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Aristotle's Criticism of Presocratic Theories of Continuity in *Physics* VI

Abstract: This paper examines Aristotle's criticism of the Presocratic atomistic theories of physical continuity. In order to assess Aristotle's account of these theories, I first supply a description of Leucippus' and Democritus' atomism, as their doctrines can be reconstructed from textual fragments. Next, I follow modern exegesis in linking the pluralistic physics of the atomists with the core of issues developed in the Eleatic school. I will analyse Zeno's paradoxes as presented by Aristotle and I will consider Aristotle's own arguments against atomism (*Physics* VI), which provided a blueprint for most of the anti-atomistic critiques in pre-modern times and represented a challenge for any subsequent defender of atomism. Discussing Pyle's, Furley's, and Vlastos' accounts of these arguments, I intend to clarify the philosophical implications of the paradoxes which arose from the first discussions on continuity in the history of philosophy.

Keywords: Atomism, Anti-atomism, Continuum, Aristotle, *Physics*, Zeno's paradoxes

1. Introduction

The term 'atomism' refers to a historical category under which various philosophical theses are bonded together. Following this logic, the thinker labelled as an atomist has to submit to a set of certain statements about the natural world, although he is not constrained to accept all these theses at once in order to be considered an atomist. According to Furley, the Greek atomists were inclined to defend against the "Aristotelians" concepts such as "the atomic theory of matter, mechanical causation, the infinity of the universe, the plurality of worlds, and the transience of our worlds" (Furley 1967, v). On the other side of the dispute, Aristotelians counter-attacked with "the continuous theory of matter, the supremacy of final causes, the finite universe, and the uniqueness and eternity of our world". (Ibid.)

One may believe that the five theses enumerated by Furley are the only essential parts that go into the intellectual scaffolding of any atomist from all ages. Nevertheless, different lists can easily come up. For instance, Pyle posits a set of four assertions that cohere into "an *ideal* Atomist position capable of serving as a sort of ideological landmark for future reference" (Pyle 1997, xi). These are: 1) the postulation of indivisible particles of

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matter; 2) the admission of vacuum in their cosmological theories; 3) the reduction of natural, visible phenomena to the motion of invisible atoms; 4) a mechanical explanation of movement. (Ibid.) But, as it was cogently pointed out, the particular historical instances of atomistic and corpuscular theories rarely fit into such a neat schematism as the one proposed by Pyle (Lüthy, Murdoch and Newman 2001, 7-8).

In this article I will address only the first feature out of the four, which would exhibit, according to Pyle, an *ideal* atomism. Therefore, when I use the terms 'atomist' or 'atomism', I am referring only to the theory of indivisible particles.

2. The Physical Atomism of Democritus

The first philosophically relevant conceptions regarding atomism were developed in the fifth century B.C. by Leucippus and his alleged disciple, Democritus, who laid out his physical theories in a work called "Great World-System" (*Megas Diakosmos*), unfortunately lost today. The outline of his cosmological thought is described by Simplicius in his commentary on the *Physics* as follows:

> Leucippus of Elea or Miletus […] had associated with Parmenides in philosophy, but in his view of reality he did not tread the same path as Parmenides and Xenophanes, but rather, it seems, the opposite path. For while they regarded the whole as one, motionless, uncreated and limited and forbade even the search for what is not, he posited innumerable elements in perpetual motion - namely the atoms - and held that the number of their shapes was infinite, on the ground that there was no reason why any atom should be of one shape rather than the other; for he observed too that coming-into-being and change are incessant in the world. Further he held that not-being exists as well as being, and the two are equally the causes of things coming-into-being. The nature of atoms he supposed to be compact and full; that he said, was being, and it moved in the void, which he called not-being and held to exist no less than being. In the same way his associate Democritus of Abdera posited as principles the full and the void. (Kirk, Raven and Schofield 1984, 400)

From this fragment there can be extracted three main theses purported to belong to Leucippus: 1) being is plural and infinite; 2) beside being there is also non-being, which has just as much reality as being itself; and 3) being and non-being comprise in an equal proportion the principles of coming-into-being. We are further informed that being is composed of innumerable atoms of various shapes and always moving, compact and full, while non-being is identical with void. The same principles are named by Democritus 'the full' (*to pleres*) and 'the void' (*to kenon*), although Cicero ascribed a similar terminology to Leucippus himself (Cicero 1885, 314). Simplicius' conjecture is that Leucippus' theory was developed as a rejection to Parmenides and to the later Eleatics regarding their thesis of a single, whole, complete, unchanged, and indivisible being, and to their complete rejection of non-being to the effect of denying void, motion and change altogether.

