Division, Syllogistic, and Science in *Prior Analytics* I.31*

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In the first book of the *Prior Analytics*, Aristotle sets out, for the first time in Greek philosophy, a logical system. It consists of a deductive system (I.4-22), meta-logical results (I.23-26), and a method for finding and giving deductions (I.27-29) that can apply in "any art or science whatsoever" (I.30). After this, Aristotle compares this method with Plato's method of division, a procedure designed to find essences of natural kinds through systematic classification.

This critical comparison in *APr* I.31 raises an interpretive puzzle: how can Aristotle reasonably juxtapose two methods that differ so much in their aims and approach? What can be gained by doing so? Previous interpreters have failed to show how this comparison is legitimate or what important point Aristotle is making. The goal of this paper is to resolve the puzzle. In resolving this puzzle we not only learn more about the relationship between division and the syllogistic in Aristotle. We will also learn something about the motivation for the syllogistic itself, by seeing the role that it plays in his philosophy of science.

I shall claim that Aristotle's comparison makes sense once we view both division and the syllogistic method as general, rigorous scientific methods aimed at investigating part-whole relations between kinds. The point of the criticisms is to show that his syllogistic method, unlike Platonic division, allows the scientist to produce valid arguments, which are of crucial importance to the scientific enterprise. With the methods situated in this wider context, Aristotle's critical comparison doesn't just make sense, it serves a crucial function within his overall project: the comparison with division highlights how the valid arguments produced by the syllogistic method are valuable in science. These valid arguments could not be produced by the method of division. Far from being an anomalous chapter

*Forthcoming in *Ergo*. Please cite the published version.

in the treatise,[1] *APr* I.31 highlights the broader philosophical and scientific interest of Aristotle's logical work.

The plan for this paper is, first, to introduce the puzzle of Aristotle's comparison and show how previous attempts to resolve it are inadequate (§1). Then, I will argue that Aristotle's comparison is legitimate because both methods are intended to contribute towards a methodology for science that 1) applies in any domain and 2) is rigorous (§2). Not only are they similar as methods, the sorts of claims that each method yields are claims about part-whole (mereological) relations among kinds (§3). Finally, I will show how the common framework resolves the puzzle and helps show what Aristotle thought was important about the syllogistic method (§4).

1 The Puzzle of *APr* I.31

Here I will give a brief functional account of Plato's method of division, introduce Aristotle's syllogistic method and, in doing so, explain the puzzle of Aristotle's critical comparison. I cannot hope to give either topic full discussion, but rather to give enough of a sense of what these two methods are that we can sensibly ask why Aristotle might compare them.[2]

1.1 Division

Plato, in several of his late dialogues (especially the *Phaedrus*, *Sophist*, *Statesman*, and *Philebus*), develops the method of division in part to solve the longstanding Socratic problem of answering the "What is *F*?" question. This is a procedure for creating classifications by dividing more general kinds into increasingly specific ones. The most important use of the method for our purposes (although possibly not its only use) is to seek the nature or essence of a target natural kind. In the *Statesman*, for example, to find

[1] As suggested by, among others, Maier (1896) II.2, p. 77 n. 2.

[2] For more on Platonic division, see Moravcsik (1973); Brown (2010); Gill (2010); Rickless (2010); Crivelli (2012), pp.13-27. For comprehensive overviews of Aristotle's syllogistic and its general philosophical significance for Aristotle, Maier (1896) II.1; Solmsen (1929); Ross (1964), pp. 1-86; Smith (1989) pp. xiii-xxviii; Leszl (2004). There has been considerable work on technical issues surrounding the syllogistic, detailed discussions of which can be found in, e.g., Lear (1980); Patzig (1968); Malink (2013). There is a vast literature on the relationship between Aristotle's syllogistic and the theory of science in the *Posterior Analytics.* See especially Maier (1896) II.1-2; Barnes (1981); Crubellier (2008); Mansion (1961); McKirahan (1992), pp. 149-163; Smith (1982b,a); Solmsen (1929), pp. 78-150. While I will at times refer to the *Posterior Analytics*, space does not permit me to fully integrate the views in *APr* I.31 with *APo*.

out what statesmanship *is* (i.e., the nature of statesmanship), the interlocutors begin by agreeing that it is a kind of *knowledge*. Then they distinguish kinds of knowledge in stages, first dividing knowledge into practical and theoretical, then dividing theoretical knowledge in turn, until they arrive at statesmanship.

