

What about Plurality? Aristotle's Discussion of Zeno's Paradoxes

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1. Introduction

Zeno seems to have been the inventor of the genre of paradoxes as we know it in the Western tradition,¹ even if he did not use the term 'paradoxes' for it. And he seems to have come up with numerous individual paradoxes:² according to Proclus in his commentary on the *Parmenides*, there were 40 *logoi*, which Elias reports are supplemented by five arguments against motion; the *Suida* claims that there were four books by Zeno.³ While according to these sources, Zeno's oeuvre seems to have been considerable, only some of these paradoxes have been preserved in our times. They can be divided into three series, the paradoxes of *topos*, the paradoxes of plurality, the paradoxes of motion, and, in addition, there is the single paradox of the falling millet seed.⁴

¹ For a discussion of this claim, see Sattler (2021).

² Cf. DK 29 A 15; Kirk, Raven, and Schofield (1983: 264–265) and Barnes (1982: 233).

³ DK 29 A 2.

⁴ The paradoxes of *topos* can be found in DK 29 A 24 and B 4, and Lee fragments 13–18; the paradoxes of plurality in DK 29 B 1–3 and A 21–23, and Lee 1–12; the paradoxes of motion in DK 29 A 25–28, and Lee

Aristotle has a special relationship to Zeno's paradoxes. This can already be seen from the fact that Aristotle (together with his three commentators Themistius, Philoponus, and Simplicius) is our main source for his paradoxes. Moreover, for Aristotle, Zeno's reasoning seems to be the paradigm for paradoxical or eristic reasoning, as can be seen from Aristotle's *Organon*, where on four occasions Zeno's motion paradoxes are used as the only examples for this kind of reasoning: two occurrences discuss inappropriate uses of arguments, such as when Zeno's motion paradox is employed by some people for showing that the diagonal cannot be measured by the side (*APr.* 65b), or when his motion paradox is improperly used in a medical context to argue against taking a walk after dinner (*SE* 172a; Zeno's paradoxes showing motion to be impossible seem to have come in handy for people who didn't want to follow their doctor's suggestion to have some exercise after their meal). The other two occurrences use Zeno's paradoxes as exclusive examples for arguments that clearly present a wrong conclusion or are clearly contrary to common (and in this case true) opinion, but are nevertheless very hard to refute (*Top.* 160b and *SE* 179b).⁵ The fact that Zeno's paradoxes of motion are used as well-known and the only examples in each of these cases shows that they were obviously familiar to a wider audience and centrally on the mind of Aristotle.

However, while Aristotle provides the first reports for the paradoxes of motion, *topos*, and the millet seed, he hardly ever mentions the paradoxes of plurality (Simplicius is our primary source for those). Given that Aristotle discusses the other paradoxes of Zeno at some length and comes back to some of them several times, it seems noteworthy that he does not show much interest in Zeno's paradoxes of plurality. Obviously this cannot be due to Aristotle not being interested in paradoxes as such and, as we will see below, it is also not the case that Aristotle did not know them.

With Plato, we seem to get a very different Zeno. When Plato talks about Zeno's paradoxes, he almost exclusively talks about Zeno's plurality paradoxes. The one work where Plato includes Zeno as a *dramatis persona*, namely the *Parmenides*, opens the main scene with a sketch of a plurality paradox of Zeno: if we assume a plurality of things, this plurality has to be like and unlike (*Pl. Parm.* 127e). And also Plato's reference to Zeno in *Phaedrus* 261c–e seems to concentrate on the plurality paradoxes.

In the context of the *Parmenides* dialogue, Plato also tells us more about the relationship between Parmenides and Zeno – most notably, that Zeno's paradoxes were meant to fend off attacks on Parmenides's position, an interpretation which has become one of

fragments 19–36; and the paradox of the falling millet seed in DK 29 A 29, and Lee fragments 37–38. For the division, cf. Lee (1967: 9).

⁵ There is a fifth reference to another paradox of Zeno's in the *Organon* that I will deal with below.

the most dominant views on their relationship.⁶ By contrast, Aristotle does not seem to be interested in their relationship.⁷

In this paper I want to investigate why Aristotle reacts to those paradoxes of Zeno he does and why, in contrast to Plato and Simplicius, he is almost completely silent on the plurality paradoxes. I will start by looking at the context in which Aristotle discusses the paradoxes of motion, *topos*, and the falling millet seed, in order to see what role these paradoxes play for Aristotle. Subsequently, I will look at the one mention of a plurality paradox we have in Aristotle and its context, as well as at the context in which Plato and Simplicius give us their accounts of the plurality paradoxes, in order to see whether this can help us to understand why Simplicius and Plato deal with the plurality paradoxes while Aristotle ignores them for the most part.

2. The paradoxes prominently discussed in Aristotle

2.1 The Motion Paradoxes

The four paradoxes of motion – the dichotomy or runner paradox, the Achilles, the arrow paradox, and the paradox of the moving rows⁸ – are probably Zeno's most famous paradoxes. Aristotle refers to them several times in his discussion of continuity in the *Physics*: to the dichotomy, which he pairs with the Achilles, three times, to the arrow paradox two times, and once he reports the whole complicated set-up required for the moving rows paradox.⁹

He introduces the arrow paradox at the beginning of book VI, chapter 9, just after demonstrating in the previous chapter that, given the continuous structure of motion and rest, there cannot be a first point in time when motion happens, or when a moving thing starts to rest. If we assume as starting point a span of time, then the beginning of motion or rest seems to take place in each part of it, and since we can divide each part further

⁶ It has, however, been doubted in recent literature, so, for example, in Sedley (2017) and Palmer (2009). I will, nevertheless, also assume that Zeno is supporting Parmenides, as does Simplicius; I argue for this in Sattler (2020).

⁷ As Richard McKirahan, forthcoming, has recently pointed out. McKirahan argues that Plato's testimony is not trustworthy, because it seems to disagree with Aristotle's and Eudemos's account. I argue against such a strong scepticism towards Plato's reliability with respect to Zeno in Sattler, forthcoming.