It is not Simplicius, however, who first attempted to explain Leucippus' theory as influenced by the Eleatic ontology, since this interpretation was already put forth by Aristotle (Furley 1967, 63-79). In *Metaphysics*, A, 985b4-985b20, Aristotle asserts that:

> Leucippus and his associate Democritus hold that the elements are the full and the void; they call them being and not-being respectively. Being is full and solid, not-being is void and rare. Since the void exists no less than body, it follows that not-being exists no less than being. The two together are the material causes of existing things. And just as those who make the underlying substance one generates other things by its modifications, and postulate rarefaction and condensation as the origin of such modifications, in the same way these men too say that the differences in atoms are the causes of other things.

Aristotle claimed, in *De generatione et corruptione*, A2, 315b6, about Leucippus and Democritus that they admitted infinite number of shapes on the part of atoms, "since they thought that truth lay in appearance, and appearances are conflicting and infinitely many, they made the 'figures' infinite in number" (Aristotle 1991, 5).

But why were the atoms indivisible for Leucippus? Apparently, their indivisibility was due to their smallness – at least that is what Galen in the second century CE informs us, in his *De elementis secundum Hippocratem*, I, 2 (Diels and Kranz 1903, 68A49; Kirk and Raven 1957, 408). As Furley convincingly shows, however, endorsing the smallest physical bodies as constituents of matter does not solve the paradoxes put forth by Zeno, to which the Atomists had allegedly tried to reply (Furley 1967, 85). The smallest physical body, although it may be indestructible, is still theoretically or conceptually divisible, a fact that renders it subject to mathematical paradoxes.

3. The Paradoxes of Zeno of Elea

Zeno's predilect method of engaging with the thought of his adversaries was by using *reductio ad absurdum*. Although many different interpretations were proposed from Antiquity to the modern era, I will not consider the bulk of them, since our scope here is to provide the *minimum* background for understanding Aristotle's criticism of his predecessors.

First, the arguments of motion. Let us consider Aristotle's wording of each of them, since in the Stagirite's text it is retained the earliest rendition of them. All of these four arguments are found in the Book VI of *Physics*, from 239b5 to 240a20. Over time, they received conventional titles: the first was called "The Dichotomy", the second "the Achilles", the third "The Arrow", and the fourth "The Moving Rows".

3.1. "The Dichotomy"

"The Dichotomy" runs for a few lines in chapter 9 of Book VI but is discussed in other places of the *Physics* (see 233a21sqq, where in Aristotle's reading, the argument is shown to be fallacious). In its most detailed form, at Physics, VI, 9, 263a4-6, the argument is laid out as follows:

> The same method should also be adopted in replying to those who ask, in the terms of Zeno's argument, whether we admit that before any distance can be traversed half the distance must be traversed, that these half-distances are infinite in number, and that it is impossible to traverse distances infinite in number - or some put the same argument in another form, and would have grant us that in the time during which a motion is in progress we should first count the half-motion for every half-distance that we get, so that we have the result that when the whole distance is traversed we have counted an infinite number, which is admittedly impossible. (Aristotle 1991, 152)

In Aristotle's view, what Zeno attempts to show by this argument is that any finite distance can never be traversed, since first one has to arrive at the half of that certain distance. But after reaching halfway, one still has to arrive at half of the half distance, and so on. Given that any part of the overall distance is divisible, the newly conceived parts are themselves divisible, so consequently this process could proceed *ad infinitum*. Thus, in order to arrive at the end point, one has to cross an infinite number of sub-sections, a task that is impossible to achieve in a finite amount of time. The conclusion of the paradox is that motion is impossible.

