τὰς διαφορὰς αἰτίας τῶν ἄλλων εἶναί φασιν. ταύτας μέντοι τρεῖς εἶναι λέγουσι, σχῆμά τε καὶ τάξιν καὶ θέσιν· διαφέρειν γάρ φασι τὸ ὂν ῥυσμῷ καὶ διαθιγῇ καὶ τροπῇ μόνον· τούτων δὲ ὁ μὲν ῥυσμὸς σχῆμά ἐστιν ἡ δὲ διαθιγὴ τάξις ἡ δὲ τροπὴ θέσις· διαφέρει γὰρ τὸ μὲν Α τοῦ Ν σχήματι τὸ δὲ ΑΝ τοῦ ΝΑ τάξει τὸ δὲ Ζ τοῦ Ν θέσει. Περὶ δὲ κινήσεως, ὅθεν ἢ πῶς ὑπάρχει τοῖς οὖσι, καὶ οὗτοι παραπλησίως τοῖς ἄλλοις ῥᾳθύμως ἀφεῖσαν.

that are recurrent in ontological jargon. I do not intend to discuss the implications of these associations here, for my interest in this paper lies mostly in the sections I marked as 3, 4 and 5. However, let me just state that I do not think proper to associate *atoms* and *plenum* as if they were synonyms. Plenum refers to *all that is full* in opposition to void, where *there is nothing at all*. It cannot be, thus, a strict reference to atoms, because it should include not only atoms, but also everything else that is composed of atoms and is visible, and tangible, and by whatever means accessible to us through our senses. This compound things, of course, are not numerically or spatially different than the mass of atoms (*cf.* DK68 B9). Still, as we shall see, compounds have some "things" that do not belong to atoms themselves, namely properties that emerge from the relationships of atoms within the compounds and internal void, which is not, of course, included in the plenum, and is part of *the* void.

This distinction between the plenum and the mass of atoms themselves is important because in this particular passage, Aristotle is not merely presenting the atomic doctrine as if he was interested in furnishing us a summary of all relevant doctrines among his predecessors. He is particularly interested in showing us how they dealt with his four causes – the material, the efficient, and the formal/final. In the general framework, he thinks he sees a sort of evolution. By evolution, I mean a correlation between time and the advancement of the complexity of doctrines. Yet, when it comes to the atomic doctrine, there seems to be a problem because it appears to be out of place. At the point in time when Leucippus and Democritus introduce their doctrine, the efficient cause is already being hinted at, if not already completely dominated by thinkers such as Anaxagoras and Empedocles.[4] Why would Leucippus and his pupil Democritus roll back and present a completely material account of physics? Not being able to find the efficient cause in their doctrine,

[4] See *Metaph.* A.4 985a10-31.

Aristotle finds himself forced to associate them with the first Ionians.[5]

Sections 1 and 2 of our passage of *Metaph.* A.4 above, then, must be read under the light of this context and especially with section 3 in view. In section 3, Aristotle explicitly associates Leucippus and Democritus with the early Ionians, implying that they too had a rendering for what-is and explaining that in the early Ionian theories, the affections of what-is were explained by *the rare and the dense*. He says, then, that, likewise, Leucippus and Democritus explained that the causes of "other things" (τῶν ἄλλων) were "the differences" (τὰς διαφορὰς), which is a rather odd statement. What are those *other things* and *differences*? The differences he presents right away in section 4 and we will deal with them promptly. As for those *other things*, they can only refer to whatever the plenum refers to. I have already said that, being the opposite of void, the plenum must refer to all there is, and not strictly to atoms, nor should it be taken as a synonym for atoms. But there is another reason to believe so, besides the way in which it is presented in section 2, and that is the comparison with the early Ionians. In the way Aristotle puts them, the theories of the early Ionians are a certain type of monism in which there is one thing that underlies everything else as matter. Thus, he says that Anaximenes's ἀὴρ is one of these things (*Metaph.* A.3 984a5-6 [DK13 A4]) and that Thales water is another (983b20-27 [DK11 A12]). He sometimes seems to include Anaximander's ἄπειρον as well, but he most probably did not.[6] Lastly, he sees in

[5] The account on the Ionians appears in *Metaph.* A.3 983b6-984a8. For the association of Leucippus and Democritus with the early Ionians, see Gomes, 2017.

[6] The association is made, according to Simplicius, by Alexander of Aphrodisias (Simp. *in Ph.* I.4 [187a12] 149.11-13 [DK 63]). Some scholars suggest that when Aristotle mentions "something *intermediary*" between two elements, as in *GC* II.5 332a19-25, he may be referring to Anaximander, since this intermediary would be somewhat undetermined (ἄπειρον). In *Ph.* I.4 187a12-26 (DK12 A9, 16; 31 A46), however, Aristotle clearly distinguishes those who postulate this intermediary (which he includes in the group of the Ionian monists) from Anaximander, Empedocles and Anaxagoras, suggesting that, for these three, the one was a sort of initial pre-cosmic state from whence the differences would be separated. For a good discussion about Aristotle's view of Anaximander's ἄπειρον see Carraro, 2016.

Heraclitus fire something like Thales and Anaximenes's principles (984a7-8 [DK18 7]). Anyway, for the comparison in our passage of *Metaph.* A.4 to work, it must include references in the atomic doctrine both to a monist principle as well as to the principles that respond for the multiplicity perceived in phenomena; and Aristotle provides both. The first can be found in the Democritean[7] plenum. That is what stands for the monist principle of the Ionians. The second lies on the differences, which function like the rare and the dense as the causes of every difference that affects the plenum.

And this is one additional reason why 'plenum' cannot be merely interchangeable with 'atoms', for the atoms cannot be affected nor bear any sort of contrary affections (*GC* I.8 325b36-326a3 [≠ DK]).[8] But compounds can, and, thus, the so-called differences must have something to do with how the compounds differentiate within the plenum, which is exactly how the one material principle and the rare and the dense function in the Ionian theories (at least according to its rendering by Aristotle).[9] Now that the roles of the plenum and of the differences have been established, I will turn to differences, and particularly to one of them which is my main target here: *rhysmos*.

II

In section 4 of our passage of *Metaph.* A.4, Aristotle says that there are three differences according to Leucippus and Democritus. He first says that their names are "shape (σχῆμα), array (τάξις) and position (θέσις)". Immediately afterwards, though, he presents another set of terms that designate these differences, and we learn

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[7] As usual, I will refer everything belonging to Leucippus *and* Democritus as Democritean, since Democritus is the recognized "heir" of their theories and because it is not the point of this paper to think of eventual differences between both.

[8] Contrary affections or contrary qualities, meaning strictly the kind of interchangeable contrary qualities from which Aristotle extract the four main contrary qualities that define his elements (see *GC* II.2).

[9] I discuss more about the elementary role of differences in the chemistry of Democritus in Gomes, 2018b.

that the first three are actually translations he proposes of what seems to be three autochthonous Democritean terms: ῥυσμός, διαθιγὴ and τροπή.[10] From these, ῥυσμὸς is certainly the most difficult to comprehend. According to the LSJ Greek-English lexicon, ῥυσμὸς is the correspondent of ῥυθμὸς in the Ionian dialect. From ῥυθμὸς comes the English word *rhythm*, and its origin is the verb ῥέω (*to flow*, *to stream*, *to pour*, etc.). Ῥυθμὸς seems to refer to a sort of recurrent and regular motion and, as such, can be understood as *measured motion*, and even *time* in the musical sense; also *metrics*, *measure*, *proportion*, *arrangement*, *order*, *state*, *condition*, *disposition*.[11]

There is also the sense of *form* or *shape*, which the LSJ extracts primarily from our passage of *Metaph.* A.4 (based on Aristotle's proposed translation of ῥυσμὸς into σχῆμα), but this sense also appears in Herodotus, who refers to the form or shape of letters; in the Hippocratic corpus: the form or shape of a body; in Xenophon: the form or shape of a breastplate; in Theocritus: the *natural features* of a country; and in Dionysius Periegetes: the *structure* of a substance; etc. Another sense provided by the LSJ is that of *manner*, or *fashion* of a thing.

Σχῆμα, according to the LSJ, really has some senses quite close to those of ῥυσμός / ῥυθμός: *form*, *figure*, *appearance* (as opposed to reality); *the bearing*, *look*, *air*, *mien* of a person; fashion, manner, way of being of something; *the form*, *character*, *characteristic property* of something; *pantomimic gestures*, *posture*; etc.

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[10] Simplicius presents the exact same formulation and translations we find in *Metaph.* A.4 in his commentary to *Ph*. I.2 185b15, 28.17-19 (DK68 A38).

[11] For these meanings of ῥυθμὸς and the passages in which they appear, please refer to the LSJ. This gathering of the meanings of the three differences (which continues in the next paragraphs) draws much from similar gatherings made by other scholars such as Alfieri (1979, p. 71-75), Morel (1996, p. 54-55), Mourelatos (2005), Gemelli Marciano (2007, p. 201-204) and Peixoto (2010). They sometimes come so close together that it is hard to identify which feature was taken from each author.