The method of division promises a way to systematically search for essence by situating the target kind in relation to other kinds in the same domain. By understanding how statesmanship is fundamentally similar to and different from other kinds of knowledge, one can hone in on the thing itself. By setting it down as a kind of theoretical knowledge, for example, Plato can distinguish statesmanship from all the manual arts in one go. The method of division provides a holistic way of searching for essence: if one can "carve nature at its joints" (*Phdr* 265e), one will find out about the essences of a number of related kinds at once. This procedure allows an inquirer to come to know the essences of kinds which are ontologically fundamental, since the comparison does not aim at *reducing* the essences to something else.[3]

1.2 Syllogistic

Aristotle describes his syllogistic method in *Prior Analytics* I.27-30, where he shows that there is a way to discover syllogisms with the desired conclusions by sorting any set of premises into six different lists. The end result is an algorithm that searches these lists and returns a syllogism with the desired conclusion. Depending on the logical form of the conclusion, only certain lists will be relevant. In what follows, when I use the term "syllogistic", I am referring to this method of finding and giving syllogisms, although the term is used in the contemporary literature to refer more generally to Aristotle's logical theory.[4]

To see how the method works, let's work through an example. Suppose we want to scientifically demonstrate that no human flies. The first thing we need to do is sort *true* premises into various lists depending on their form. The relevant lists for getting this particular conclusion are:

1. Propositions of the form "No human is X" with different values of X: winged, immortal, etc.

[3] The idea that knowledge is holistic in the way described above may be present in the Socratic dialogues. I am here claiming that it is only with the method of division, which rises to prominence later in Plato's career, that we have a satisfactory way of *achieving* this holistic knowledge.

[4] For the phrase "*syllogistike methodos*" see Alex Aphr *in Top* 2, 1-2.

2. Propositions of the form "Every human is X": mammal, animal, etc.
3. Propositions of the form "No flyer is X": fish, horse, etc.
4. Propositions of the form "Every flyer is X": winged, perceiver, vertebrate, animal, etc.[5]

Premises such as "Some human is seated" or "Not every flyer is aquatic" are notoriously not considered at all, and because Aristotle claims that this system is sufficient for finding any deduction, he is committed to the claim that one only needs universal premises for deductions.[6] Aristotle's procedure looks for a pair of premises with the same term substituted for X either from lists 1 and 4 or from lists 2 and 3. If there is such a pair, you can construct a sound argument for the conclusion. In the example, we could use the propositions:

1. No human is winged. (list 1)
2. Every flyer is winged. (list 4)
3. No human is a flyer. (desired conclusion)

While this is a trivial case, the method is quite powerful. It is a highly tractable procedure that always finds a syllogism with the desired conclusion whenever there are premises which *could* produce a syllogism and never outputs an argument that is not a syllogism.[7] Aristotle himself gets quite excited about his method:

[5] The two other lists, not relevant for this example, would be propositions of the form "Every X is a human" and "Every X is a flyer". Aristotle proves that no pairs of premises other than those he discussed can together produce a syllogism (*APr* 44b25-37). In this particular case, the lists are not relevant because there is no way to use them in any of the three sorts of syllogisms (*Celarent*, *Cesare*, and *Camestres*) that can bring about the desired universal negative conclusion (*APr* I.26). Note that Aristotle describes these lists as lists of *terms* for which the corresponding proposition is true. However, it is equivalent to work with lists of propositions and the point is easier to understand.

[6] In this example problem, they would be of no help, since a universal conclusion requires both premises to be universal (*APr* I.24), but Aristotle does not use particular premises in proving particular conclusions either, relying instead on *Darapti* and *Felapton*. On this problem, see Smith (1989), pp. 152-3 and Striker (2009), pp. 200-1.

[7] As described by Aristotle, this algorithm is "totally correct" in the technical sense used in computer science, because, given a set of premises and a possible conclusion, it will either output a syllogism of the conclusion from the premises or the result that there is no syllogism of that conclusion.

> The method is one and the same for all things, both concerning philosophy as well as any skill or learning whatever. (*APr* I.30 46a3-4)[8]

The method can be applied in any argumentative context. While the arguments that one gives on a particular occasion differ depending on the subject matter (physics, biology) and intent (scientific demonstration, dialectically effective argument), the principles behind these arguments (what makes them *valid*) and the ways of finding them are the same.