⁸ There is a problem with the naming of the paradoxes. The name "dichotomy" is also used to refer to one of the plurality paradoxes; and the name "stadium paradox" is used by some scholars to refer to the fourth paradox of motion, to what is here called the moving row paradox (cf. Barnes 1982: 261), and by some to refer to the first paradox of motion, viz., the paradox that in a finite time a runner will either never be able to reach the end of a finite race course or cannot even get started (following Aristotle, *Top.* 160b7). I will stick here to the names given above, as they are commonly used in the discussion (even if the usage of the name "dichotomy" may not be historically correct, cf. Vlastos 1975: 215, n. 2). For further discussion of Zeno's paradoxes, see the contributions to this volume by Beori and Crubellier.

⁹ See Sattler (2015).

into smaller parts, there is no real first moment of motion or rest. If, on the other hand, we assume there to be an indivisible now as the starting point, then we face the problem that in an indivisible now there can in fact be no motion or rest, since motion and rest is what happens in between two points of time – if a thing is at rest, it is in the same place in the second now as in the first; if it moves, it is in a different place. Thus, in an indivisible now, a thing is neither in motion nor at rest, rather it is un-moved according to Aristotle (*Ph.* 239b1–2). Having shown this, Aristotle now infers that Zeno’s arrow paradox will not pose a problem, since:

Ζήνων δὲ παραλογίζεται· εἰ γὰρ αἰεὶ, φησὶν, ἡρεμεῖ πᾶν [ἢ κινεῖται] ὅταν ᾗ κατὰ τὸ ἴσον, ἔστιν δ’ αἰεὶ τὸ φερόμενον ἐν τῷ νῦν, ἀκίνητον τὴν φερομένην εἶναι οἰστόν. τοῦτο δ’ ἐστὶ ψεῦδος· οὐ γὰρ σύγκειται ὁ χρόνος ἐκ τῶν νῦν τῶν ἀδιαίρετων, ὥσπερ οὐδ’ ἄλλο μέγεθος οὐδέν.

Zeno reasons falsely: for if, as he says, everything rests [or is in motion] whenever it is in/against what is equal, and what moves is always in the now, the moving arrow is unmoved. But this is wrong. For time is not composed of indivisible nows, nor is any other magnitude (*Arist. Ph.* 239b5–9).

According to Aristotle, we only get into the arrow paradox, if we assume nows to be indivisible and extensionless and time to consist of indivisible, extensionless nows.¹⁰ For only in such a now would the moving arrow be in a place equal to its own size and only if time consisted of nothing but such nows would the flying arrow in every part of its course be in a place equal to its own size and thus at rest. Aristotle has already shown in chapter 2 of book VI that time cannot consist of indivisible, extensionless nows, and he has just shown in chapter 8 that in an indivisible, extensionless now there can be neither motion nor rest (the distinction between rest and not-moving is not yet to be found in Zeno).

In this context, Aristotle also introduces the other three paradoxes of motion (telling the reader that there are four *logoi peri kinēseōs*, which cause so much trouble for those who want to solve them). He has, however, already introduced the runner paradox earlier in his *Physics*, in 233a21–23. There Aristotle showed that his argument for time and space being infinite in the very same way also demonstrates that Zeno’s argument makes false assumptions:

διὸ καὶ ὁ Ζήνωνος λόγος ψεῦδος λαμβάνει τὸ μὴ ἐνδέχασθαι τὰ ἄπειρα διελθεῖν ἢ ἄψασθαι τῶν ἀπείρων καθ’ ἕκαστον ἐν πεπερασμένῳ χρόνῳ.

¹⁰ For a detailed reconstruction of the paradox, see Sattler (2020).

For Zeno's argument turns out to be wrong (in assuming) that it is not possible to go through the infinite or to touch each single (part) of the infinite in a finite time. (Arist. *Ph.* 233a21–23)

Zeno's argument suggests that something moving over a finite distance in a finite time, first has to cover half of this distance, then half of the remaining distance, and again half of the still remaining distance, ad infinitum. Accordingly, this paradox seems to show that when attempting to cover a finite distance in a finite time, (a) a runner in fact has to pass an *infinite* number of *spatial parts*, and (b) she has to do so in a *finite time*, which seems to be impossible.¹¹ In the context of this first introduction, Aristotle is only concerned with the second problem, that infinitely many spatial parts seemingly need to be covered in a finite time, so that of the two aspect of motion, time and space, one seems to be infinite, the other finite. Aristotle's immediately preceding discussion has shown that in considering motion, whenever we divide the distance covered, we also have to divide the time taken, so that both are equally infinite. And after the passage just quoted, Aristotle goes on to show that this infinity is unproblematic, since it is infinity of division, which has to be clearly separated from infinity of extension. What is infinite in division can be captured in a finite time. (Finally, Aristotle also shows that we cannot assume one of the two aspects of a finite motion, time or space, to be finite, and the other infinite in extension, since this would get us into inconsistencies).

This paradox is taken up once more in *Physics* book VIII.8, when arguing that under the assumption of a finite universe, only circular motion can be continuous in the sense of going on without interruption ad infinitum. In contrasting the continuous circular motion with linear motion that at some point would have to come to an end in a finite universe and start again, Aristotle gives us an analysis of the mid-points of a continuous motion: if we think of them as on a track passed by a continuous motion, they are only potential points. Once they are actualized, e.g., by the moving thing coming to a halt, then such a mid-point is in fact the end of one motion and the beginning of another, second motion. But if the moving thing travels continuously and does not stop there, then this potential point is not actualized, and we cannot say that the thing moving has arrived at this point or departed from it.¹² In 263a4–11, Aristotle applies this analysis to Zeno's runner paradox. He now gives us also what has been called the 'regressive form' of the paradox, that covering even half of the finite distance would mean that the runner must have already gone through an infinite number of spatial parts; accordingly, the runner cannot even get started. In his reply, Aristotle focuses on the first problem here, that in attempting to cover a finite distance, it seems an infinite number of spatial parts have to be passed (subsequently, he goes through this problem also solely with time – that a finite stretch of time seems to contain infinitely many parts of time). Pointing out that there are

¹¹ For a discussion of a potential third problem, namely that an infinite number of tasks needs to be performed in a finite time, see Sattler (2019).

¹² For both of these would take time, and they cannot take place at the same time.

not actually infinitely many parts, but only potentially infinitely many (in the sense that at each point of the run, time, or distance, we could perform a division and thus derive two parts), he thinks he has also dealt with Zeno's first problem.