Aristotle's translation of *rhysmos* into *schēma* may seem at first to indicate that he understood *rhysmos* as referring to the geometric shapes of individual atoms. In *Ph.* I.5 188a25-26 (DK68 A45) he provides examples of the shapes that atoms may bear: "angular and angle-less, straight and round".[12] There is almost a century of debate among modern scholars around the adequacy of this translation of *rhysmos* into *schēma*.[13] Even though there is an undisputable overlap in the semantic spectrum of these two words, to the point that they could be considered synonyms in many aspects, there is, among the scholars of ancient atomism, a sort of consensus that the translation into *schēma* ends up suppressing a dynamical aspect that would be more pronounced in *rhysmos*. This dynamical aspect can be grasped in the titles of two treatises attributed to Democritus, extracted from the list in DL 9.47 (DK68 A33): *On the different rhysmoi* (Περὶ τῶν διαφερόντων ῥυσμῶν) and *On the changes of rhysmos* (Περὶ ἀμειψιρυσμιῶν).[14] The lexicon of Hesychius of Alexandria[15] defines ἀμειψιρυσμεῖν as "to change regarding the composition or change of form (ἀλλάσσειν τὴν σύγκρισιν ἢ μεταμορφοῦσθαι)" (DK68 B139). This verb occurs in a pseudo-Hippocratic letter (18.1 [DK68 C5]) with exactly this sense and referring to cosmic compounds. Another occurrence of a term with the root of ῥυσμὸς appears in Clement of

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[12] […] σχήματος γεγωνιωμένον ἀγώνιον, εὐθὺ περιφερές. Transl. Barnes, 1995.

[13] See, for instance, Peixoto, 2010; and also Morel, 1996, p. 54-55 & n. 31.

[14] Pierre-Marie Morel translates (1996, p. 55) the title into '*Sur les changements de rythmes*', but I would avoid 'rhythm' in translations, because this modern word already has acquired some senses that were probably not present in its early uses (*cf.* Benveniste, 1966, p. 332). Moreover, it does not seem to me that the word 'rhythm' should be in the plural, as in Morel's translation. Hicks (1972) translates the title into '*Of Changes of Shape*', adopting the Aristotelian translation of ῥυσμός, but preserving the idea that the plural applies to the changes and that ῥυσμὸς only qualifies the type of change in question. See also Leszl, 2007, p. 46-47, who rejects that this title refers to single atoms, which cannot change. As for myself, I agree with the translation of Laks & Most (2016) in LM27 D2, but I will return to it later.

[15] Hesychius of Alexandria, Greek grammar that lived probably around the V and VI, compiled a lexicon of strange or uncommon Greek words in a work called Συναγωγὴ πασῶν λέξεων κατὰ στοιχεῖον (*Alphabetic collection of all words*), including words used by the Democritus, which were included as fragments in DK.

Alexandria (DK68 B33), where the terms μεταρυσμοῖ and μεταρυσμοῦσα have the sense of *change of form, transformation*.[16]

Morel suggests (1996, p. 55, 57) that ῥυσμὸς might have been used by Democritus to designate the atoms themselves. His impression might have something to do with the following passage in which ῥυσμούς seems to refer to "shapes and atoms" (σχημάτων καὶ ἀτόμων):

> Democritus says that it [*i.e* the soul] is a certain fire and heat. For among the *shapes and atoms* (σχημάτων καὶ ἀτόμων) that are infinite, he says that the spherical is fire and soul, <and> similar to the so-called motes in the air, which appear in the sunbeams <that enter> through the windows, for he says, about their panspermy, <that is is> the elements of all nature (and the same says Leucippus). *Among them* (τούτων), the spherical are soul, for these *rhysmoi* are the most apt to slip themselves through everything and, being themselves in motion, to move the rest […] (*de An.* I.2 403b31-404a8 [DK67 A28])[17]

[16] Sextus Empiricus also transmits the term ἐπιρυσμίη, which may relate to the formation of opinions (DK68 B7), and suggests a sort of *superficial arrangement* or an *arrangement of the surface*, which may be what can immediately affects us (through sense organs).

[17] Ὅθεν Δημόκριτος μὲν πῦρ τι καὶ θερμόν φησιν αὐτὴν εἶναι· ἀπείρων γὰρ ὄντων σχημάτων καὶ ἀτόμων τὰ σφαιροειδῆ πῦρ καὶ ψυχὴν λέγει, οἷον ἐν τῷ ἀέρι τὰ καλούμενα ξύσματα, ἃ φαίνεται ἐν ταῖς διὰ τῶν θυρίδων ἀκτῖσιν, ὧν τὴν μὲν πανσπερμίαν τῆς ὅλης φύσεως στοιχεῖα λέγει· ὁμοίως δὲ καὶ Λεύκιππος· τούτων δὲ τὰ σφαιροειδῆ ψυχήν, διὰ τὸ μάλιστα διὰ παντὸς δύνασθαι διαδύνειν τοὺς τοιούτος ῥυσμοὺς καὶ κινεῖν τὰ λοιπὰ κινούμενα καὶ αὐτά, […]. My translation with borrowings from Hicks, 1907; Shiffman, 2011; and Laks & Most, 2016 (LM27 D132). The ὧν in ὧν τὴν μὲν πανσπερμίαν τῆς ὅλης φύσεως στοιχεῖα λέγει refers to 404a1-2: ἀπείρων [...] ὄντων σχημάτων καὶ ἀτόμων. This passage is somewhat difficult and there are many (like Hicks and Shiffman, for instance) who translate the καὶ into 'or', understanding that shapes and atoms are interchangeable. I believe, however, that the sentence might be rendered as 'among the shapes and atoms that are infinite', which, to me, acknowledge two numbers: (1) the number of types of shapes that atoms may assume, and (2) the number of the atoms themselves, since there can be an infinite number of atoms for each shape. *Cf.*, however, the translation of Laks & Most (LM27 D132), which conveys the same meaning in a more readable way (because not so literal) than mine.

In fact (and this is the most traditional reading), it is possible to read ῥυσμοὺς as referring to the spherical forms of the shapes.[18] Yet, it does not seem the case that ῥυσμοὺς be interchangeable with σχημάτων καὶ ἀτόμων (shapes and atoms) from the first sentence. It is more likely that they refer to a feature pertaining them. The key term is τούτων (among them), which connects the two sentences. Τούτων recovers not only 'shapes and atoms', but also the genitive, allowing us to read that as saying that *among the shapes and atoms* mentioned at the beginning, the spherical shapes are soul. The sequence, where we find ῥυσμοὺς, is already an explanation of why the spherical shapes are soul. The *rhysmoi* of these things (shapes and atoms) explain why they are capable of slipping themselves through everything else. There is an ambiguity here, which, however, is easily dismissed. The *rhysmoi*, on one hand, can refer to each shape individually, that is, to each shape, one *rhysmos*; or, on the other hand, they can refer to aggregates formed by the shapes aforementioned. It is natural that the first option be preferred and, in fact, the regular usage of σχῆμα by Aristotle when referring to the atomic doctrine suggests that, in this particular case, a *rhysmos* is a feature of a *schēma*. The shape, which in this case refers to atoms and, therefore, to solid bodies, and not to geometric shapes, has a *form* or *configuration*. I like the term 'configuration', because it differentiates ῥυσμὸς from μορφή, which would be the proper Aristotelian term to designate a *form* in a context of this sort.[19] The most important here, however, is to highlight that this is not a situation in which *rhysmos* is interchangeable with *schēma*, and, therefore, this passage cannot be used to suggest that the atomists referred to atoms as *rhysmoi* and neither that Aristotle was suggesting this.

The problem with Morel's suggestion is that there seems to be no other explicit association that could suggest that *rhysmoi* means a *set of atoms*, or that *schēma* and *rhysmos* are interchangeable, except

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[18] See, for instance, Taylor, 1999, p. 171-172.

[19] See, for instance, *GC* I.1 314a21-24 (DK67 A9) and Simp. *in Cael.* I.10 [279b12] 295.7-8 (DK68 A37), the fragment of Aristotle's lost treatise *On Democritus*.

when referring to features of atoms. In other words, it does not seem to be the case that when Aristotle uses the word σχήματα to refer to atoms it can be replaced by ῥυσμοὶ in the same way that the *difference rhysmos* can be *translated* into *schēma* in our passage of *Metaph.* A.4. The substitution in the first case would concern to the designation of an object, while the translation in the second case concerns the name of a property. Those are two different domains. I am sure that this distinction was perfectly clear to Aristotle. What may have driven his readers to mistake the different uses he makes of σχῆμα is the fact that, for Aristotle, the geometric shape of the atoms is their only feature capable of differentiation, and, thus, the one that defines them. For Aristotle, the atoms can be called shapes because, as bodies, this is their fundamental and definitional feature: "[Leucippus says] that they are defined by an infinite number of shapes, each indivisible solid being defined <by one> [shape]" (*GC* I.8 325b26-28).[20] Hence, naturally, this feature being the one that he uses to designate them when what interests him is to emphasize the diversified character of the plenum.