Aristotle decides to solve the puzzle by pointing that finite time shares with finite magnitude the property of infinite divisibility, so that, in Zeno's example, to each sub-section would correspond a temporal sub-section in the time continuum, thus enabling one to complete the task in a finite amount of time (Aristotle 1991, 97). Now, I will describe the main modern interpretations that were given to Zeno's line of reasoning.

a) In one of the interpretations, the argument has the implicit premise that the infinite divisibility of any continuum (here, the stadium) entails the generation of an infinite sum, since the parts of the continuum are infinite, and by adding up all the parts one obtains an infinite quantity. But, to quote an Aristotelian adage, the infinite cannot be traversed. Hints that Zeno had such an assumption were derived from other arguments, namely the argument from plurality (Diels and Kranz 1903, 29, B1), (Vlastos 1967, 244). On this account, Zeno is accused of incoherence: while assuming that the number of sequences have no last member *i.e.,* a member at which the division ultimately stops, he nevertheless seems to posit such a last member. Consequently, the distance is composed of an infinity of parts that are all larger than this alleged last and smallest member of the sequences, which does indeed lead to the conclusion that the distance has an infinite length (Vlastos 1967, 244). The paradox is easily solved by observing that any sequence is succeeded by a smaller sequence that has a size larger than zero. Thus, the sum of the sequences is not infinite.

b) In the literature of the last decades, the argument has been reinterpreted as describing on Zeno's behalf a logical impossibility, namely the fact that it is impossible to complete an infinite number of sequences, since that activity, by its definition, has no last member. In an article from 1966, Gregory Vlastos proposed a novel interpretation of the argument, and based on his interpretation, claimed to solve Zeno's paradox. On Vlastos' reading, Zeno's Stadium paradox entails not the *physical* or *mental* impossibility of completing an infinite number of sub-distances in a finite time, but it actually implies a *logical* contradiction, namely the "completion of an infinite sequence of discrete acts" (Vlastos 1966a, 97-8), an idea about which Zeno thought it did not need to stress to his contemporaries that it is a patent self-contradiction. Assuming that this is the true interpretation of Zeno's paradox, Vlastos compares the "The Dichotomy Argument" (or the "Race Course", as he prefers to refer to it) to modern mental/mathematical experiments, mainly Max Black's Beta Machine, and refutes the claim that Zeno's paradox is structurally similar to the infinity machines imagined in contemporary literature (Vlastos 1966a, 98-100).

This route enables Vlastos to provide his own solution to the problem raised by the paradox: beginning from the start point (*S*), the runner is not obliged to traverse the whole distance from *S* to the effect that it actually reaches the goal (*G*), but he simply has to complete a distance equal to *SG* that is metrically indistinguishable from *SG*. In this manner, Vlastos evacuates as unwarranted from the formalization of the argument the very premise that, at the end of the race, the runner has to arrive at *G*. It suffices to be at a place *indistinguishably* close to *G* (Vlastos 1967, 102). Vlastos, however, is fully aware of the paradoxical tint his solution carries, so, as a conclusion, he adds: "Not often in the history of thought has a puzzle been contrived whose brazen denial of a familiar truth can be successfully gainsaid only by the denial of another commonplace belief whose truth seems fully as certain: that the only way to reach a point is to make a unique motion which terminates at {(or beyond)} that point" (Vlastos 1967, 103).

3.2. "The Achilles"

This argument, called the Achilles, is introduced by Aristotle at *Physics* VI, 9, 239b15-29:

> The second is the so-called Achilles, and it amounts to this, that in a race the quickest runner can never overtake the slowest, since the pursuer must first reach the point whence the pursued started, so that the slower must always hold a lead. This argument is the same in principle as that which depends on bisection, though it differs from it in that the spaces with which we have successively to deal are not divided in halves. The result of the argument is that the slower is not overtaken. (Aristotle 1991, 110)

As Aristotle highlights, this argument has similar premises to the former argument: its salient novelty is the introduction of different speeds. Various interpretations have been given to this line of reasoning, which tend to propose solutions similar to those proposed in the case of the Dichotomy.