In *Physics* VI.9, the chapter we started out with for this paradox, Aristotle also sketches the Achilles paradox, only to make it clear that he considers the Achilles to be a variation of the runner paradox, which thus can be solved in the very same way the runner can. And he also sketches the complicated set-up of the moving rows paradox.

References to the motion paradoxes come at important moments in Aristotle's demonstration of the central features of the structure of continua: in the context of showing how to conceive of infinite divisibility; how to understand this infinity; when showing that time, space, and motion, all three, have to be thought of as continua equally; and that there cannot be motion or rest in an indivisible now. Accordingly, Zeno's motion paradoxes seem to be in the background of the whole discussion of continuity (in *Physics* book VI), which for Aristotle is the central structure underlying time, space, and motion.¹³

Since at least the first three motion paradoxes seem to have been the most important challenge posed to the assumption of infinite divisibility of time, space, and motion, which Aristotle presupposes in his account of continuity, we should not be surprised that these paradoxes figure prominently in his discussion of continuity.

2.2 The *Topos* Paradoxes

In the literature, we usually find reference to only one *topos* paradox, namely to DK 29 A 24.¹⁴ I think that fragment DK 29 B 4, which connects *topos* and motion, should, however, also be counted as a paradox of *topos*, since it raises important questions for an account of space and place. It claims that nothing can move where it is, nor where it is not. But since this latter paradox is transmitted to us only in Diogenes Laertius, we will not deal with it here.¹⁵

The *topos* paradox that Aristotle discusses is the following:

ἔτι δὲ καὶ αὐτὸς εἰ ἔστι τι τῶν ὄντων, πού ἔσται. ἢ γὰρ Ζήνωνος ἀπορία ζητεῖ τινὰ λόγον· εἰ γὰρ πᾶν τὸ ὄν ἐν τόπῳ, δῆλον ὅτι καὶ τοῦ τόπου τόπος ἔσται, καὶ τοῦτο εἰς ἄπειρον.

¹³ For a detailed discussion of the individual motion paradoxes, see Sattler (2020).

¹⁴ In his *Nachtrag* Diels suggests understanding it no longer as a testimony, but rather as the fifth of Zeno's paradoxes, DK 29 B 5, following Calogero's suggestion in *Studi sull'Eleatismo* (1932). Köhler (2014) argues against understanding it as a fragment rather than a testimony.

¹⁵ Some scholars think it may originally have been part of the arrow paradox.

Further, if it [*topos*] is itself one of the existent things, it will be somewhere.¹⁶ For Zeno's difficulty demands some explanation: for if everything that exists is in a *topos*, it is obvious that also *topos* will have a *topos*, and this will go on *ad infinitum* (Arist. *Ph.* 209a 23–25).

In outline (and reconstructed also with the help of Aristotle's discussion in 210b22 ff.), this paradox claims that if everything that exists is in something, and whatever is in something is in a *topos*, then if *topos* is also something that exists, it will have to be in something and thus in a *topos*, and this *topos* will in turn need a *topos* in order to exist, *ad infinitum*.¹⁷ Given that the assumption of the existence of *topos* leads to an infinite regress, the implicit conclusion to be drawn from this is that *topos* does not exist.

Aristotle introduces this paradox at the beginning of his treatise on *topos* in *Physics* book IV.1 as one of the problems a discussion of *topos* has to deal with. As with all scientific inquiry, the inquiry into *topos* first has to establish whether its object exists, and if so, what exactly it is (i.e. what a consistent conception of *topos* would look like). With respect to the question what *topos* is, Aristotle thinks there is just one philosopher who has tried to give an answer, and that is Plato in his *Timaeus*, but he got it all wrong by confusing matter and space. On the question whether it does indeed exist, Zeno poses the clearest challenge so that, unsurprisingly, Aristotle feels the need to reply to it. He gives his reply in chapter 3, after having distinguished eight different senses of 'in', claiming that *topos* may be 'in' something, but not in the locative sense, so that we do not get an infinite regress.

In order to establish a science of nature, which Aristotle claims to be his aim at the beginning of the *Physics*, he needs to show that motion exists and can be consistently conceived, and he needs to do the same for *topos*, in which motion takes place. Accordingly, he has to show that Zeno's paradoxes, which seem to demonstrate that our understanding of motion and *topos* leads into inconsistencies, can be solved.

2.3 The Paradox of the Falling Millet Seed

Aristotle refers to Zeno's paradox of the falling millet seed in *Physics* book VII, 250a19–25, in his discussion of a lower threshold of a force. He establishes that if a force A can move something, say a ship, a distance D in a time T, it does not necessarily mean that force A/2 can move the same ship half the distance in the same time, or the same distance in double the time, as it may be that half the force cannot move the ship at all. Aristotle sees this understanding also as the solution to Zeno paradox of the falling millet seed:

¹⁶ So Philoponus, Simplicius, Themistius, and Ross. Morison (2002) and Sedley (2007) read ποῦ instead of ποῖ; Sedley translates accordingly "where will it be?" while Morison interestingly translates as a plural "where will they be?"

¹⁷ For a detailed reconstruction and discussion of this paradox, see Sattler, *Conceptions of Space*, chapter 2.

διὰ τοῦτο ὁ Ζήννος λόγος οὐκ ἀληθής, ὡς ψοφεῖ τῆς κέγχρου ὀτιοῦν μέρος· οὐδὲν γὰρ κωλύει μὴ κινεῖν τὸν ἀέρα ἐν μηδενὶ χρόνῳ τοῦτον ὃν ἐκίνησεν πεσὼν ὁ ὅλος μέδιμνος. οὐδὲ δὴ τοσοῦτον μόριον, ὅσον ἂν κινήσειεν τοῦ ὅλου εἰ εἴη καθ' αὐτὸ τοῦτο, οὐ κινεῖ. οὐδὲ γὰρ οὐδὲν ἔστιν ἀλλ' ἢ δυνάμει ἐν τῷ ὅλῳ.