This terminological ambiguity becomes particularly tricky because Aristotle rejects the idea that motion is an inherent feature of atoms. His translation of the terms that designate the differences in our passage of *Metaph.* A.4 remove from the Democritean terms precisely their dynamic, or even unstable, precarious and temporary character.[21] By doing this, his *schēma* might refer both to the geometrical shape of the atoms and to the structural form of the aggregates (which include, but is not restrict to, its geometrical shape) using the same word, without loss of meaning. Hence,

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[20] […] ὁ μὲν ἀπείροις ὡρίσθαι σχήμασι τῶν ἀδιαιρέτων στερεῶν ἕκαστον ὁ δὲ ὡρισμένοις. The English translation is mine, based on the solution proposed by Chorão (2009, p. 105, n. 442). This infinite number of atomic shapes is criticized by Aristotle in *Cael.* III.4 303a19-20, where he suggests that all geometric shapes are constituted by a finite number of basic shapes, and that, for this cause, it is not possible that there be an infinite number of composite shapes. This argument is problematic because it presupposes that the atomic shapes are always regular shapes, which does not seem to be the case (*cf*. Cherniss, 1935, p. 6-7).

[21] *Cf*. Morel, 1996, p. 55.

probably, the opinion of Benveniste (1966, p. 328-329) that Aristotle's translation is fairly precise. In fact, from the examples found in fragments and testimonies about Democritus and Leucippus, it is not clear that *rhysmos* is something pertaining to atoms alone. On the contrary, there are many more examples of the use of the term and its derivatives in reference to aggregates. The most renowned of them is the fragment transmitted by Clement, which says:

> Nature and education are very similar. For education also *reconfigures* (μεταρυσμοῖ) man, and, by *reconfiguring* him (μεταρυσμοῦσα), models <his> nature (φυσιοποιεῖ). (*Strom.* IV 151 [DK68 B33])[22]

There is no question that *man* (which Democritus also calls *microcosmos* in DK68 B34) is itself a compound, which indicates clearly that *rhysmos* is also – and perhaps primarily – a property of compounds.[23]

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[22] Ἡ φύσις καὶ ἡ διδαχὴ παραπλήσιόν ἐστι. Καὶ γὰρ ἡ διδαχὴ μεταρυσμοῖ τὸν ἄνθρωπον, μεταρυσμοῦσα δὲ φυσιοποιεῖ. My translation. *Cf.* the translation of Miriam C. D. Peixoto (2011, p. 420): "Natureza e educação são coisas bastante semelhantes. Pois é verdade que a educação *transforma* o homem, e esta *transformação produz natureza*." The verb I use, *reconfigures*, touches the semantic field of transformation, but aims at preserving and highlighting the fact that there is a structure that is being modified and the fact that the final result of the process is something whose structure is similar to the initial configuration. For man continues to be man, having changed (in Aristotelian terms) only in one of its qualities: it turned from uneducated into educated. This quality, however, as we see by the remainder of the fragment, is crucial and affects, in a certain sense, man's own nature. Hence my choice of specifying (by the introduction of the pronoun 'his') that this change affects the nature of *that man*, which is modeled (or produced) by education. In this sense, my choice for *models* instead of *produces* to translate the ποιεῖν of φυσιοποιεῖν aims at calling attention to the malleable nature of man and the fact that it has a configuration. *Cf.* also the translation in LM27 D403, where the verb μεταρυσμεῖν is rendered as 'to modify a configuration' and φυσιοποιεῖν is rendered as 'to produce a nature'.

[23] *Cf.* Vlastos, 1946, p. 55, who, referring to the fragment DK68 B33, links *rhysmos* to the *configuration* of man's soul-atoms. *Cf.* also Taylor, 1999, p. 233. Taylor initially believed, against Vlastos, that *rhysmos* referred exclusively to the shapes of individual atoms, but he eventually changed his mind to agree with Vlastos.

A similar anthropological use appears in a Democritean sentence transmitted by Stobaeus:

> Thoughtless people *are configured* (ῥυσμοῦνται) by the tricks (κέρδεσιν) of fortune, but those who know such things best <are configured [or configure themselves]> by those [*i.e.* tricks or cunning arts] of wisdom. (3.4.71 [DK68 B197])[24]

Again, people's configuration varies according to their *ethos*. Those who know best are capable of determining their own configuration, that is, their states, desires, etc., whereas those who are thoughtless are determined by the circumstances of fortune.

Another example in which *rhysmos* appears clearly associated with compounds occurs in *MXG* 2 975b28-29 (DK30 A5 [2.11]): "Democritus also says that water, air and each of the multiple things, being the same, differ in *rhysmos* (ῥυθμῷ)."[25] In this passage, water, air and each one of the remaining compound things differ among themselves because of their *rhysmos*.[26] If we consider Aristotle's suggestion that Leucippus's method to conceive the atomic doctrine was a *top-down* procedure (*cf. GC* I.8 325a23-b5 [DK67 A7]), that is, that he starts from the phenomena and stipulates from them the

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[24] Ἀνοήμονες ῥυσμοῦνται τοῖς τῆς τύχης κέρδεσιν, οἱ δὲ τῶν τοιῶνδε δαήμονες τοῖς τῆς σοφίης. My translation with borrowings from Laks & Most, 2016 (LM27 D297). There are at least two levels of wordplay here, one around ῥυσμοῦνται and the other around κέρδεσιν. For the ones who are wise, ῥυσμοῦνται can be read in the middle voice meaning they *can determine* their own configuration by the *tricks* or *advantages* (another possible translation for κέρδεσιν) that wisdom provides them, whereas it remains for those who are thoughtless *to be determined by* the tricks of destiny. See also the translation of Laks & Most, where ῥυσμοῦνται is read in middle instead of passive voice and translated as 'derive their bearing'.

[25] Φησὶ δὲ καὶ Δημόκριτος τὸ ὕδωρ τε καὶ τὸν ἀέρα ἕκαστόν τε τῶν πολλῶν, ταὐτὸ ὄν, ῥυθμῷ διαφέρειν. My translation. Ῥυθμὸς, as we have seen, is the Attic spelling of the Ionic ῥυσμός. It occurs again in DK68 B266, where τῷ νῦν καθεστῶτι ῥυθμῷ refers to the "current established [scil. political] configuration" (as translated in LM27 D363).

[26] I consider that water and air are compounds in atomism (see Gomes, 2018a, p. 131), based on *Cael.* III.4 303a12-16 (DK67 A15), Simp. *in Cael.* III.4 [303a10] 611.4-11 (≠ DK), and other passages that deal with the problem of fire and heat (see n. 47 below).

invisible principles that sustain them, then, it is reasonable to suppose that the attribution of a *rhysmos* to atoms could have been made by analogy with something that is recognized primarily in compounds. The difference is that, in the case of compounds, configuration is malleable, unstable, and dynamic, whereas in the case of atoms, at least in what concerns its geometric shape, it would be fix and unchangeable.

Let me return to Benveniste, to whom, for Democritus, *rhysmos* means "'form', understood as distinctive form, the characteristic arrangement of the parts in a whole." (Benveniste, 1966, p. 330).[27] Parts in a whole refer primarily to a compound. I understand why he thinks that 'form' would be a good translation for ῥυσμὸς, but I recognize that there is a certain difficulty in adopting it in contexts where *rhysmos* is mentioned by Aristotle, since 'form' is employed normally to translate technical terms of Aristotelian philosophy such as εἶδος, ἰδέα and μορφή. When proposing *schēma* as the translation of *rhysmos*, however, Aristotle loses an important aspect, which is the dynamic character of *rhysmos*, evinced by its relation with the verb ῥεῖν (to flow).[28] This dynamical character is also something that makes it somewhat difficult to relate *rhysmos* with individual atoms, for, if *rhysmos* refers somehow to the shape of atoms, then it should not have any dynamical character whatsoever, otherwise, the immutable atoms would have a changeable property. It is also strange that Aristotle would not mention the most important aspect of what, in Democritean atomism, seems to be the most crucial determination of the features of a compound – its atomic structure – limiting himself to mentioning just secondary aspects: the way in which atoms conjoin to for sub-aggregates – *diathigē* – and the relative position between atoms within aggregates – *tropē*.

In view of this difficulty, but still understanding, because of the relation between *rhysmos* and the letters A and N of the example in

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[27] "[…] « forme », en entendant par là la forme distinctive, l'arrangement caractéristique des parties dans un tout".