The basic idea is that any scientist, philosopher, or technician inquiring into any subject matter with the aim of getting truth ought to first discover true premises of these particular kinds and then produce syllogisms for the conclusions desired. Demonstrations are syllogisms the possession of which gives us knowledge, since they have true, explanatory premises. This means that the syllogistic method plays an important role in our pursuit of knowledge, even though it is not sufficient for generating scientific knowledge.

1.3 The Puzzle

These two methods seem incredibly different. First, they have very different goals. The goal of the method of division is an account of the essence of a target natural kind, which Aristotle and later philosophers would call a "definition". The goal of the syllogistic is a deductive argument for a given conclusion. That conclusion need not state the *essence* of anything at all—in the example above, "not being a flyer" is not a part of human nature, even if it is necessarily true. Most strikingly, division has as its goal something that must be *true*, which is neither necessary for the conclusion of a syllogism nor for a syllogism itself (which is not even a candidate for truth or falsity).[9] While we want our syllogisms to have true premises (and hence a true conclusion) in demonstrative contexts, in dialectical contexts, we only want to have premises in accordance with belief. So a perfectly good use of the syllogistic method might conclude a falsehood from falsehoods.

[8] Ἡ μὲν οὖν ὁδὸς κατὰ πάντων ἡ αὐτὴ καὶ περὶ φιλοσοφίαν καὶ περὶ τέχνην ὁποιανοῦν καὶ μάθημα·

[9] It might be objected that division aims at *essences*, which are also not candidates for truth or falsity. Even on this interpretation, however, there is a big difference in content between division and syllogistic, which doesn't aim at essences any more than it aims at essential predications. But Plato also does use terms like "true" and its cognates to describe the goals of division (*Sph* 268c-d). Moreover, it cannot simply be the goal to find essences, but to find the essence *of the target kind*. It can only be successful if the essential features or definientia are essential true *of the target*.

The methods also take very different routes. The method of division begins with a genus and progressively narrows it down until one reaches the target kind. The syllogistic method consists of two steps, neither of which is anything like this. The first step organizes premises into six lists and takes premises for a given deduction from two of these lists. The second constructs a deductive argument for the conclusion with those premises. In neither case does the user of the syllogistic method "narrow down". Nor does the divider ever seek premises for a deductively valid argument or give such an argument.

Most striking, perhaps, is that it might be objected that division and syllogistic *seem* to yield very different sorts of claims.[10] The method of division investigates definitions, which are a kind of identity claim. Syllogistic, by contrast, investigates quantificational claims. These claims differ significantly in their syntactic structure, but also in their modal status. Definitions require a very strong connection between the definiens and definiendum, much stronger than even the modal propositions of Aristotle's syllogistic.[11] Even if Aristotle talks about definitions in terms of identity (e.g., in *Topics* I.7) and predication (e.g., *Topics* I.4-5), he does not talk about them in quantificational terms. That is to say, definitions do not fit into any of the four types of proposition distinguished at the outset of the *Prior Analytics.*

Aristotle's comparison of the two methods in *Prior Analytics* I.31 seems so far-fetched that, instead of clarifying their connection, it reinforces the impression that they are fundamentally different. He introduces his discussion by immediately finding fault with the fact that division does not do what the syllogistic does:

> It is easy to see that division of genera is a small part of the aforementioned method. For division is a kind of weak syllogism. For, 1) it asks for what it ought to show and 2) it deduces something higher up. This first point eluded all those using division and they tried to persuade us that a demonstration concerning essence and the what it is can come about, with the result that they neither understood what in particular[12] it is possible that those dividing[13] deduce, nor that it was possible in the way in which we said. (*APr* 46a31-39)[14]

[10]See Moravscik (2004) for a development of this worry.

[11]For example, it is necessary that all and only triangles have angles summing to two right angles, but that is not the definition of a triangle.

[12]Reading ὅ τι instead of ὅτι.

[13]Reading διαιρουμένους with Waitz over διαιρουμένοις (Ross) διαιρουμένοι (Cherniss).