Hence Zeno's reasoning is false when he argues that there is no part of the millet seed that does not make a sound; for there is no reason why any such part should not in any length of time fail to move the air that the whole bushel moves in falling. In fact, it does not of itself move even such a quantity of the air as it would move if this part were by itself; for no part even exists otherwise than potentially in the whole. (Arist. *Ph.* 250a19–25)

Aristotle does not describe the paradox here – he seems to assume that the paradox is well enough known so that his audience would understand what he is talking about. There is a variant of this paradox in Simplicius's commentary on the passage, whose reliability has, however, been challenged, since it claims this paradox to be in dialogue form and lets Protagoras appear in it as an interlocutor of Zeno. Nevertheless, from both versions the same rough problem can be reconstructed: while one millet seed does not make a sound when falling, a whole bushel does; but a bushel is derived by adding always another millet seed, and yet another, so that one single seed must also make a sound. And hence a single seed does and does not make a sound. Understood like this, this paradox seems to follow a common structure that we find in Zeno's paradoxes: something is both F and not-F, a falling millet seed does and does not make a sound.

While Aristotle himself does not spell out the paradox fully, he shows that his account of a lower threshold also helps to solve this paradox. For given that there are lower thresholds to the ability of forces moving something, the fact that the whole bushel may move the air such as to make a sound need not mean that each individual seed can make a sound.

3. Zeno's plurality paradoxes

We have seen that Aristotle discusses Zeno's paradoxes at various places in his *Physics*, most notably in his discussion of continuity, *topos*, and the lower threshold of a force. But he does not even mention the plurality paradoxes anywhere in his *Physics*. There is, however, one brief passage in Aristotle where one of the plurality paradoxes is mentioned, which shows at least that he is aware of Zeno's plurality paradoxes. In order to figure out why Aristotle hardly seems to engage with the plurality paradoxes, while he does so with the other paradoxes, let us have a brief look at this one instance in Aristotle, and then look at the context in which Plato and Simplicius discuss Zeno's plurality paradoxes.

3.1. Aristotle's Discussion of a Plurality Paradox

It *Metaphysics* III, in the 11th aporia, we find Aristotle discussing the question whether Being and being one (a unity) are the substances of things, a claim Plato and the Pythagoreans seem to have made.¹⁸ He argues against the possibility that these most universal principles can exist separately and *kath' auta* by showing that then no plurality could arise from them at all: if there is Being existing in itself, then everything else would be different from Being and thus would not exist “so that it necessarily follows, according to the argument of Parmenides, that all things that are, are one and this is Being.” While assuming that Being exists separately thus leads to the position of Parmenides, assuming being one to exist separately would lead to everything else to be not-one. This is problematic, since to some degree, everything that exists has to be one, for “all things are either one or many, and of the many each is one” (for a many is nothing but many times a one). It is here that Aristotle brings in one of Zeno's plurality paradoxes, seemingly in order to support the point that assuming being one to exist separately, and, following on from this to be indivisible, leads into problems:

ἔτι εἰ ἀδιαίρετον αὐτὸ τὸ ἓν, κατὰ μὲν τὸ Ζήνωνος ἀξίωμα οὐθὲν ἄν εἶη (ὁ γὰρ μήτε προστιθέμενον μήτε ἀφαιρούμενον ποιεῖ μείζον μηδὲ ἕλαττον, οὐ φησιν εἶναι τοῦτο τῶν ὄντων, ὡς δηλονότι ὄντος μεγέθους τοῦ ὄντος· καὶ εἰ μέγεθος, σωματικόν· τοῦτο γὰρ πάντη ὄν· τὰ δὲ ἄλλα πῶς μὲν προστιθέμενα ποιήσει μείζον, πῶς δ' οὐθὲν, οἷον ἐπίπεδον καὶ γραμμὴ, στιγμή δὲ καὶ μονὰς οὐδαμῶς)· ἀλλ' ἐπειδὴ οὗτος θεωρεῖ φορτικῶς, καὶ ἐνδέχεται εἶναι ἀδιαίρετόν τι ὥστε [καὶ οὕτως] καὶ πρὸς ἐκεῖνόν τιν' ἀπολογίαν ἔχειν (μείζον μὲν γὰρ οὐ ποιήσει πλεῖον δὲ προστιθέμενον τὸ τοιοῦτον)· ἀλλὰ πῶς δὴ ἐξ ἐνὸς τοιούτου ἢ πλειόνων τοιούτων ἔσται μέγεθος;

Further, if the one itself is indivisible, according to Zeno's doctrine, it will be nothing. For that which neither when added makes a thing greater nor when subtracted makes it less, he asserts to have no being, evidently assuming that whatever has being is a spatial magnitude. And if it is a magnitude, it is corporeal; for the corporeal has being in every dimension, while the other objects of mathematics, e.g. a plane or a line, added in one way will increase what they are added to, but in another way will not do so, and a point or a unit does so in no way. But since he argues crudely, an indivisible thing *can* exist, so that the position may be defended even against him; for the indivisible when added will make the number, though not the size, greater. But how

¹⁸ Cf. Menn, *The Aim and the Argument of Aristotle's Metaphysics*, chapters Iβ3 and Iβ4. According to Menn, *aporiai* 9–11 “are supposed to show that the [Platonic] genera cannot be *archai*.” He sees *Metaphysics* VII as giving a systematic treatment of *aporiai* 5–11, “fleshing out their difficulties against the physicists and the dialecticians into a full argument that neither the physical nor the dialectical account of the *ousia* of a thing yields *archai* prior to the thing.”

can a *magnitude* proceed from one such indivisible or from many? (Arist. *Metaph.* 1001b7–18, translation by Ross).

Zeno's paradox claims that if something is indivisible it seems to be nothing: if this indivisible thing is added to something, it will not enlarge this thing (presumably either because as an indivisible thing, it would not become a proper part of that to which it is added, or because it would need to be without size to be truly invisible),¹⁹ nor would it diminish the thing if it is then subtracted (again, because it does not seem to be a proper part or it is without size). But if it does not make any difference to whatever it is added to or subtracted from, then it does not seem to be (the idea that what is must be able to make some difference may be a predecessor to the Eleatic Stranger's suggestion in the *Sophist* that we can define being as whatever has the ability to be affected or to affect others). Aristotle immediately points out the implicit assumption this paradox rests on – that the things talked about are assumed to be magnitudes, and more specifically corporeal magnitudes, since only with corporeal magnitudes can we say that they will increase something in size when added, and decrease it in size when subtracted. He makes it clear that already with lower-dimensional mathematical magnitudes, such as lines, this would not be the case, since if we put one line on top of another, we have not increased the size of the initial line.