[28] On this, see Mourelatos, 2005, p. 42.

section 6 of our passage of *Metaph*. A.4, that *rhysmos* referred to individual atoms, some scholars propose interpretations for this difference that relate somehow to the motion of individual atoms. According to Alfieri (1979, p. 73), the dynamic sense of *rhysmos* points to an "adaptability" characteristic of atoms, meaning a "capacity of aggregation", that is, a sort of disposition for associating with other atoms that is greater or smaller depending on their shape (this, however, stable). Morel, in his turn, thinks that *rhysmos* "integrate, at the same time, the form of the atom, [a form] immutable in itself, and the movement that transports it", indicating that, for Democritus, "the idea of form cannot be dissociated from the idea of motion" (Morel, 1996, p. 54, n. 31).[29] Gemelli Marciano rejects the idea that *rhysmos* refers to the shape of isolated atoms, understanding that it refers to the "characteristic and distinctive aspect of a moving corpuscle, in a variable and mutable context, or even of irregular form" (Gemelli Marciano, 2007, p. 203).[30] All these understandings recall more or less that of Mourelatos (2005, p. 57), who associate *rhysmos* with the relational property of *motility* he identifies for atoms. Because of this I will concentrate more in discussing his account, which is the most detailed of all.

III

In his paper, Mourelatos presents a very detailed and logically solid scheme of atomic properties, starting from the ones he calls *intrinsic*, meaning the properties that belong to the atom itself without any dependence on its relations or reference to other atoms or the void. These properties, then, develop towards *relational* ones, properties that pertain individual atoms insofar as they perform among other atoms. One could say that the overall project of

[29] "[…] le concept de *rhusmos* intègre à la fois la forme de l'atome, en elle-même immuable, et le mouvement qui l'emporte. [...] l'idée de forme est indissociable de l'idée de mouvement."

[30] "[…] ῥυσμός non è la figura geometrica di un atomo isolato e astratto, bensì l'aspetto caratteristico e distintivo di un corpuscolo in movimento in un contesto vario e mutevole o comunque di forma irregolare".

Mourelatos is the same as my own.[31] There is, however, a difference in the scope of these two particular stances within the major project.[32] I would define that major project as an attempt to describe Democritean atomic microphysics and compound chemistry, which necessarily involves filling many gaps due to the fragmentary state of Democritean sources. Those are not two separate realms, but rather a continuous one: from the fundamental characteristics of individual atoms, a number of intrinsic properties emerge; then, from these, a larger number of relational ones; and, from the third level onwards, properties both intrinsic and relational (in various levels, even between entities of different levels) emerge that pertain "pairs, trios and n-tuples of atoms",[33] until the level of the qualities that are perceivable by the senses; so that chemistry emerges from microphysics.[34]

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[31] As remarked by the colleague who presented Mourelatos' paper to me during IAPS 6 held in Delphi last year (2018), where I presented an earlier version of this paper in a discussions session. While not being aware of such an important text about one my major points of interest in Democritean philosophy is rather embarrassing, this unawareness allowed me to develop an understanding of some of the features of Mourelatos' paper by other means and routes. I'd like to thank everyone that attended the discussion session where I presented my paper, which was very rich and helpful. If you ever read this, the reason I'm not naming you is because I don't want to imply that you would endorse anything wrong that I say here.

[32] Namely Mourelatos' 2005 paper and what I have been trying to deal with in my research about Democritus starting from my 2018 dissertation and texts that further develop themes I started working with then. See Gomes, 2018a; Gomes, 2018b; and Gomes, 2019.

[33] I borrow these expressions from Mourelatos (2005, p. 40), who, however, mentions them in a different context.

[34] At some point, complexity gets so overwhelming that it can be (and I would say it certainly is) practically impossible to trace smoothly from microphysics to chemistry. Yet, the logic of this physicalist "system" demands that it be continuous all the way through. The division between *truth* and *convention* (DK68 B9) – the later related to sensible qualities – is imposed by an epistemological threshold defined by a gnoseological limitation, not an ontological one. However, as ontology is a type of *logos*, and, as such, a noetical object, the "truth" about ontology, ends up being a sort of bet about actual things in themselves. It can surely be very consistent, logically speaking, but still nonetheless a bet.

Mourelatos' paper is focused on the two first levels of microphysical emergence, which apply only to individual atoms, even if the second level depends on the relation between *this* particular atom and the ones surrounding it. This is where he halts his investigation in that paper, leaving an eventual discussion about the emergence of properties from third level onwards for further developments (Mourelatos, 2005, p. 62). I say "discussion" on purpose, because already at that third level things will start to get really complicated as the amount of emergent properties will certainly grow in rapid geometric progression. Hence, it can be counterproductive to keep deriving properties using the same method proposed by Mourelatos in his paper (which is not a problem with the method, but with the object). It seems to me that Democritus himself would avoid doing it from that point onwards.

My approach to the problem is not alternative or concurrent to that of Mourelatos, but, in a way, complementary. I have tried to deal with some features of the first and second levels (with less details than Mourelatos, though) and with some features of the higher levels where we already have a chemistry. When it comes to chemistry, the approach must be more generic, since you cannot possibly enumerate and deduce every single property of phenomena all the way down to atomic intrinsic properties, not because of a logical impossibility – this is a physicalist theory after all – but because of practical and epistemological limitations. Still, the role I am ascribing to the so-called *differences* is that of "metatypes", types or classes of properties, or, perhaps, even patterns of emergence that may be recognized by the human mind and allow for certain extrapolations within defined boundaries, which one could relate to disciplines or fields of knowledge. This, of course, is done by Democritus in a rather rudimentary way regarding terminology. I believe that the confusion Aristotle finds himself in when trying to interpret the Democritean terms in *Metaph.* A.4 has something to do with that. Democritus uses the same terms to refer to different things in different levels, but he seems, nonetheless, to be quite aware that there are differences among property types as well as in the behavior of properties within and between the different levels.

Mourelatos (2005, p. 57) found a place for *rhysmos* at the second level of his property scheme relating it to a property he called *motility*. At first, it seemed to me that there was an incompatibility between that atomic relational property of motility and the uses I found in Democritus of *rhysmos* relating to the configuration of compounds. But as I tried to sort that difference out, I was little by little convinced that there were, actually two slightly different uses of *rhysmos*: one at Mourelatos' second level and another at the chemical level (that is, from the third level upwards).

So, let us see first what Mourelatos meant by motility. He says that motility is "the pattern of motion determined by [the] shape-size" intrinsic properties of an atom (Mourelatos, 2005, p. 57). This definition must be qualified by a number of adjectives that placed them within the categories Mourelatos devised in his framework. Thus, motility is a (i) *fixed*, (ii) *dispositional*, (iii) *multivalent* property of atoms, (iv) *dependent of shape and size*.[35] *Fixed* (i) means that the property is not subject to change, so that, for a given atom, its motility is invariable. *Multivalent* (iii) means that the property may assume different values, so that different atoms may have different motilities. *Dependent of shape and size* (iv) is obvious: it means that the different values are a function of the intrinsic properties of shape and size, which, by the way, are conjoined in Aristotle's *schēma*.[36] Lastly and most importantly for our present discussion, motility is a *dispositional* (ii) property, meaning that it is like a set of possibilities of motion, and, thus, very similar to an Aristotelian *potency*. Motility, then, is the whole set of possibilities of motion in terms of trajectories and speeds, and these two combined, that an atom may assume. If the atom was something that had a life-span we should add 'during its lifetime', but this is not the case. Please, remember that those

[35] The terms in italics are his, extracted from the synthetized outline in Mourelatos, 2005, p. 60.

[36] See their derivation at Mourelatos, 2005, p. 48-50.

possibilities of motion are also determined by the vicinity of the atoms, other atoms, therefore, with which they collide.[37]

So far I have no disagreements with Mourelatos. I do believe that there is such a thing as what he calls motility, and that it is a property of atoms in the exact same way he describes. One thing puzzles me, though. In the synthetized outline of p. 60, Mourelatos includes two items one level below "ii. Motility". It is not very clear to me if they are supposed to be explanations of the two properties of the upper level, namely, (i) *conjunctivity* and (ii) *motility*, if they are both related to motility alone, or if, with those two items marked as α and β, he wanted to indicate the effect of the pair formed by conjunctivity and motility, which, according to him, is what is really unique about a given atomic type (Mourelatos, 2005, p. 58). What is curious, however, is that each one of the sentences in that lowest level could also be taken as definitions of the properties in the level above. The first (α) could be a definition of conjunctivity: "The tendency of atoms of like shape/size to aggregate"; whereas the second (β), could be taken as a definition of motility: "The kinematic disposition of different atomic shapes/sizes".

As it happens with motility, Mourelatos presents a definition of conjunctivity when deriving the property. He says that it is "the 'repertoire' a given atomic shape and size offers 'of possible arrays with other atomic shapes and sizes'" (Mourelatos, 2005, p. 56).[38] At this point, he recalls the testimonia regarding the famous *like-to-like* principle attributed to Democritus, which, is usually taken *prima*

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[37] Alfieri's proposition mentioned above points in that direction, but he considers that *rhysmos* is also some sort of disposition for aggregation that would fit better what Mourelatos calls *conjunctivity*, which, although depending on the shape and size of the atoms, as it happens with motility, is more related to the Democritean dynamic term *diathigē* (Mourelatos, 2005, p. 56-57). I tend to agree with Mourelatos on this. Now Morel and Gemelli Marciano seem to me to advance too further in the relationship between *rhysmos* and motion, turning it into or at least pushing it too close to the actual occurrent motion of atomic shapes. *Cf.* Morel, 1996, p. 56.