[14]Ὅτι δ' ἡ διὰ τῶν γενῶν διαίρεσις μικρόν τι μόριόν ἐστι τῆς εἰρημένης μεθόδου, ῥᾴδιον ἰδεῖν·

In this passage, Aristotle both announces the substance of his criticism and describes how the users of division got in such trouble. The line of thought Aristotle attributes to the dividers is:

1. Divisions are demonstrations of essence.

2. So, divisions deduce essence.

While Plato does occasionally call divisions "demonstrations" (e.g., *Plt* 273e, 277a, b), he isn't obviously using the term in Aristotle's sense, as introducing a deductive argument of a special sort. The inference relies on something *Aristotle* believes—namely that all demonstrations are deductions (*APr* I.1, *APo* I.2).[15] Aristotle here is just assuming on the basis of the word "demonstration" that the two methods try to deduce something, and then arguing that, where division fails, syllogistic succeeds. But this assumption seems totally unjustified. From the basic descriptions above, division is a method for finding essences, syllogistic a method for finding and giving valid arguments. However, Aristotle doesn't provide us with any reason to think that one of the methods is "part" of the other, or that a division is a sort of "weak" syllogism. Understanding why Aristotle makes these claims is one major question of this paper.

In addition to these polemical points, Aristotle has a number of precise complaints against division, first appearing in 1 and 2 above. Importantly, these precise complaints are meant to *explain* the sense in which division is a weak syllogism and a small part of the syllogistic method, as can be seen from how he links the first three sentences with "for". Understanding these precise claims, then, offers the surest route to understanding the polemics. Aristotle ends up making four distinct claims in the body of the chapter:

1. Divisions are not deductions of the definitions they seek, because the definition does not follow necessarily from the divider's assumptions. Instead, the strongest claim deducible from the divider's assumptions is not of scientific interest. (46a31-46b25)

2. Division cannot demolish claims because it cannot deduce negative propositions (cf. *APr* I.26). (46b26)

ἔστι γὰρ ἡ διαίρεσις οἷον ἀσθενὴς συλλογισμός· ὃ μὲν γὰρ δεῖ δεῖξαι αἰτεῖται, συλλογίζεται δ' ἀεί τι τῶν ἄνωθεν. πρῶτον δ' αὐτὸ τοῦτο ἐλελήθει τοὺς χρωμένους αὐτῇ πάντας, καὶ πείθειν ἐπεχείρουν ὡς ὄντος δυνατοῦ περὶ οὐσίας ἀπόδειξιν γενέσθαι καὶ τοῦ τί ἐστιν. ὥστ' οὔτε ὅ τι ἐνδέχεται συλλογίσασθαι διαιρουμένους ξυνίεσαν, οὔτε ὅτι οὕτως ἐνεδέχετο ὥσπερ εἰρήκαμεν.

[15] Could it be someone other than Plato? In §1.4, I will consider the possibility that Aristotle is referring to other members of the Academy.

3. Division cannot deduce features that are not definitional such as accidents, properties, or genera. (46b27-8)
4. Division is useless in solving open problems, such as whether the diagonal of a square is commensurable or not with its side. (46b28-35)

Aristotle only argues for 1 and 4, treating 2 and 3 as common ground with the practitioners of division, who only claim that their method establishes definitions.

His argument for 1 begins with a general description of the problem that division encounters. He had shown earlier (*APr* I.26) that every syllogism with a conclusion of the form "All A is B" has a middle term that is between A and B in generality (46a39-b3). However, if we look at an arbitrary division, this will not be the case:

> For: let A stand for animal, B for mortal, Γ for immortal, and Δ for human, whose account it is necessary to get. Then [the divider] assumes all animal is either mortal or immortal: All this (what would be A) is either B or Γ. Again the one who is always dividing sets down that a human is an animal, so that he assumes A belongs to Δ. On the one hand, there is a syllogism that all Δ will be either B or Γ, so that necessarily human is mortal or immortal, but it is not necessary that it is a mortal animal, but asked. But this was what was necessary to deduce. (*APr* 46b3-12)[16]

While we can conclude something trivial like "every human is either mortal or immortal" on the basis of a division, there is clearly no way to argue deductively for the desired conclusion that every human is mortal. The only thing that the divider can do to get closer to her goal is to ask her interlocutor to agree to the claim that every human is mortal (46a33-34). By asking for this, the divider "begs the question" in the technical Aristotelian sense by assuming the very claim under discussion. By showing that division begs the question for an arbitrary case, Aristotle is entitled to conclude in general that division cannot produce a syllogism of its target. This is the