But such non-bodily indivisibles could increase the quantity of something by increasing the number, even if not the size – I may think about two points in my mind, then add a point to these two and thus get three points, even if I get no increase in size. Accordingly, Zeno's paradox leaves out many cases of indivisible things that would make a difference when added or subtracted, only not in the very restricted way Zeno allows them to make a difference. For Aristotle this is crude (φορτικῶς) reasoning and does not really help with the question whether the one as something indivisible can exist. Accordingly, this plurality paradox is not scientific or sophisticated enough to be included in the discussion of this aporia.

The accusation of crude reasoning fits with the way Aristotle treats paradoxes in the *Organon*, as we can see, for example, in the *Sophistici Elenchi*, chapter 2. But it is in notable contrast to Aristotle's treatment of Zeno's paradoxes in the *Physics*, where Aristotle may call some of them not hard to solve, but never remarks on them being not scientific or sophisticated enough to be discussed.

Interestingly, Aristotle does not take into account the context of this paradox and thus any possible reason for why Zeno may have restricted his argument to corporeal magnitudes. It may be that in arguing against pluralists, Zeno takes up from them the assumption that the plurality they are concerned with is a corporeal plurality. And given that we have other paradoxes of Zeno showing that if we assume such bodily things and

¹⁹ Obviously, the atomists Leucippus and Democritus later on would not agree to something having to be without size to be indivisible.

ones to be divisible, we get into the trouble of infinite divisibility, he may here simply give us the second horn of the dilemma, that the corporeal one that pluralists have to work with cannot be indivisible either or that bodies cannot be divided into indivisibles, just as they also cannot be divided into what is always further divisible.

By pointing out that Zeno's argument only works for corporal magnitudes, Aristotle implicitly also shows part of the way of how to deal with this paradox. But he is not taking into account whether it may be a good argument against a certain audience. And in contrast to his treatment of the paradoxes in the *Physics*, Aristotle simply puts this argument to the side as being crude without explicitly explaining his solution,²⁰ while the paradoxes of motion, *topos*, and the falling millet seed at least seem to demand an answer in his eyes, which Aristotle does then spell out.

While in his *Physics*, Aristotle discusses Zeno's paradoxes in order to show that a science of motion is indeed possible, and will not run into these paradoxes, in the *Metaphysics* he seems to bring in a paradox of Zeno in order to show that it is not decisive for the discussion about the separate existence of Being and Oneness and that, accordingly, he does not have to deal with it.²¹

3.2. Plato's Discussion of the Plurality Paradoxes and Plato's methodology

Let us now look briefly at the context in which Plato gives us his account of Zeno's paradoxes in the *Parmenides* and the *Phaedrus*. In both dialogues, Plato is clearly interested in Zeno's plurality paradoxes. Part of the background for this interest may be that Plato's Forms can be understood as displaying essential features of Parmenides's Being (being ungenerated and imperishable, not incomplete, unmoved, the same with itself, initially without any complexity) which allegedly has to be One. But Plato's Forms come as a plurality so that the possibility of plurality may at least require clarification.

The opening of the *Parmenides* shows Zeno as just having finished a reading from his book and Socrates asking whether he has understood it correctly: assuming a plurality of things would lead to these things being both like and unlike and thus to a contradiction; this in fact supports Parmenides' claim that there can only be the One. Plato does not provide any details about the way in which Zeno reached his paradoxical result. A rough sketch of this paradox might go as follows: if things are many, the same thing is both like (to itself) and unlike (to something else). But rather than engage with the concrete content of the paradox here – why the assumption of a plurality would lead each of these

²⁰ Not explicitly spelling out a solution to the paradox may also be due to the context of *Metaphysics* B, which is meant to show possible *aporiai*, not yet their solutions.

²¹ Menn thinks that Aristotle's reason for introducing the paradox here is "to bring out the impossibility of transition from an indivisible one to continuous magnitudes."

things to be like and unlike – Plato sketches the general structure of the plurality paradoxes and shows that they are meant as a support for monism by attacking pluralism.

We see that this plurality paradox seems to be rather different from the plurality paradox Aristotle deals with, which is part of a group of paradoxes showing that the one required for a plurality of things, the unit, can neither be divisible, for then it would not be one, nor indivisible, for then it seems to be nothing.

While Plato does not tell us how Zeno arrived at this seeming contradiction, in the following lines he lets Socrates discuss the paradox further by pointing out that such a result would be truly contradictory and thus problematic only if it could be shown to hold for intelligible things, like similarity itself, but that it is unproblematic with respect to sensible things: according to Socrates, it is not strange if a sensible thing is similar and dissimilar, since it can partake in both similarity as such and dissimilarity as such. Given this explanation, Plato's background assumption here seems to be that the F itself cannot be not-F in any way, as this would undermine its very being. By contrast, sensible things are complex, they are not just F as such, but can take on being F in one respect and not-being F in another, and thus can be similar and dissimilar in different respects. We find an analogous distinction with respect to the explanation of change already in the *Phaedo*, and that differences in respect do not need to lead to a contradiction, Plato already showed in his usage of the principle of non-contradiction in the *Republic*.²² Similarly, we are told we should not be surprised that he, Socrates, can be both one and many, since he is one of the seven people in the room, and at the same time many, since we can distinguish his right side from his left side, and his back from his front (Pl. *Prm.* 128e–130a).

The possibility of plurality is also part of what is discussed in the dialectical exercise of the second part, which is explicitly claimed to be based on Zeno's method (Pl. *Prm.* 135d8). Plato here seems to be at least inspired by Zeno's method and indeed, among other things, engaging with it – not only showing the One or the others (and thus also a plurality) to be F and not-F, but also the One or others to be neither F nor not-F.

In Plato's *Phaedrus* we find a reference to Zeno in a rhetorical context. In 261c–e, Plato refers to the 'Eleatic Palamedes', who is usually identified with Zeno,²³ as showing that the same things will appear both as similar and dissimilar (ὄμοια καὶ ἀνόμοια), one and many (ἓν καὶ πολλά), at rest and in motion (μένοντα καὶ φερόμενα), which also covers mainly the plurality paradoxes,²⁴ again without giving any details. Placing Zeno in

²² See Sattler (2018) and (2020), chapter 5 for details.