[38] Those single quotes are there because he is actually quoting himself in this particular passage.

facie as some sort of tendency for similar things to come together: "doves with doves, cranes with cranes; in a sieve, lentils with lentils, barley with barley, wheat with wheat; on a beach, oblong pebbles together, round pebbles together (68B164, 68A38, A128)" (Mourelatos, 2005, p. 57). And so, in order to account for that, Mourelatos include in conjunctivity, or, more likely, include as a particular type of conjunctivity, the tendency of atoms of similar shape to aggregate, which is exactly what the statement above marked as α says.

Now, if statement α is not exactly conjunctivity, but a particular feature (or subproperty) of conjunctivity, then we may have to consider that statement β is also a feature (or subproperty) of motility. Thus, the expression 'kinematic disposition' may not be merely another way to refer to a 'pattern of motion' (as in the definition of motility; see above), but to something else, and, as that, it might have something to do with whatever it is that causes similar things to be drawn to each other. This association, however, is just a speculation on my part. I could not find the specific derivation or definition of 'kinematic disposition' in Mourelatos' text. It could mean that certain shapes would be more prone to motion than others, like what is said about the spherical atoms (I will return to them later). This is certainly included in motility: certain shapes may slip more easily (as it happens with the spherical ones, by the way) through the interstices between other atoms, and thus, be said to be *more motile*. But this is already implied in the property of motility and would not require something like statement β. Or would it? I will leave it at that. I may be in *aporia*, but this is far from being a major problem in the overall explanation.

What, to me, is a problem is that I find it hard to cope with the usual interpretation of the like-to-like principle – or *tendency*, as I prefer to qualify it –, which, in its turn, has a lot to do with a premise regarding motion that I do not share with Mourelatos. Now

Mourelatos (2005, p. 40) assume (and justify it very appropriately)[39] that atoms have no immanent or intrinsic motion. Atomic motion would be *caused* by previous collisions, as explained and criticized in the commentary Alexander of Aphrodisias to our passage of *Metaph.* A.4:

> They [scil. Leucippus and Democritus] say that the atoms move by hitting one another and striking against one another, but where the principle of motion comes from for the things that exist by nature, they do not say. For motion due to hitting one another is motion by force and not according to nature, and motion by force is posterior to motion according to nature. (Alex. *in Metaph.* A.4 [985b19] 36.21-25 [DK67 A6])[40]

Mourelatos does not feel moved by the complaint of Alexander (or Aristotle, for he would certainly second this) that the atoms should have some sort of natural motion, for he understands (correctly, one should say) that this critique, coming from a peripatetic, is demanding that an eventual Democritean natural motion should adhere to one of the natural motions (upwards or downwards) that elements are bound to in the Aristotelian *kosmos*. Yet, Alexander is right to mention that motion caused by collisions is forced, meaning that it is external to the thing that moves with such a motion. And so, if you do resort to the infinite chain, it means motion will always be forced by something previous. The recourse to infinity, as Mourelatos (2005, p. 46, n. 22) points out, is not a problem

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[39] Except, maybe, for the argument that the motion of hypothetical atom existing singly in the void would be imperceptible and, thus, motion and rest can only be relative to other atoms (*cf.* Mourelatos, 2005, p. 44-45, n. 20) is not a very solid one, for it does not prove, nor disprove that motion is only relative. Because if this is a matter of perception, the atom itself can still be either in motion or at rest. You could actually have any number of atoms moving in parallel trajectories with the same speed, and they would still seem to be at rest, even with no single thing resting. This, however, is not the main justification, at all.

[40] Translated by Laks & Most, 2016 (LM27 R38). Οὗτοι γὰρ λέγουσιν ἀλληλοτυπούσας καὶ κρουομένας πρὸς ἀλλήλας κινεῖσθαι τὰς ἀτόμους· πόθεν μέντοι ἡ ἀρχὴ τῆς κινήσεως τοῖς κατὰ φύσιν, οὐ λέγουσιν· ἡ γὰρ κατὰ τὴν ἀλληλοτυπίαν βίαιός ἐστι κίνησις καὶ οὐ κατὰ φύσιν, ὑστέρα δὲ ἡ βίαιος τῆς κατὰ φύσιν.

in itself in Democritean cosmology, for, according to it, the universe is infinite, as well as time. There is, however, *another* problem, which goes by the name of *rest*.

Even if Aristotle or his followers did not do this, it is possible to formulate a sound Aristotelian argument against the explanation of motion by means of a past series of collisions in terms of *act and potency*. If an atom has no natural motion, it means that it is capable of rest or, in Aristotelian terms, that it has the potency of being at rest. Mourelatos (2005, p. 54, item 5, but also 7) thinks so and he even marks rest as one of the possibilities of the result of the collision between two atoms. However, according to Aristotelian act an potency framework, if something has a potency and is unperishable, given an infinite time, it will actualize this potency, unless it be hindered by something else external. In the case of atoms, which are eternal and have the whole void to move in, there is no such hindrance to how they can move, except for the temporary disorder of their vicinity, which is not persistent, as the other atoms also move. Moreover, motility, not being a hindrance *to* motion, but only to certain types of *trajectories* and *speeds*, does not represent a persistent hindrance either. Therefore, given an infinite amount of time, which atoms have, they will eventually and necessarily stop. All of them. And they will never start moving again, unless something external to the atoms themselves – again, all of them, for they are all at rest now – kicks in and restart the chain of motion.

In order to avoid the problem of the potency of rest, Aristotle eventually sees himself bound to introduce a *prime mover* in his system (see *Metaph.* Λ.7). Note that this is not merely a problem of infinite recursion, and that this solution is not due only because Aristotle's *kosmos* is a finite one. The real problem is one of *entropy*. The second law of thermodynamics states that the entropy of a closed system cannot decrease over time and will eventually stagnate into a state of homogeneity and, eventually rest. Another way of saying this, in terms that would make more sense in an Aristotelian *kosmos* (and other ancient Greek *kosmoi* as well), is to say that in order to keep *physis* going on eternally, since entropy cannot decrease, there must

be a constant afflux of *energy* from outside the system into the *kosmos*. The question is what is *energy*? Energy would be anything that keeps activity going on. In the case of the Aristotelian *kosmos*, energy comes in with the name of *desire* (*cf. Metaph.* Λ.7 1072a24-29, b3-4). To make a long story short, let us say that he establishes that the whole *physis* is moved by the desire of actualizing itself and becoming as the prime mover is, that is, pure act. There are, of course, hindrances that impede this, and thus the process keeps going on eternally. Yet, if there was no prime mover to serve as such an example or ideal of full being, and thus to keep feeding things with the desire of fully actualizing their potencies, *physis* would eventually stop, that is, entropy would have come to a maximum.

Earlier, the "divine" Parmenides had solved this in a simpler way in the cosmology of the so-called "second part" of his poem. To say it was simpler does not imply it was a better solution than Aristotle's. What made it simple was the fact that Parmenides had no scruples against introducing a *divinity* (δαίμων) right *in the middle* of that world[41] (DK28 B12.3).[42] This divinity, which is clearly distinct from the elements – the bright and the dark –, is responsible for starting and presumably for keeping generation going on (B12.4), which she does by "leading the female to mingle with the male and again, in the opposite direction | the male with the female" (B12.5-6; trans. Laks & Most, 2016 [LM19 D14b.5-6]). Further on, Parmenides says that this divinity actually conceived Eros, that is *love*, "as the very first of all the gods" (B13; trans. Laks & Most, 2016 [LM19 D16]), which, I believe, can only possibly mean that love is needed for the process of mingling things and producing generation. If this is correct, it means that love functions in this Parmenidean cosmology as what stirred things otherwise lingering at rest into moving in the first place in order for mixing to start. As such, it is analogous to (if not an

[41] I say "that world" in respect to those who believe that that cosmology was not Parmenides' own cosmology, which is not my case.

[42] This placing of the divinity of B12 is not necessarily topologically precise, but indicates nonetheless that the divinity is not external to the world as Aristotle's prime mover, whom he calls god (*cf. Metaph.* Λ.7 1072b24-30), by the way.

inspiration for) the Aristotelian *desire* we have seen above; *ergo*, energy. This could continue with the demiurge of Plato's *Timaeus*, who would also have a similar role (among others) of providing energy to the system, but I think it is already clear enough.

Now Democritus does not implement anything close to such a divinity in his system, which means that if his is a thermodynamically closed system, then, entropy will increase to a maximum and everything will stop. This is another way of saying that if his atoms have the potency of being at rest, they will eventually come to rest, as the act of that potency. In face of this problem, some people try to find in the void the required source of energy (even if they do not realize it fully). For they try to find in the image that the void *yields* to the atoms (DK68 A58; LM27 R109 [≠ DK]) an *action* that is performed by the void. An action of this sort is a kind of *work*. And work is something that introduces energy. I, however, reject this, for I believe there is enough evidence that the void is a sort of *background* and, as such, that it is completely passive. So that the yielding of the void would merely be a figure of speech. This is as far as I will go in this paper, for discussing the nature of the void would divert us even more from our present interest. As Mourelatos seems to agree with me in this, let us move on.