[16] ἔστω γὰρ ζῷον ἐφ’ οὗ Α, τὸ δὲ θνητὸν ἐφ’ οὗ Β, καὶ ἀθάνατον ἐφ’ οὗ Γ, ὁ δ’ ἄνθρωπος, οὗ τὸν λόγον δεῖ λαβεῖν, ἐφ’ οὗ τὸ Δ. ἅπαν δὴ ζῷον λαμβάνει ἢ θνητὸν ἢ ἀθάνατον· τοῦτο δ’ ἐστίν, ὃ ἂν ᾖ Α, ἅπαν εἶναι ἢ Β ἢ Γ. πάλιν τὸν ἄνθρωπον ἀεὶ διαιρούμενος τίθεται ζῷον εἶναι, ὥστε κατὰ τοῦ Δ τὸ Α λαμβάνει ὑπάρχειν. ὁ μὲν οὖν συλλογισμός ἐστιν ὅτι τὸ Δ ἢ Β ἢ Γ ἅπαν ἔσται, ὥστε τὸν ἄνθρωπον ἢ θνητὸν μὲν ἢ ἀθάνατον ἀναγκαῖον εἶναι, ζῷον θνητὸν δὲ οὐκ ἀναγκαῖον, ἀλλ’ αἰτεῖται· τοῦτο δ’ ἦν ὃ ἔδει συλλογίσασθαι.

sense in which division is a weak syllogism: it cannot deduce its goal, but only the triviality Δ is B or Γ.

This account of why division is a weak syllogism also explains, as we expected it would, why the method of division is "a small part" of the syllogistic method. Division is a weak syllogism because it can only deduce a triviality. The syllogistic can deduce this triviality, but also much else. So it is straightforward to think that division is a small part of the syllogistic method. We now have an answer for what Aristotle means when he says that division is a small part of the syllogistic and a weak syllogism.

Aristotle also argues for 4 on the basis of an example. Suppose that we want to know whether the diagonal of a square is commensurable or incommensurable with its side. The divider assumes that the diagonal is a length and then divides length into commensurable or incommensurable. But without having proven the theorem, the divider is stuck: where should she put the "diagonal"? Division seems to offer no guidance on this.

In general, Aristotle's criticisms in *APr* I.31 strongly suggest that Aristotle thinks division was intended to do what the syllogistic does (produce valid arguments), but give no hint as to why anyone should expect this. These methods seem to be, on their face, far too different to make such a connection. This constitutes the major puzzle of this paper.

1.4 Previous resolutions of the puzzle

Previous commentators have failed to motivate Aristotle's critical comparison. They have taken three different approaches towards resolving this puzzle.

The most common response is **Confusion**: one party of the debate is simply confused about the relationship between the various methods. Some commentators have pointed the finger at Aristotle, others at the defenders of division.

Ebert and Nortmann (2007) claim that the fault lies with Aristotle himself:

> Aristoteles' Kritik dürfte aber auf einer falschen Voraussetzung beruhen, denn die Methode der Dihairesis ist ein *heuristisches* Verfahren zur Gewinnung einer Definition, nicht aber ein Verfahren, bei dem eine Definition *deduziert* werden soll. (pp. 794-795)
>
> Diese Kritik des Aristoteles an der Dihairesis scheint unberechtigt. Denn das Verfahren wird bei Platon keineswegs

deducktiv gebraucht, sondern immer so, daß ein Gegenstand, dessen Eigenschaften bekannt sind, durch eine fortschreitende Eingrenzung mit einer nächsthöheren Gattung und einem Unterscheidungsmerkmal ausgestattet wird, das ihn von anderen Arten unterscheidet, die ebenfalls unter diese nächsthöhere Gattung fallen. Gerade weil es bei dieser Methode nur um die Gewinnung von Definitionen (i. S. v. Definientia) geht, laufen die hier von Aristoteles erhobenen Vorwürfe ins Leere. (p. 796)

Among those who think that the mistake resides on the part of defenders of division, there is a disagreement about who exactly is included in that group. Alexander thinks that it is everyone in Plato's circle, including Plato.[17] Striker (2009), on the other hand, lays the blame not on Plato but other Platonists:

> Aristotle's harsh criticism of division in this chapter may be understandable if there were people in the Academy who thought that the method of division was all that they needed in philosophy, and who therefore paid no attention to Aristotle's innovations. (p. 209)