²³ Cf., for example, *ad locum* in the Cooper edition of Plato's works.

²⁴ The opposition 'in motion and at rest' may, however, point to one of the motion paradoxes, most likely the arrow paradox. In this case, the series given by Plato may be an attempt to combine the plurality and motion paradoxes by showing that the basic structure is the same in both series: to make the same thing seem both F and not-F. Similarly, in *Parmenides* 128e ff., Plato mentions motion and rest as a central pair of concepts and may thus hint at the motion paradoxes: "»But if someone first distinguishes as separate the forms, themselves by themselves, of the things I was talking about a moment ago – for example, likeness and unlikeness, multitude and oneness, rest and motion, and everything of that sort – and then shows that in themselves they can mix together

the context of practising sophistry and ἀντιλογική τέχνη here seems to fit with the claim we find in Diogenes Laertius VIII.57, that Aristotle called Zeno the inventor of dialectic. It also shows that both Plato and Aristotle considered Zeno as a thinker who is relevant for questions of method.

Let us finally look at the source that provides us with most of the plurality paradoxes we know of, Simplicius's commentary on Aristotle's *Physics*.

3.3. Simplicius's Discussion of the Plurality Paradoxes

Simplicius presents Zeno's plurality paradoxes in his commentary on Aristotle's *Physics* I.3.²⁵ There Aristotle discusses Melissus and Parmenides when examining the question whether the principles of Being could be one rather than a plurality. While Aristotle discusses arguments of Melissus and Parmenides in I.3, he has already made it clear in the previous chapter that their investigation, whether Being is one and immovable, is in fact not part of natural philosophy – for Aristotle such a question rather belongs to first philosophy, i.e. to metaphysics. Nevertheless, he dips into it here as a kind of metaphysical digression. So it is at a point in Aristotle's *Physics* that explicitly touches upon a more metaphysical problem that Simplicius engages with the paradoxes of plurality. More precisely speaking, it is when Aristotle points out that some atomists yielded both to Parmenides and Zeno:

ἐνιοὶ δ' ἐνέδοσαν τοῖς λόγοις ἀμφοτέροις, τῷ μὲν ὅτι πάντα ἓν, εἰ τὸ ὄν ἐν σημαίνει, ὅτι ἔστι τὸ μὴ ὄν, τῷ δὲ ἐκ τῆς διχοτομίας, ἄτομα ποιήσαντες μεγέθη

Some gave in to both of these [sc. Eleatic] arguments – to the argument that all is one if Being means one, by saying that non-Being is, and to the argument from dichotomy, by positing atomic magnitudes (Arist. *Ph.* 187a1–3, translation by Furley, slightly modified).

Those who gave in to both arguments seem to be the Academic atomists for Simplicius,²⁶ given that he introduces Xenocrates and his indivisible lines in this discussion. In the following commentary, Simplicius first explains the extent to which some have yielded to both Eleatic arguments, before he looks separately at Parmenides's claim that all things are one and then at Zeno's dichotomy paradox. He makes it clear that he

and separate, I for my part», Socrates said, »would be utterly amazed, Zeno«” (Pl. *Prm.* 129d–e, translation by Gill and Ryan with alterations).

²⁵ There are also two passages in Philoponus in *Ph.* referring to Zeno's plurality paradoxes, in 42.9 (= DK 29 A 21) which employs an example of one thing being simultaneously many, and in 80.23, which refers to the impossibility of infinite divisibility.

²⁶ This is also Alexander's and Porphyry's understanding; cf. also Furley (1967: 88, 104–110) and Sedley (2007). Makin (1993: 51), however, understands this passage as referring to Leucippus and Democritus.

agrees with Plato's depiction of the relationship between Parmenides and Zeno in his *Parmenides* dialogue that Zeno's paradoxes are meant to support Parmenides' position. Dealing with Parmenides's claim first, Simplicius shows that Plato gave in to Parmenides in the sense that he agreed with the premise that what is other than Being is not; but that nevertheless, Plato did not agree with the alleged consequence that what is not is nothing, since for Plato it is some particular non-Being.

It is when he is turning to the dichotomy claim that Simplicius introduces most of Zeno's plurality paradoxes. The term 'dichotomy' has been understood to refer to Zeno's first paradox of motion, since in *Physics* 239b22 Aristotle himself calls this paradox 'dichotomy'.²⁷ However, Simplicius, following Alexander, clearly takes it to refer to an argument against plurality:²⁸

Alexander says that the second argument, the one from dichotomy, is by Zeno, who says that if being had size and were divided, both Being and not-Being would still be many; and through this shows that the One is none of the things that exist (*Simp. In Ph.* 138.4–6).

The point of this argument may be understood as follows: if the one Being had size (as physical things do),²⁹ then it would have to be divisible, and if divisible, it would have to have parts, and thus not be one any longer but many. This argument prompts Simplicius to discuss the question whether Zeno really does away with Parmenides's One, as Alexander and Eudemus claim. In the context of this discussion, Simplicius introduces what I would count as five other paradoxes of plurality (though it is not always easy to decide whether Simplicius is quoting a new argument of Zeno or whether one of the plurality arguments continues). So in *in Ph.* 138.32 he claims that

Alexander took from the words of Eudemus the opinion that Zeno did away with the One. For Eudemus says in his *Physics*: 'is it then that One is not this, but it is something? For there was a question about this. And they say that Zeno said that if anyone were to give him whatever One is, he would have the power to say what the things that exist are. And there was a question, it seems, because each of the sensibles was said to be many both by the categories and by division, but the point was supposed to be nothing. For what would neither increase something when added to it, nor diminish it when taken away, was not thought to be among the things that exist.

We see that this fragment questioning the one is connected, at least by Simplicius, with the argument we just saw in Aristotle's *Metaphysics*.³⁰ Simplicius gives several

²⁷ Cf. Zekl's (1987) commentary *ad locum*, and Furley (1967: 82).

²⁸ Cf. also Ross (1936: 479).