Another way of trying to contour the problem of the potency of rest involves appealing to the like-to-like principle, understanding that it works as a sort of attraction force that brings together atoms of similar shapes.[43] Again, *force in time*, means work, which implies energy input. This, however, does not really solve the problem, because such a force, based on a potency, would eventually lead to a complete homogenization of the universe in layers, when all like atoms would be close together and well fit. And this would certainly happen, because, do not forget, time is infinite. This state, as you can

[43] Some people even think that an attraction force such as this would require the existence of a repelling force, either from unlike shapes or from the atomic stuff itself, which would explain Philoponus claims (*in GC* I.8 [325a32] 158.26-159.3 [WL 21.5 > DK67 A7]) that the atoms never really touch each other. See Taylor, 1999, p. 186-188; and *cf.* with Gomes, 2018a, p. 157-158 & n. 333.

imagine, is a state of rest. A like-to-like *tendency* (not force), on the other hand, could be understood as a sort of rudimentary and optimist perception of the phenomenon of entropy, not a solution to the problems it introduces.

So, how could Democritus solve the problem of entropy without introducing something other than atoms and void in his system? Well, by denying the possibility of rest altogether, not motion. If there is no potency of rest, it means that entropy is being countered by a source of energy. And if the void is utterly passive, the positive afflux of energy can only be caused by the atoms themselves, meaning that they have in themselves what I will call an *impetus* of motion.

The impetus of motion is not motion itself, but only the energetic component of motion. There are two other components, which I already mentioned, namely, *trajectory* and *speed*,[44] which account for the external performance of motion. Mourelatos' motility fits in here, but only insofar as the potential trajectories and speeds by which a given atom may perform at a given time (or throughout eternity, it doesn't really matter). It does not account, however, for the impetus. For, of course, the way he sees it, there is no such thing as impetus, since the atoms are immobile in themselves, satisfying one of the so-called "Parmenidean requirements".

This interpretation of atomism that I propose, of course, fails in the Parmenidean test, which is one of the three "conceptual devices" deployed by Mourelatos (2005, p. 43-44) in his text, but one that I would not make use of, my version of Democritus being so anti-Parmenidean as to deny the possibility of rest.[45] As a matter of fact, rest would be a mere phenomenon, a *convention*, meaning that rest is

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[44] Trajectory involves the geometrical path of a motion and vectorial notions such as *direction* and *orientation*. Speed is a general term that should account for *velocity* and *acceleration* combined, that is, something that has to do with time in relation to a trajectory.

[45] As a matter of fact, I don't think the Parmenidean device is necessary at all for the derivation of the properties in Mourelatos' framework, *even* with the denial of motion. He might have hinted at that in Mourelatos, 2005, p. 43, n. 19, but I am not sure whether he did or not.

something only perceivable by the senses. Down to the atomic level, nothing would be ever at rest. This is a sort of radical Heraclitean Democritus, after all, which I think fits better his Ionian background mentioned in part I than one that was indoctrinated by the so-called "Eleatic school".[46]

IV

But what does all this have to do with *rhysmos*? The idea that heat could be something relative to the *mobility* of the spherical atom[47] could be used to argue in favor of the interpretation that *rhysmos* has something to do with atomic motion.[48] Spherical atoms would be naturally (or by definition) *more prone to motion* and would produce heat because of their high mobility. This is fine, except that we should use, for precision sake, Mourelatos' term *motility* instead of *mobility*. Mobility is not only too general, but also deceptive, because it includes not only possibilities of trajectories and speeds as motility, but also the potency of rest, since it includes a sort of capacity for motion, in general, and not only the possibility of this or that kind of performed motion as in motility.

And if you reject the potency of rest and assume that every atom move regardless of anything else, this is not useful for distinguishing one atomic type from another. While the impetus of motion present in every atom is surely necessary for the production of heat, it does not explain why *this* atomic type can produce more heat than *that* other one, because every atom has it in the same way. Motility, on the other hand, is something that distinguishes an atomic type from another, and thus, is the exact thing we need to explain something as

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[46] I do not, however, claim anything close to "Heraclitean requirements for being". I merely think a historically coherent Democritus would be closer to an Ionian like Heraclitus than to an Italian like Parmenides. Details and other arguments about this claim would have to wait until another opportunity.

[47] *Cf. Cael.* III.4 303a12-16 (DK67 A15); *de An.* I.2 403b31-404a8 (DK67 A28), 405a5-13 (DK68 A101); *GC* I.8 326a3-5 (≠ DK).

[48] As intended by Morel and Gemelli Marciano; see references at the end of section II above.

the emergence of properties due to the presence of certain types of ingredients in a compound, that is, chemically.

The motility of spherical atoms is what accounts for the mobile performances it presents in its relations with other atoms and, at least according to the testimonia, something in that performance is accountable for the production of heat. Having no edges,[49] spherical atoms are harder to entangle. The trajectory of their performances tend to be more chaotic because it is much harder to confine them. Heat can be relative to the speed that the atom develops or even to the friction that results from its contact with other atoms, with the difference that its trajectory is not given by an intrinsic determination particular to individual atoms, but by random collisions with other atoms that, given the sphericity of the spherical atoms, are not capable of hindering them.[50]

When Theophrastus finds the term μεταρρυθμίζεσθαι (meaning 'change of *rhysmos*'), he concludes that this is an inconsistency in Democritus' theory (*CP* 6.7.2 [DK68 A132]). He says that changes of taste, according to Democritus, would be the result of changes of *rhysmos* in the compound. Theophrastus, however, by adopting, as it seems, Aristotle's translation of *rhysmos* into *schēma* and by concluding that it was an intrinsic property of individual atoms,

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[49] Or because they almost do not have them, considering the sphere as a polygon of many or infinite sides, as Aristotle says to be the case with Democritus (*cf. Cael.* III.8 307a16-17 [DK68 A155a]). Still, it is unlikely that Democritus had to recourse to this sort of explanation to define circles and spheres. This may be an interference of some later notion of elementary geometric shapes, possibly related to Xenocrates or Aristotle's understanding of what Xenocrates and his group were discussing in the Academy.

[50] The idea that heat is somehow a function of the speed of the atom is also present in a comment of Diogenes Laertius (DL 9.33 [DK67 A1]) about the astronomic arrangement of Leucippus (allegedly extracted from the work *Great cosmology*). According to Diogenes, Leucippus placed the celestial bodies in orbits around the earth, the most distant being occupied by the Sun and the closest by the Moon. The intermediary stars would be set aflame because of the speed of their displacement (διὰ τὸ τάχος τῆς φορᾶς), which leads to the supposition that the sun would be the most hot and fiery body because it occupied the most external orbit (*cf.* Graham, 2009, p. 7).

understood μεταρρυθμίζεσθαι as 'change of shape' (μετασχηματίζεσθαι) – as in, for instance, a scalene solid becoming round – and declared that Democritus's explanation was impossible since the atom is unchangeable. Such a change could only happen by the rearrangement of atoms within the compound or by the exchange of atoms between the compound and the external environment, that is, by changes in the *configuration* of the compound. This recalls a passage of *GC* I.9 where Aristotle discuss the possibilities of a body being affected in the atomic model:

> but we see the same body, remaining continuous, at one time liquid and at another solid, and this happens to it without division or composition taking place, or turning (τροπῇ) or joining (διαθιγῇ), as Democritus says; for it has become solid from being liquid without any change in array (μεταταχθὲν) or position (μετατεθὲν) in its nature (327a16-20 [DK68 A38])[51]

In this passage, Aristotle mentions two of the three differences from *Metaph.* A.4 – *tropē* and *diathigē*. Both are related to phenomena of state change (*i.e.* alteration) in compounds. Differently than what he does in *Metaph.* A.4 985b15-17, where he translates the two terms respectively into τάξις (array) and θέσις (position), here Aristotle chooses two words with the prefix μετα-, which indicates change and evinces their dynamic character. *Rhysmos*, however, is not mentioned, nor is its dynamic correlate that would be the verb μετασχηματίζεσθαι. The reason for this omission might be a clue to Aristotle's own understanding of *rhysmos*. If *rhysmos* related somehow to the geometric shape of the atoms, then it would make no sense to talk about change of geometric shape (μετασχηματίζεσθαι), because the atoms are unchangeable. If, however, *rhysmos* referred to the configuration of a compound and, in this sense, to its form (in an ampler sense), then it would also sound problematic to Aristotle, because in Aristotelian alteration, by definition, the substance, and,

[51] […] ὁρῶμεν δὲ τὸ αὐτὸ σῶμα συνεχὲς ὂν ὁτὲ δὲ πεπηγός, οὐ διαιρέσει καὶ συνθέσει τοῦτο παθόν, οὐδὲ τροπῇ καὶ διαθιγῇ, καθάπερ λέγει Δημόκριτος· οὔτε γὰρ μεταταχθὲν οὔτε μετατεθὲν τὴν φύσιν πεπηγὸς ἐξ ὑγροῦ γέγονεν, […]. Translated by Williams (1982) with the sole change of 'touching' for 'joining'.

therefore, the form, must remain the same. This could be the reason why Aristotle dismisses the possibility that *rhysmos* had a dynamic role in the process of alteration of properties of compound bodies in the atomic model of aggregation and disaggregation, for *rhysmos* relates, even if precariously, to a notion of form, either a configuration of a compound, or atomic motility, which, in the end, is a sort of *form of motion*. Notwithstanding, Theophrastus seems to betray Aristotle's omission when mentioning the term μεταρρυθμίζεσθαι, suggesting that Democritus did have a role for *rhysmos* in his own processes of change. His accusation that this is an inconsistency in the atomic theory only strengthens the point that *rhysmos* should not be taken as an intrinsic property of individual atoms, independent of their relations with the other atoms that form a compound. On the contrary, *rhysmos* seems to be something that determines the effect of atoms within a compound, an effect determined by the interaction of atoms with each other through collisions, as Mourelatos suggested.