So Aristotle's target was not Plato, but *other* proponents of the method of division. The earliest such view seems to be that of Philoponus:

> He wants to celebrate through these things the method he handed down. For no one, he says, of those before us knew this, but they all used the method of division and through it they thought that they could demonstrate. And they say he is hinting at Plato. And Plato apparently does celebrate the method of division and most of all when it comes to be by contradiction, since it is the most inescapable.[18] However, he at least did not say it was demonstrative. For clearly he knew the difference between the method of division and demonstration. For he

[17] Alex Aphr *in APr* 333,10 ff, *in Top* 1,14-19. Cherniss (1944) might also think that Plato is confused because he says that Aristotle shows how division "transgresses the laws of thought" (p. 28).

[18] Philoponus' view about division by contradiction is more fully explained in the commentary on the *Categories* (*in Cat* 29,19-30,24). There he argues that one should always divide into contradictory opposites (such as white/non-white) rather than contraries (white/black), because the former, unlike the latter, are inescapable (ἄφυκτοι). He further claims that division according to contradictories are knowledge-producing (*in Ph* 20,24-5). The original source for this claim seems to be *Sph* 235c, which is paraphrased at *in Cat* 30,19-21.

> says that there are four methods of philosophizing which are instruments of dialectic: division, definition, demonstration, and analysis. Perhaps then he is hinting at others who thought that the method of division was demonstrative. (Phlp *in APr* 306,31-307,9)[19]

Confusion can make sense of the existence of *APr* I.31, but is otherwise unmotivated and quite uncharitable. There is little evidence that any defender of division was confused. Plato lacked Aristotle's technical language to talk about deduction, so it is unclear what would even constitute evidence one way or the other. While he does occasionally call a division a proof ("ἀπόδειξις"), he does not use the expression in the same sense as Aristotle.[20] The same is true for other members of the Academy: there is no fragment or report in which someone claims divisions are deductions of a definition. There is a text that does seem to bear on the question. Sextus Empiricus reports Xenocrates as supplementing a division with a proof (ἀπόδειξις) of that division:

> Xenocrates, however, somewhat unusually compared with the others, and using the singular forms, said, "All that exists either is good or is bad or neither is good nor bad." And while the rest of the philosophers accepted such a division without proof, he thought it proper also to include a proof, as follows. If there is anything which is distinct from good things and from bad things and from things which are neither good nor bad, that thing either is good or it is not good. And if it is good, it will

[19] Βούλεται διὰ τούτων ἐξυμνῆσαι τὴν παρ' αὐτοῦ παραδεδομένην μέθοδον· οὐδεὶς γάρ, φησί, τῶν πρὸ ἡμῶν ταύτην ἠπίστατο, ἀλλ' ἐκέχρηντο πάντες τῇ διαιρετικῇ μεθόδῳ, καὶ διὰ ταύτης ἐνόμιζον δύνασθαι ἀποδεικνύναι. αἰνίττεσθαι δέ φασιν αὐτὸν εἰς Πλάτωνα. φαίνεται δὲ ὁ Πλάτων ἐξυμνῶν μὲν τὴν διαιρετικὴν μέθοδον καὶ μάλιστα τὴν κατὰ ἀντίφασιν γινομένην ὡς ἀφυκτοτάτην οὖσαν, οὐ μέντοι γε ταύτην ἀποδεικτικὴν λέγει εἶναι. σαφῶς γὰρ οἶδε διαφορὰν διαιρετικῆς καὶ ἀποδεικτικῆς· τέσσαρας γάρ φησι μεθόδους εἶναι κατὰ φιλοσοφίαν ὄργανα τῆς διαλεκτικῆς, διαιρετικήν, ὁριστικήν, ἀποδεικτικὴν καὶ ἀναλυτικήν. ἴσως οὖν εἴς τινας ἄλλους αἰνίττεται τὴν διαιρετικὴν ἀποδεικτικὴν νομίζοντας.

[20] Shorey (1924); Striker (2009), p. 209. The only places in the vicinity of any discussion of division where "ἀπόδειξις" comes up are in the *Statesman* (*Plt* 269c2, 273e5, 277a2, 277b6, 284b2). Here there is no hint of anything deductive being required, especially because what is being demonstrated is *the king* or *the statesman*, not a proposition or fact. We do get a contrast, however, between the "ἀπόδειξις" of the statesman and the "μύθος" about Kronos. This suggests that, when dividing, the Visitor is not intending to tell a story, although the story could *contribute* to the division/demonstration (273e5). Without going too deep into this issue, it seems safe to say that the Visitor marks a non-narrative kind of exposition with the term "ἀπόδειξις".