First, I will take into consideration the textual material by which it is possible to reconstruct Aristotle's resolution of the paradox. As we have seen, Aristotle likens this argument with the previous one. This is a first step in realizing that his solution must be similar to the one provided in the case of the Dichotomy, although some exegetes pointed to the differences between the arguments (Barnes 1999, 274). Therefore, Aristotle adds in *Physics*, VI, 9, 239b22-29:

> But it [the argument] proceeds along the same lines as the bisection-argument (for in both a division of the space in a certain way leads to the result that the goal is not reached, though the Achilles goes further in that it affirms that even the runner most famed for his speed must fail in his pursuit of the slowest), so that the solution too must be the same. And the claim that that which holds a lead is never overtaken is false: it is not overtaken while it holds a lead; but it is overtaken nevertheless if it is granted that it traverses the finite distance. (Aristotle 1991, 110).

Following Aristotle's suggestion and for the purpose of simplifying the argument, I shall attempt to introduce the measure of double halves in its description, without eliminating any element from its original composition. Take *SG* as the distance where the race takes place. While Achilles starts his run at *S*, the tortoise simultaneously begins running at a point (*T*) on the track *SG*; when Achilles reaches the point situated at half of the distance between *S* and *T* (S_1), the tortoise is already at some point beyond *T*, which can be marked as T_1 - if the Dichotomy is functional here, Achilles will never reach *T*, but on this account it is granted to Achilles that he reaches *T*;

suppose that Achilles also recovers the deficit and quickly reaches the point at the half of the sequence TT_1.

If we introduce the Dichotomy scenario here, Achilles has to traverse smaller and smaller sequences of which there is no last member, so Achilles will never reach T_1. Even if he somehow reaches T_1, the tortoise will already be at some point (T_2) beyond T_1, between which there is an infinity of sequences Achilles has to traverse in order to reach T_2, and identical conditions apply to the T_2T_3 sequence. The Achilles argument is the Dichotomy repeated *ad infinitum*. Regardless of the tortoise's speed, the runners will never simultaneously be at the same point.

If the Achilles is at heart a dichotomy argument, then it is highly plausible that Aristotle construes his response in the same lines as he proceeded with the Dichotomy. Granted that space is infinitely divisible, so is time; the tortoise and Achilles will have to divide the same spatial sequences but given that Achilles is a faster runner than the tortoise, he will complete this task in a shorter time interval than the tortoise. Thus, Achilles will eventually catch up with the tortoise. However, Aristotle is not explicit whether this is his intended solution. He even expresses his discontent with the solution at *Physics*, 263a15-18 (Aristotle 1991, 153).

Vlastos proposes his own solution that is much in line with his interpretation of the Dichotomy. Arguing that Zeno's reasoning in the Achilles boils to the dilemma devised in the Dichotomy, Vlastos repeats the solution he proposed for that specific argument: "Though no contemporary Z-runs reach coincident points at the same instant, a Z-run can always be found which would bring Achilles as close to the tortoise as we please (…) Achilles is in a position to make the difference between him and the tortoise less than any assignable quantity, however small – a perfectly good way of overtaking her, without each of them having had to make a unique run reaching P at the same instant" (Vlastos 1966a, 108).

3.3. "The Arrow"

This argument is referred to twice in chapter 9 of the Book VI (first at 239b5-9, then at 239b30-32), but is one of the most discussed of Zeno's arguments. In its lengthier form, the argument is laid out as follows:

> Zeno's reasoning, however, is fallacious, when he says that if everything when it occupies an equal space is at rest, and if that which is in locomotion is always in a now, the flying arrow is therefore motionless. This is false; for time is not composed of indivisible nows any more than any other magnitude is composed of indivisibles.