In a very interesting insight Morel suggests that the notions of *rhysmos* and *idea*[52] complement each other to produce the notion of form applied to the atom. According to Morel (1996, p. 58-59), *idea* "suggests that the atom is, at the same time, a body and an intelligible, and that its indivisibility is not merely material uncuttability, but also an inalterability of form." For him, the notion of *idea*, would convey the geometric aspect of form – and, thus, would be closer to what Aristotle calls *schēma* – while *rhysmos* would convey the dynamic aspect. This would mean that Aristotle errs when he translates *rhysmos* into *schēma*, for *schēma* would be a better translation for *idea*.[53] I think Morel is right in saying that *idea* fits better the idea of shape, which is conveyed by the word σχῆμα. This, however, does

[52] A term that seems to have been used by Democritus. Besides a work whose title would be Περὶ ἰδεῶν (DK68 B6), the term appears in a scholium to Clement of Alexandria (DK68 A57), in Plutarch (also in DK68 A57), in Simplicius (DK68 A67, B167), and in the lexicon of Hesychius (DK68 B141).

[53] Mourelatos (2005, p. 42) has a very similar opinion and considers that the proper Democritean term for shape would be ἰδέα.

not necessarily mean that *rhysmos* is an exclusive feature of atoms. Aristotle, when discussing atomism, never uses the word ἰδέα, which he knew. Moreover, this word, being technical in his own jargon, would not require any translation. He does seem to think, however, that the shapes of atoms are directly translatable into certain qualities in the atomic theory (as in sphericity meaning heat), and, thus, he could have understood *rhysmos*, which would be something primarily related to the form (in the sense of configuration) of compounds, as being a geometric form, thus, shape.

To avoid ambiguities, I propose that *rhysmos*, when applied to atomic compounds, be understood from the third level onwards as *configuration*,[54] and when applied to individual atoms at the second level, be understood as Mourelatos' *motility*. There will be, however, new instances of motility-type properties of compounds in upper levels (starting from what would be the fourth level) as well. These properties will certainly be dependent on the compounds *configuration* as well as other third level properties. The question is if *rhysmos* would apply to them as motility or only as configuration. My guess, based on the uses of rhysmos I showed earlier is that in those upper levels, configuration tends to be the priority. For this reason, I believe that the *rhysmos*-motility of the second level is a rather secondary use, derived from its use as configuration in upper levels. That might be the reason for Aristotle difficulty to grasp it, and for eventual confusions between *rhysmos*, *idea*, and *schēma*.

It seems to me that this proposition fits well with the example given by Aristotle in section 5 of our passage of *Metaph.* A.4, in which *rhysmos-schēma* has its variation exemplified by the difference between the letters A and N. The example functions very well both for the shape of individual atoms and for the configuration of compounds, so that this passage cannot be used to prove that *rhysmos* is an exclusive property of individual atoms. In the first case,

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[54] Laks & Most (2016) seem to have a similar understanding, for they consistently translate ῥυσμὸς and its correlates as variations of *configuration* (see LM27 D2, 31, 32, 38, 132, 363, 403), with the only exception of D297 (DK68 B197), quoted above.

one must take each letter as representing the shape of an atomic type (its *idea*), whereas in the second case, as explains Benveniste (1966, p. 329), it is possible to think that A and *N* (it works better in italics) are compounds, each of them having three components. You could even produce another letter with just two components, like Λ.[55]

V

The association of atoms and the letters of the alphabet, suggested by Aristotle in *GC* I.2, even if relatively static, could be borrowed to produce a picture of how *rhysmos* worked in the atomic theory. Aristotle says that

> Democritus and Leucippus, having got the figures, get alteration and generation from these: generation and corruption by their aggregation and segregation, alteration by their arrangement and position. Since they thought that the truth was in appearance and that the appearances were infinite and contrary to each other, they made the figures infinite. Changes in the compound were thus thought to give the same thing contrary appearances to different observers. The admixture of a small particle would effect a transposition, and if one component were transposed the compound would appear utterly different, just as 'tragedy' and 'trugedy' come into existence from the same letters. (*GC* I.2 315b6-15 [DK67 A9])[56]

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[55] The letter A would be formed by /, \ and –; ***N*** by /, \ and /; whereas **Λ** would be formed by / and \, which are common to **A** and ***N***. In fact, all letters **A** we can see and compare with letters ***N*** are compounds. The "ideas" of A and N, their unitary and abstract notions, do not differ between themselves according to *rhysmos-schēma*, except metaphorically.

[56] Δημόκριτος δὲ καὶ Λεύκιππος ποιήσαντες τὰ σχήματα τὴν ἀλλοίωσιν καὶ τὴν γένεσιν ἐκ τούτων ποιοῦσι, διακρίσει μὲν καὶ συγκρίσει γένεσιν καὶ φθοράν, τάξει δὲ καὶ θέσει ἀλλοίωσιν. Ἐπεὶ δ' ᾠοντο τἀληθὲς ἐν τῷ φαίνεσθαι, ἐναντία δὲ καὶ ἄπειρα τὰ φαινόμενα, τὰ σχήματα ἄπειρα ἐποίησαν, ὥστε ταῖς μεταβολαῖς τοῦ συνκειμένου τὸ αὐτὸ ἐναντίον δοκεῖν ἄλλῳ καὶ ἄλλῳ, καὶ μετακινεῖσθαι μικροῦ ἐμμιγνυμένου καὶ ὅλως ἕτερον φαίνεσθαι ἑνὸς μετακινηθέντος· ἐκ τῶν αὐτῶν γὰρ τραγῳδία καὶ τρυγῳδία γίνεται γραμμάτων. Transl. Williams, 1982. The manuscripts offer τραγῳδία καὶ κωμῳδία. About the correction of κωμῳδία to τρυγῳδία see West, 1969, p. 150-151, and Rashed, 2005, p. 99-100, n. 2. Although

A letter only acquires effective meaning when it is placed and read within a word. It is its articulation within words that have meaning. The isolated letter does not convey absolutely nothing about the eventual words that might be formed from it. The mere exchange of an *a* for an *u* makes the word 'tragedy' become its opposite: a '*trugedy*', an ancient term that meant comedy. But we cannot say that the individual letters convey meaning to the words they form. It is not the *a* that makes the whole a tragedy, nor the *u* that makes the whole a trugedy. *A* and *u* affect the way these words are read and refer to distinct sounds. Moreover, their effect depends directly on the relation between the *a* and the *u* with the immediately preceding letters, *t* and *r*, forming distinct syllables, *trag* and *trug*, that in their turn, associate themselves to the next syllables, in a complex relation that keeps gaining sense as the word is pronounced. Besides, we can also think of the formation of syllables as a sort of restriction imposed to the sounds of letters. They do not sound anymore like they would if they were isolated, but once combined they produce coordinated sounds. Something similar occurs in the formation of words from syllables. It is difficult do express this is a written text, but the word 'tragedy' is not merely the accomplished unit that is read here, but the dynamical relationship between the sounds of the syllables *trag*, *e* and *dy*, pronounced in a given way, with a given intonation. Its contrast with 'trugedy' seems more subtle in the written word, but there is an awkward feeling when *trug* is uttered instead of *trag*, when the word 'trugedy' is pronounced. Something seems to be out of place with 'trugedy', just as in the comedies humor is produced by something slightly out of place, even though the whole seems coherent with the surrounding reality.[57] In

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rare, τρυγῳδία is a synonym of κωμῳδία, and its origin is attributed to Aristophanes or even Democritus himself. It is possible the rarity of the term itself may have led copyists to change the word in the manuscripts to κωμῳδία.