²⁹ And as Zeno shows in fragments quoted later by Simplicius.

³⁰ Parts of this report from Simplicius can also be found earlier, in 97.13 ff. and 99.7 ff., where in the context of discussing the Lycophon problem that having many predicates seems to make a subject a plurality, Simplicius

arguments of Zeno that seem to support the idea that Zeno bound existence to physical extension, which seems to be problematic also for a one. At the end Simplicius concludes, however, that this holds true only of a one as presupposed by pluralists. Themistius's claim that Zeno argues positively that Being is one is brought in as support for this conclusion. Finally, Simplicius points out that what Porphyry took to be a dichotomy argument by Parmenides is really, as it seemed already to Alexander, by Zeno. In the course of this discussion, Simplicius gives us 3 of the 4 fragments that Diels and Kranz list as genuine B fragments, and the only verbatim quotations of the plurality paradoxes.³¹

While Simplicius's *in Ph.* 138.2–141.12³² is the one passage which gives us the most encompassing account of Zeno's plurality paradoxes, we should bear in mind that we get them in the context of the discussion about whether Zeno also does away with the one by tying all existence to corporeal existence and a discussion of Zeno's relationship to Parmenides. Accordingly, Simplicius may give us only a selection of Zeno's plurality paradoxes that are relevant for the question he is discussing here. He may leave out others that could have been tied to a plurality leading to things being like and unlike, as we find it at the beginning of Plato's *Parmenides*.

In contrast to Simplicius, Aristotle is not interested in the question whether Zeno's paradoxes also do away with Parmenides's One; as already mentioned, Aristotle does not seem to connect Parmenides and Zeno very much at all.³³ Accordingly, a discussion, such as we find in Simplicius, of Zeno's paradoxes of plurality that focuses on the question of how Zeno's paradoxes relate to Parmenides's One, is not to be found in Aristotle's *Physics*. Furthermore, for Aristotle, this would also have been a question more appropriate to metaphysics than to natural philosophy, which, as we saw above, Aristotle thus puts to the side in *Physics* I. So presumably it is no accident that the only mention of a plurality paradox we find in Aristotle is in his *Metaphysics*. Why Aristotle does not discuss the plurality paradoxes any further there, neither he nor Simplicius tells us explicitly. But let us see whether we can derive a possible explanation from what we have seen about the context in which Aristotle deals with Zeno's paradoxes.³⁴

cus brings in Eudemus's claim that Zeno also argued against the one. Diels/Kranz give these last two passages together with Aristotle's *Metaphysics* passage as DK 29 A 21 and thus obviously understand them as dealing with the same paradox.

³¹ The fourth fragment gives us one of the *topos* paradoxes in D.L. IX.72.

³² And indeed in part up to 144.18.

³³ Cf. McKirahan and my reply to it.

³⁴ We do not know, however, whether there were in fact several more substantial paradoxes of Zeno and Aristotle only presents the tip of an iceberg, in which case the plurality paradoxes would not be singled out in the same noteworthy way as being ignored.

4. Conclusion

We saw that Aristotle is mainly interested in Zeno's paradoxes in so far as they are relevant for natural philosophy. By contrast, the plurality paradoxes clearly belong to a metaphysical investigation. The need for a conceptual basis for plurality was clearly raised by Parmenides' poem and Zeno's paradoxes.³⁵ But judging from Aristotle's treatment of Parmenides and of one of Zeno's plurality paradoxes in his *Metaphysics*, Aristotle does not seem to think that this problem as it was raised by the Eleatics still requires philosophical attention, and presumably took it that philosophers after Parmenides and Zeno had dealt with this challenge sufficiently. These post-Eleatic philosophers not only had come up with (at least more or less) consistent pluralistic systems, but they had also given an account of what grounds plurality – for Anaxagoras it is with the help of mind, which divides the initial undifferentiated mass, that we derive plurality;³⁶ for Empedocles strife divides the unified Sphairos into separate masses of the four elements;³⁷ and for the atomists the void is at least one of the reasons for the separation of the atoms. We see that what grounds plurality can be rather different – mind, a force, or a predecessor of space; and at least with Empedocles and the atomists it grounds not only plurality on the phenomenal level, but also on the level of what truly is.

Also Plato assumes plurality on the phenomenal and on the fundamental level. While his *Parmenides* dialogue can be read as including a metaphysical discussion about the possibility of plurality, Plato posits a plurality of Forms without assuming any means that would ground it – the fact that each Form is essentially what it is, seems to be enough to ensure this plurality. This also seems to be the way Aristotle is going with his understanding of plurality – there is no indication that for Aristotle we first have to derive plurality with the help of some means or that plurality would develop from some undifferentiated mass. Rather a plurality of different substances is Aristotle's starting point, and these individual substances are all different from each other, not simply due to force or space, but because of their essences. That Aristotle takes plurality to be unproblematic and not in need of further discussion is also supported by his treatment of the void in *Physics* IV.6–9: the void is used for a variety of tasks by his predecessors, and Aristotle prominently names its function as a condition for motion and as explaining differences in density. While he briefly mentions the void being used also as a separator in order to derive plurality (for example, in *Ph.* 213b22–27), this function is quickly dropped in his discussion, and he concentrates on the other two. He introduces the argument from the Pythagoreans for a void in order to ensure plurality in chapter 6, but it is the only one he does not reply to in chapter 7. Thus Aristotle shows no need to deal with arguments

³⁵ And, to a lesser degree, by the material monism of the Milesians, though there it seems to be put forth less as a challenge than as a desideratum that had not been sufficiently dealt with in their theory.

³⁶ See Arist. *Ph.* 250b24 f., and *Simp. in Ph.* 300.29 f. (= DK 59 B 13).

³⁷ *Emp. Physica*, I.232–330; though deriving individual things is a more complicated story

concerning plurality, even if the context suggests such a discussion. Presumably, Aristotle thinks that his account of the form of something takes care of the question why we have a plurality of individual things on the metaphysical level and his understanding of the limits of continua in *Physics* VI is enough to make it clear what for him ensures that things are separate from each other on the physical level.