> The third is that already given above, to the effect that the flying arrow is at rest, which result follows from the assumption that time is composed of moments: if this assumption is not granted, the conclusion will not follow. (Aristotle 1991, 110)

Was it Zeno's assumption that time is composed of indivisible instants or 'nows'? If it was, it seems that Zeno might had embraced atomism, at least its temporal kind. According to Vlastos, who had carefully examined the argument as it appears in the earliest sources, (Vlastos 1966b, 206-8) Aristotle inserted this implication, since the concept used by Aristotle, *nun*, is a term that could not have occurred previously in Zeno's text, since *nun* is mainly an instant devoid of any duration. In polemical discussions, Aristotle means by *nun* an atomic duration of time. (Vlastos 1966b, 208). There are, however, strong reasons to conjecture that time atomism did not emerge until the post-Aristotelian period (Sorabji 1983, 365). Therefore, the Arrow does not present much interest for our purposes. I will move to fourth argument described by Aristotle.

3.4. "The Moving Rows"

The "Moving Rows" argument is deserving of a brief description. The argument is developed at *Physics*, 239b33-240a20:

> The fourth argument is that concerning equal bodies which move alongside equal bodies in the stadium from opposite directions -- the ones from the end of the stadium, the others from the middle -- at equal speeds, in which he thinks it follows that half the time is equal to its double. The fallacy consists in requiring that a body travelling at an equal speed travels for an equal time past a moving body and a body of the same size at rest. That is false. E.g., let the stationary equal bodies be AA; let BB be those starting from the middle of the A's (equal in number and in magnitude to them); and let CC be those starting from the end (equal in number and magnitude to them, and equal in speed to the B's). Now it follows that the first B and the first C are at the end at the same time, as they are moving past one another. And it follows that the C has passed all the A's and the B half; so that the time is half, for each of the two is alongside each for an equal time. And at the same time it follows that the first B has passed all the C's. For at the same time the first B and the first C will be at opposite ends, being an equal time alongside each of the B's as alongside each of the A's, as he says, because both are an equal time alongside the A's. That is the argument, and it rests on the stated falsity. (Aristotle 1991, 111)

This reasoning is problematic, mostly due to the implausibility that Zeno could have embraced the assumption that Aristotle clarifies here *i.e.,* that a body moves across a moving body of equal size and a resting body of equal size in the same amount of time (Ross 1936, 81). Some modern commentators, *pace* Tannery, had denied that the argument was originally pointed against indivisibles (Furley 1967, 73-4; Sorabji 1983, 331-2).

3.5. The Paradoxes of Plurality

Another set of arguments exerts a powerful influence on the first atomists *i.e.,* the three paradoxes of plurality that aim at showing the contradictions of the pluralistic positions. The first is preserved in Simplicius' commentary on the *Physics* in a fragmentary and garbled shape. As reconstructed, the argument has two parts: the pluralist claims that there are many things: either each thing will be so small as to lack size, either it will be so large as to be of unlimited size (Simplicius 2011, 50). Hermann Fränkel reconstructed the logical order of the argument (Fränkel 1942, 15). According to Frankel, the first premise of the argument is that each object from the plurality will have no magnitude, since each object has to bear to properties of unity, identity to itself and indivisibility. On this ground, it is impossible for the objects to have any magnitude since extension would imply having parts. Consequently, lack of parts translates into having a magnitude less than zero. Here comes along an existential claim: only what has magnitude is existent. Thus, a plurality would be composed of non-existent objects, which is absurd. Simplicius readily explains why Zeno links existence with magnitude: if an object lacking magnitude were added to another object, it would be safe to affirm that it does not add anything to the latter, since it has its initial magnitude preserved. Moreover, if the same object is subtracted from the object having a magnitude, that object will have the same size as before.

An easy way out of this conundrum would be to admit that objects have magnitude. At this moment, the second horn of the dilemma is introduced: if objects have magnitude, it has to be an infinite one. Since magnitude or extension carries the property of divisibility, any object will have parts. The parts themselves, in order to be distinct, will have magnitudes. Since Zeno rejects the idea of finite divisibility, an object will be composed of an infinity of parts, each having size. Hence, the object will be of infinite magnitude. As in the first part of the argument, magnitude plays as a kind of principle of individuation: without it, two objects or the parts of the same object would be indistinguishable.

According to Vlastos, Zeno's fallacy resides in assuming that the "sum of an infinite number of terms, each of which has finite size, is infinitely large" (Vlastos 1961, 170). This mistake was corrected by Aristotle by positing infinite convergent series.