[57] Sedley (2004, p. 84, n. 36) prefers the traditional reading of 315b15 with "tragedy and comedy" being composed by the same "alphabet" instead of "tragedy and trugedy" in which a single letter is enough to transform one word in its contrary. He defends that the solution with tragedy and comedy better reflects the complexity of the atomic theory, because it is not only the substitution of one or another atom in the compound that produces change, but much more the interaction of many

the same way, an isolated atom is not capable of determining the features of a compound, but the coordinated *rhythm* of all the atoms in a dynamical atomic configuration (the *rhysmos* of the compound) has a decisive role.

The idea of *rhysmos* as something that relates to the atomic configuration not only harmonizes well with the other two differences, but also makes more sense with the idea of rhythm (derived from its Attic correlate ῥυθμός). We could think of the dynamic character of *rhysmos* as a sort of dynamic configuration. If we could see this configuration by means of a high-definition microscope, what we would see is a structure whose form would be dynamically stable. Perhaps we would perceive its dynamics as a certain vibration of the structure, which we could associate with the idea of rhythm. The relationship between rhythm and the atomic figures (σχήματα) could then be explained by means of the influence that different geometric shapes would bear on the determination of the trajectory and speeds of atoms after the collisions – their performed motility –, for the trajectories and speeds adopted by two spheres that hit each other at a given angle will be much different than those of a sphere and a pyramid.[58] In other words, different atoms with different geometric shapes – which determine their individual *rhysmoi* – would be responsible for different vibration frequencies of the structure of compounds. There would be,

atoms within the compound, not necessarily with the exchange of atoms with the external environment. The sense of a comedy emerges from the words that compose it, which, in their turn, are composed of letters that only generate sense (*i.e.*, only manifest intelligible properties, in the case of words, and sensible properties, in the case of bodies) when combined in words. With tragedy and trugedy, the emphasis befalls more over the "physical" change of a word into another instead of the semantic change, which is secondary and almost accidental. This is also an interesting interpretation and I would say that it is still possible even with the use of the term 'trugedy', since it signifies comedy.

[58] *Cf.* Mourelatos, 1987, p. 161; and also Mourelatos, 2005, p. 53-55.

therefore, a direct and important relation between the individual *rhysmoi* of atoms and the *rhysmoi* of the compounds.[59]

Bibliography

ANGIONI, L. (2005). *Metafísica* de Aristóteles Livro XII. *Cardernos de História e Filosofia da Ciência* (série 3) 15, n. 1, p. 201-221.

ANGIONI, L. (2008). Aristóteles. *Metafísica*. Livros I, II e III. *Clássicos da Filosofia: Cadernos de Tradução* 15, p. 1-71.

ALFIERI, V. E. (1979). *Atomos Idea*: L'origine del concetto dell'atomo nel pensiero greco. 2 ed. Galatina, Congedo Editore.

BARNES, J. (ed.) (1995). *The Complete Works of Aristotle*. The revised Oxford translation. Digital edition. Princeton, Princeton University Press. (1st ed. 1984)

BENVENISTE, É. (1966). *Problèmes de linguistique générale*. Vol. 1. Paris, Gallimard.

BETEGH, G. (2012). 'The Next Principle' (*Metaphysics* A 3-4, 984b8-985b22). In: STEEL, C. (ed.). *Aristotle's Metaphysics Alpha*. Symposium Aristotelicum. Oxford, Oxford University Press. p. 105-140.

CARRARO, N. (2016). How did Anaximander Become a Material Monist? *Rhizomata* 4, n. 2, p. 154-175.

CHERNISS, H. F. (1935). *Aristotle's Criticism of Presocratic Philosophy*. Baltimore, John Hopkins Press.

CHORÃO, F. (2009). Aristóteles. *Sobre a Geração e a Corrupção*. Tradução e notas. Lisboa, Imprensa Nacional-Casa da Moeda.

DALIMIER, C.; PELLEGRIN, P. (2004). Aristote. *Traité du ciel*. Traduction et Presentation. Paris, GF Flammarion.

DIELS, H.; KRANZ, W. (2012). *I Presocratici*. Trad. Giovanni Reale; Diego Fusaro, et al. 4 ed. Milano, Bompiani.

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GEMELLI MARCIANO, M. L. (2007). *Democrito e l'Accademia*: Studi sulla transmissione dell'atomismo antico da Aristotele a Simplicio. Berlin, Walter de Gruyter.

GOMES, G. L. (2017). O atomismo segundo Aristóteles: pluralismo ou monismo? *Phaine* 2, n. 3, p. 56-79.

GOMES, G. L. (2018a). *A química atomista de Leucipo e Demócrito no tratado* Sobre a geração e a corrupção *de Aristóteles*. Dissertação de Mestrado. Belo Horizonte, Universidade Federal de Minas Gerais.

GOMES, G. L. (2018b). Elementos no atomismo, segundo Aristóteles. *Hypnos* 41, p. 146-165.

GOMES, G. L. (2019). The Elementary Role of the So-Called Differences in the Atomism of Leucippus and Democritus. *Prometheus* 29, p. 295-311.

GRAHAM, D. W. (2009). Leucippus's Atomism. In: CURD, P. K.; GRAHAM, D. W. (eds.). *The Oxford Handbook of Presocratic Philosophy*. (Available at Oxford Handbooks Online, https://doi.org/10.1093/oxfordhb/9780195146875.003.0009).

HICKS, R. D. (1907). Aristotle. *De Anima*. With Translation, Introduction and Notes. Cambridge, Cambridge University Press.

HICKS, R. D. (1972). Diogenes Laertius. *Lives of Eminent Philosophers*. With an English Translation. 2 ed. 2 vols. Cambridge, Harvard University Press. (Loeb Classical Library 184-185).

LAKS, A.; MOST, G. W. (eds.) (2016). *Early Greek Philosophy*. 9 vols. Cambridge/London, Harvard University Press. (Loeb Classical Library 524-532).

LAWSON-TANCRED, H. (1998). Aristotle. *Metaphysics*. Translated with an introduction. London, Penguin.

LESZL, W. (2007). Democritus' works: from their titles to their contents. In: BRANCACCI, A.; MOREL, P.-M. (eds.). *Democritus: Science, the Arts, and the Care of the Soul*. Proceedings of the International Colloquium on Democritus (Paris, 18-20 September 2003). Leiden/Boston, Brill, p. 11-76.

LESZL, W. (2009). *I Primi Atomisti*. Raccolta dei testi che riguardano Leucippo e Democrito. Firenze, Leo S. Olschki.

LIDDELL, H. G.; SCOTT, R.; JONES, H. S.; MCKENZIE, R. (1996). *A Greek-English Lexicon*. 10ed. Oxford, Oxford University Press.

MOREL, P.-M. (1996). *Démocrite et la recherche des causes*. Paris, Klincksieck.

MOURELATOS, A. P. D. (1987). Quality, Structure, and Emergence in Later Presocratic Philosophy. *Proceedings of the Boston Area Colloquium in Ancient Philosophy* 2, p. 127-194.

MOURELATOS, A. P. D. (2005). Intrinsic and Relational Properties of Atoms in the Democritean Ontology. In: SALLES, R. (ed.). *Metaphysics, Soul, and Ethics in Ancient Thought*. Oxford, Clarendon Press, p. 39-64.

MUELLER, I. (trans.) (2014). Simplicius. *On Aristotle On the Heavens* 3.1-7. 2ed. London, Bloomsbury.

PEIXOTO, M. C. D. (2010). Rhusmos e o Movimento dos Átomos na Física de Demócrito. *Kriterion* 122, p. 413-428.

PEIXOTO, M. C. D. (2011). Considerações sobre o visível e o invisível no pensamento de Demócrito. In: PALUMBO, L. (org.). *Logon didonai. La filosofia come esercizio del render ragione*. Studi in onore di Giovanni Casertano. Napoli, Loffredo, p. 281-304.

PRIMAVESI, O. (2012). *Metaphysics* A: A New Critical Edition. In: STEEL, C. (ed.). *Aristotle's Metaphysics Alpha*. Symposium Aristotelicum. Oxford, Oxford University Press. p. 387-515.

RASHED, M. (2005). Aristote. *De la génération et de la corruption*. Texte et traduction. Paris, Les Belles Lettres.

SEDLEY, D. (2004). *On Generation and Corruption* I. 2. In: DE HAAS, F.; MANSFELD, J. (eds.). *Aristotle's On Generation and Corruption, Book* I. Symposium Aristotelicum. Oxford, Oxford University Press. p. 65-89.

SHIFFMAN, M. (2011). Aristotle. *De Anima*. Translated with Introduction and Notes. Newburyport, Focus.

TAYLOR, C. C. W. (1999). *The Atomists: Leucippus and Democritus*. Toronto, University of Toronto Press.

VLASTOS, G. (1946). Ethics and Physics in Democritus (Part Two). *The Philosophical Review* 55, p. 53-56.

WEST, M. L. (1969). An Atomist illustration in Aristotle. *Philologus* 113, p. 150-151.

WILLIAMS, C. J. F. (1982). *Aristotle's De Generatione et Corruptione*. Translated with notes. Oxford, Oxford University Press.

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