That Aristotle considers the plurality paradoxes as metaphysical questions seems to be clear from the fact that the only time he mentions one of them is in the aporia book of his *Metaphysics*. And it is with the plurality paradoxes on a metaphysical level that Zeno's connection to Parmenides would be most relevant,³⁸ so we should not be surprised if their relationship is not important for Aristotle.³⁹ In fact, Aristotle does once mention Parmenides and Zeno together, in his *Sophistici Elenchi* 182b22–27, where he claims that they both share in presenting one, metaphysically very fundamental *logos*, namely that 'being' and 'one' mean the same thing, which allegedly was hard to refute even for experts.

Since questions concerning plurality were intensively dealt with by Aristotle's post-Parmenidean predecessors, Aristotle is not concerned in his *Metaphysics* with establishing plurality;⁴⁰ instead he deals with new topics such as the distinction between form and matter, substance and accident, potentiality and actuality, and so forth.

While for the assumption of plurality Aristotle builds heavily on the basis of his post-Parmenidean predecessors, he clearly does not think that these thinkers have dealt with motion sufficiently. For example, he explicitly claims in *De generatione et corruptione* 33b22 ff. that Empedocles has talked about *kinēsis* in a naïve and unsatisfying way; and he accuses the atomists of never explaining why the atoms move in the first place in his *Metaphysics* 985b: "the question of the origin and nature of motion in things they [the atomists] too ignored, just as blithely as the others."

Furthermore, in Aristotle's treatise on *topos* it becomes clear that a conception of space is not something that has already been established – we have seen Aristotle claiming that apart from Plato nobody has yet worked on it in the sense of trying to show what it is, and Plato got it all wrong. And finally, we have no evidence that the idea of a lower threshold of forces, which is the context of Aristotle's discussion of the falling millet seed paradox, had been a topic dealt with by the natural philosophers before Aristotle.

In his *Physics*, Aristotle attempts to establish a *science* of nature, an *epistēmē physeōs* (*Ph.* 184a15); he is not satisfied with an *eikōs mythos*. For this he needs to demonstrate that motion as the central concept of natural philosophy, as well as important related concepts,

³⁸ Even if we assume that some of his plurality paradoxes also question Parmenides' ontology (against which I argue in Sattler 2020).

³⁹ The paradoxes of motion may also be connected with Parmenides's poem, but here the connection is less striking, and the motion paradoxes can in any case be seen as a challenge for natural philosophy that is independent of any Eleatic background.

⁴⁰ Apart from the one brief mention of a plurality paradox in *Metaphysics* Beta we saw above, where he brushes it aside.

such as *topos* and force, can be conceived consistently. Accordingly, he needs to show that possible paradoxes concerning these concepts have no bite.

Aristotle wants to show not only that there is motion – this he seems to take for granted – but that there can be a *science* of motion, a physics, which he is the first to fully establish. For Aristotle there is no similar science of plurality; rather, plurality is an assumption taken for granted in all sciences, and, if at all, discussed in metaphysics. For Aristotle, any scientific inquiry presupposes plurality in assuming that there is a distinction between an *archê* and that of which it is an *archê* – the very first sentence of his *Physics* claims that we know some area or field if we know its *archê* (*Ph.* 184a10 ff).

It seems as if the Zeno of Aristotle and of Plato are very different thinkers. Aristotle hardly connects Zeno with Parmenides, and almost leaves out the plurality paradoxes completely, while these are exactly the two points Plato focuses on. However, the main reason for this difference lies in the different contexts in which Plato and Aristotle discuss Zeno: we saw that Plato takes up Zeno mainly in the context of ontology, which explains his focus on the plurality paradoxes and on Zeno's relationship to Parmenides, while for Aristotle, Zeno's philosophy is most relevant in the context of establishing a science of nature. And we may think Plato is not reacting to the dichotomy problems explicitly, since he is an atomist of sorts. Moreover, while the plurality paradoxes are the most prominent paradoxes for Plato, we also find him referring to some of the other paradoxes as well. We saw that Plato also refers to motion and rest as one pair of opposites that feature prominently in Zeno's paradoxes. And there is also a reference to the *topos* paradox in Plato's *Timaeus* – he does not name Zeno there, but in his discussion of the receptacle, he discusses the idea that *everything* that exists seems to be in a place and space. As a reply to this assumption, Plato claims that in fact there are things that exist but are not in a place, like the Forms; and thus questions one of the main premises of this paradox.⁴¹ Finally, we saw that both Plato and Aristotle are interested in Zeno's method. Thus while Plato and Aristotle seem to give us a very different Zeno, we see that this is mainly due to the different interests with which they approach Zeno, and that their accounts are in fact compatible.

We saw that Plato is interested in Zeno's plurality paradoxes and in the second part of the *Parmenides* he also discusses the possibility of plurality. Aristotle can build on this, and earlier, accounts. The problem that a plurality of things will lead to them being like and unlike can easily be shown to be unproblematic with the help of a principle of non-contradiction according to which *x* can be like one thing in one respect, and unlike another in a different respect. This is an understanding of the principle of non-contradiction that we do not yet find with Parmenides and Zeno, but that Plato clearly uses in his *Republic*, and that Aristotle explicitly discusses in his *Metaphysics* IV.⁴² Thus, Aristotle does not need to deal with these kinds of paradoxes separately. But the paradoxes of

⁴¹ For details of this hint in Plato, see Sattler, *Conceptions of Space*, chapter 2.

⁴² For details, see Sattler (2020), chapters 2, 3, and 5.

motion, *topos*, and the falling millet seed are not sufficiently covered by the Presocratics or Plato, and as they may be conceived as serious obstacles for a science of nature, Aristotle takes them on in his *Physics*.⁴³

⁴³ I want to thank the St. Andrews work in progress group for feedback on the paper.

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What about Plurality? Aristotle's Discussion of Zeno's Paradoxes

While Aristotle provides the crucial testimonies for the paradoxes of motion, *topos*, and the falling millet seed, surprisingly he shows almost no interest in the paradoxes of plurality. For Plato, by contrast, the plurality paradoxes seem to be the central paradoxes of Zeno and Simplicius is our primary source for those. This paper investigates why the plurality paradoxes are not examined by Aristotle and argues that a close look at the context in which Aristotle discusses Zeno holds the answer to this question.

KEY WORDS

Aristotle, Zeno, Simplicius, Plato, plurality paradoxes, metaphysics, science