It is certain that Zeno's dilemma confronted later thinkers with the need of developing ways of responding to the argument. Democritus put fourth indivisibles as a way of countering Zeno's principle of infinite divisibility, while Aristotle proposed his famous distinction between potential and actual infinite (Furley 1967, 77). In what follows I will discuss Aristotle's contribution to this specific topic.

4. Aristotle's Criticism of Atomism

According to Fred D. Miller Jr., Aristotle's natural philosophy rests on two fundamental principles. The first principle is the isomorphism thesis: all kinds of magnitude share an identical core structure; the other one is the irreducibility thesis: the structure of any continuous magnitude is irreducible to a more fundamental structure (Miller 1982, 88). Consequently, Aristotle denies the possibility of indivisible elements of time, space, and motion.

Aristotle attacked the atomistic thesis in various places of his work, but most especially in *Physics* VI and *On generation and corruption*. The object of Aristotle's criticism were extensionless atoms, similar to mathematical points, although he was aware of the kind of atomism which espouses atoms of different sizes and shapes, as he points out in *Metaphysics*, A, 4, 985b4-22.

Book V of the *Physics* provide the basic definitions of continuity, contiguity, and succession. Both the definitions of a continuous and a contiguous thing rest on the explanation of what succession is. Therefore, in *Physics*, V, 3, 227a1-7, succession entails that "a thing is in succession when it is after the beginning in position or in form or in some other respect in which it is definitely so regarded, and when further there is nothing of the same kind as itself between it and that to which it is in succession, e. g. a line or lines if it is a line, a unit or units if it is a unit, a house if it is a house (there is nothing to prevent something of a different kind being between)" (Aristotle 1991, 85).

Therefore, a thing is in succession to another if and only if they form a series in which nothing of the same kind comes between them (although something of a different kind can breach the continuity without breaking the succession). Yet, as Helen Lang highlights, succession is the "weakest condition for the formation of a series" (Lang 1992, 50). It is important for Aristotle to establish strong enough conditions for the formation of series with regards to his views on motion and his critique of previous accounts of motion.

According to Lang, Aristotle wants to refute at once two opposite theses regarding natural motion: the thesis belonging to the atomists, who posit an infinity of moved movers that interact one with another but barely form a unified whole or series, and Plato's thesis that reduces all motion to the motion of the soul (Lang 1992, 50). Therefore, in addition to succession, Aristotle posits two other conditions required for a series, contiguity and continuity. Aristotle asserts, in *Physics*, V, 3, 227a8-12, that "a thing that is in succession and touches is contiguous," while "the continuous is a subdivision of the contiguous: things are called continuous when the touching limits of each become one and the same and are, as the word implies, contained in the other" (Aristotle 1991, 85).

Aristotle's reflection on continuity and contiguity are not strictly related to the problem of motion touched on in Book VII of *Physics*. The same definitions bear significant weight in the attack on indivisibilism from Book VI. That section of the *Physics* from 231a18-231a28 starts with a recapitulation of the previous definitions and an indication of their role in refuting atomism: "nothing that is continuous can be composed of indivisibles: e. g. a line cannot be composed of points, the line being continuous and the point indivisible" (Aristotle 1991, 94).

Aristotle's contention rests on the absence of any extremities in the case of indivisible. In this context, an entity that is continuous or contiguous to another needs to possess parts or extremities distinct from itself. Aristotle's example is that of mathematical points, that cannot compose a line since, being extensionless, cannot enter into a relation of continuity or contiguity with one another. Indivisible points are part-less, therefore they cannot touch or be together in the same place throughout their extremities (*Phys*ics, VI, 1, 231a2-30), and thus cannot compose a magnitude. For Aristotle, there are three modalities of something touching or being in contact with another: 1) whole through whole; 2) part through part; and 3) part through whole. Indivisibles can only touch in the third modality, and therefore cannot compose a continuum, which has spatially distributed parts (*Physics*, VI, 1, 231b1-5).