> be one of the three; but if it is not good, either it is bad or it neither is bad nor is good. But if it is bad, it will be one of the three, while if it neither is good nor is bad, it will again be one of the three. Thus everything that exists either is good or is bad or neither is good nor bad. (SE *M* I.4-5, trans. Bett, 1997)[21]

This passage suggests that Xenocrates, at least, does not confuse the two in the way that Aristotle suggests. He is attempting to demonstrate a proposition of the form "Every G is S1 or...or Sn", where G is a genus and S1...Sn are its species (or at the very least, subclasses). But this is not the problematic step for Aristotle, who rather thinks the problem is demonstrating that the target kind is set under one of the S1-Sn.

Finally, it seems unlikely that Aristotle is only targeting some members of the Academy because Aristotle is quite explicit that the error he is diagnosing in this chapter is common to *everyone* who used the method (*APr* 46a35), so it would be strange if he was not criticizing the first and most prominent user of division: Plato.

Moreover, there is not much reason to think that *Aristotle* is confused in the way that Ebert and Nortmann suggest. In the *Posterior Analytics* II.5, a chapter that directly refers to our passage, Aristotle explicitly says that there is "no absurdity" about division making clear a definition without demonstrating or deducing, in exactly the same way that induction is clarifying even though it is not deductive (*APo* 91b33-4). Later in the same book, he calls division "useful" in the hunt for essence (*APo* 96b25-6).[22] Thus this reading attributes not only confusion in Aristotle, but also inconsistency with his other discussions of division. We should therefore accept **Confusion** only if all else fails.

Crubellier (2014), by contrast, argues that both division and Aristotle's method at I.27-29 are aimed at *finding* scientific propositions, a view which I will call **Discovery**. Because they share this project, the comparison is

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[21] ἰδιαίτερον δὲ παρὰ τοὺς ἄλλους ὁ Ξενοκράτης καὶ ταῖς ἑνικαῖς πτώσεσι χρώμενος ἔφασκε· "πᾶν τὸ ὂν ἢ ἀγαθόν ἐστιν ἢ κακόν ἐστιν ἢ οὔτε ἀγαθόν ἐστιν οὔτε κακόν ἐστιν." καὶ τῶν λοιπῶν φιλοσόφων χωρὶς ἀποδείξεως τὴν τοιαύτην διαίρεσιν προσιεμένων αὐτὸς ἐδόκει καὶ ἀπόδειξιν συμπαραλαμβάνειν. εἰ γὰρ ἔστι τι κεχωρισμένον πρᾶγμα τῶν ἀγαθῶν καὶ κακῶν καὶ τῶν μήτε ἀγαθῶν μήτε κακῶν, ἐκεῖνο ἤτοι ἀγαθόν ἐστιν ἢ οὐκ ἔστιν ἀγαθόν. καὶ εἰ μὲν ἀγαθόν ἐστιν, ἓν τῶν τριῶν γενήσεται· εἰ δ᾽ οὐκ ἔστιν ἀγαθόν, ἤτοι κακόν ἐστιν ἢ οὔτε κακόν ἐστιν οὔτε ἀγαθόν ἐστιν· εἰ δὲ κακόν ἐστιν, ἓν τῶν τριῶν ὑπάρξει, εἰ δὲ οὔτε ἀγαθόν ἐστιν οὔτε κακόν ἐστι, πάλιν ἓν τῶν τριῶν καταστήσεται. πᾶν ἄρα τὸ ὂν ἤτοι ἀγαθόν ἐστιν ἢ κακόν ἐστιν ἢ οὔτε ἀγαθόν ἐστιν οὔτε κακόν ἐστιν.