Points also fail the condition of succession, according to Aristotle. For example, in the case of points and temporal instants, there will always be intertwined a line or a temporal interval – a line in the case of points, time in the case of instants (*Physics*, VI, 1, 231b7-9). However, I think that Aristotle's contention doesn't hold much ground. Aristotle thinks that indivisibles cannot constitute a continuum since they do not accomplish the general condition of succession – that two things are in succession whenever they come one after another without an intervening thing of the same kind.

Now, on Aristotle's account, between two points there is always a line that breaks off the condition of succession. Yet inasmuch the line is of a different kind than the point, why should we think that an intervening line makes succession between two points impossible, since Aristotle asserts that "there is nothing to prevent something of a different kind being between" (Aristotle 1991, 85). On this reading, it is possible that a point succeeds another even if there is an intermediary line between them.

On the other hand, if Aristotle would try to sustain his argument and say that two points cannot be in succession because the line that mediates between the two is of the same kind as them, this move would generate another contradiction. It would force him to acknowledge what he tried to reject in the first place *i.e.,* that lines are not composed of indivisibles and are generically different from points. The same line of argument applies to the relation between instants and time, bearing in mind that Aristotle rejected the possibility of time being composed of instants.

Other arguments, concerning the divisibility of motion, were as influential as the previous one and gave birth to a whole literature of problems in Antiquity and the Middle Ages. For instance, the argument from 231b20-232a1-10 sets the stage for a series of arguments regarding the isomorphic structure of magnitude, time, and motion. If one mobile passes over a magnitude composed of three indivisibles, then the motion by which it passes over has to be composed of three indivisible sub-motions – otherwise, a motion that is divisible in an indefinite number of parts would divide the indivisibles of the said magnitude into lesser parts, which is against the atomist's thesis. The difficulty rises out of the fact that at every time of the motion, the mobile is necessarily being moved. Yet it cannot be in the process of starting to move and to already have moved simultaneously, since that would entail that motion is not comprised of movements, but of 'movings' (*kinema*). Therefore, it is impossible that motions take place in this jerk-like manner or that magnitudes are indivisible (Murdoch 1984, 47-8; Sorabji 1983, 365-6).

Some of Aristotle's arguments tried to disprove indivisibilism by demonstrating to continuous structure of measure. In this category falls, for example, the argument implying two mobiles from the beginning of *Physics* VI, 2, 232a25-232b1-20. There a faster and a slower mobile are opposed: the faster mobile covers a certain distance in less time than the slower mobile; by the time the slow mobile crosses the finish point, the faster mobile already reaches in the same amount of time a further point. This argument establishes that mobiles with different speeds will divide space in different segments and in considerably different time spans (Murdoch 1984, 48-9). The argument suggests that a magnitude composed of three indivisibles, traversed by mobiles with varying speeds in different time spans, would be divided in less than three indivisible parts.

5. Conclusion

To recapitulate, the origins of the pre-modern debates on continuity and atomism are to be traced in the distant background of classical Greek philosophy. I therefore provided a brief sketch of the physical atomism of Democritus, based on the testimonies of Aristotle and later authors, such as Simplicius, taking into account the reconstructions articulated by modern scholars (especially Furley, Sorabji, and Vlastos). Since Aristotle himself thought the atomistic theory to be a reaction to the doctrines of monism and immobility of being professed by the Eleatic school, his explanation was adopted and developed by modern scholars of ancient philosophy. I therefore provided in my account a description of Zeno's paradoxes of motion and of his arguments against plurality, as they are rehearsed in the Aristotelian texts and in Simplicius' works. These paradoxes are an important development in the history of debates concerning the continuum, all the more because Aristotle redescribed them so as to fit his own understanding of the issues regarding infinity and continuity. The central piece of Aristotle's criticism is Book VI of his *Physics*, where he lays out some original arguments against atomism. Rendered carefully and consulting their modern interpretations, these arguments can be reconstructed, and one can even make their eventual shortcomings more noticeable. Regardless of their potentially problematic aspects, these arguments had an enduring career in Antiquity and the Middle Ages becoming part of virtually any anti-atomist's stock of arguments. Their force determined Epicurus to reform Democritus' atomism as to make it resilient to the attacks inspired by Aristotle's criticism.

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