[22] For thorough treatments of division in *APo* II.13, see Charles (2000), 221-239 and Bronstein (2016), 189-222.

justified. Aristotle's point is that his method is better than division because it is far more general:

> Aristote suggère que le projet de la diérèse est en un sens apparenté à celui du Pont aux Ânes – si du moins « la méthode que nous exposons ici » (46a32) vise spécifiquement le Pont aux Ânes et non pas l'analytique dans son ensemble. Ce que les deux projets ont en commun, c'est (1) la mise en ordre de séries de termes reliés entre eux par des relations d'implication notionnelle ; et (2) l'utilisation de ces séries pour produire des propositions scientifiques, ou tout du moins (dans un contexte dialectique) pour obtenir l'assentiment de l'interlocuteur. (p. 298, cf. p. 24)

This interpretation has a number of benefits. First, it makes sense of the placement of the chapter directly after the chapters that describe Aristotle's method for finding syllogisms. Moreover, it gives Aristotle a reasonable point to make that does not attribute any real confusion to any party and fits well with Aristotle's positive use of division in *Posterior Analytics* II. Indeed, the notion of "ordering terms" and the use of the series "to produce scientific propositions" are real and important commonalities between division and the method of I.27-29. Finally, the claim that the syllogistic is more general, since it can be used for any kind of proposition, is clearly *true.* In this way, it is a real improvement on **Confusion**. **Discovery** suffers from the problem that it does not have much to do with Aristotle's arguments against division in this chapter, even though it is certainly right that the "aforementioned method" referred to here is the one described in I.27-30. Aristotle here argues that divisions are not syllogisms of their target claims—he does not argue against their ability to discover any kind of proposition. We can see this by the chain of explanations that begins the passage:

> It is easy to see that division of genera is a small part of the aforementioned method. For division is a kind of weak syllogism. (*APr* 46a31-3)

Aristotle here claims that it is a small part of the aforementioned method *because* it is a weak syllogism. But if **Discovery** is right, then this would be a non-sequitur. What reason do we have for thinking that division is an inferior *way of* discovering truths from the fact that it is an inferior kind of syllogism? Aristotle never claims that his own way of finding syllogistic premises, described in I.27-29, is itself syllogistic. We could only get a plausible line of thought here if we assume that the syllogistic was the *only way to discover new propositions.* But Aristotle never commits himself to this and his claims about induction as a non-syllogistic way of learning (*APo* 71a5-6). Indeed, Crubellier's account of why division is a weak syllogism shows this:

> Il est possible de décrire la diérèse comme un sullogismos parce que, tout comme l'inférence syllogistique s'achève par la récapitulation des prémisses et la production de la conclusion, la diérèse produit la définition recherchée par la récapitulation de ses étapes et que, comme dans la déduction, le répondant n'est pas libre de la refuser. Mais c'est une déduction « sans force » parce que son application se limite aux questions définitionnelles et parce que, même dans ce champ limité, elle ne produit pas réellement de connaissance nouvelle: si l'interrogateur peut conclure, par exemple, que l'homme est *un animal mortel*, c'est parce que le répondant lui aura déjà accordé que « l'homme est un animal » et que « l'homme est mortel ». (p. 298)

In this passage, Crubellier tries to reconcile the obvious fact that Aristotle is claiming division *is a syllogism* with **Discovery**. But his account of why it is "weak" or "sans force" because it is limited to definitional questions and commits a *petitio principii* does not fit Aristotle's own explanation:

> For division is a kind of weak syllogism. For, 1) it asks for what it ought to show and 2) it deduces something higher up. (*APr* 46a32-4)

This explanation of the weakness of division only has to do with the fact that it does not deduce what it claims to deduce, not because it is limited to definitional questions, which is presented by Aristotle as quite distinct criticisms later in the chapter (46b26-8). Thus, while **Discovery** does point to important commonalities, the line of argument that Aristotle adduces in 46a31-34 does not make reference to division's limited ability to find anything but only its lack of syllogistic power. The commonality, therefore, plays no explicit role in Aristotle's argumentation. While this is not sufficient for rejecting **Discovery** outright, if another interpretation can be found that clearly elaborates Aristotle's argument without attributing confusion to anyone, that would be preferable.

Finally, according to Smith (1989), the real issue has to do with obtaining **Knowledge**:

> Aristotle is sometimes criticized for treating this procedure as a rival in some way to his theory of deductions: after all, it may be urged, the two have quite different objectives, and therefore it is no more a valid criticism of division that it fails to prove than it would be to object that deductions or demonstrations fail to define. But there is a deeper point. Aristotle's real complaint is that division is not a method which leads to the acquisition of *knowledge*: at each step, the divider must 'ask for the initial thing.' Thus, the method cannot produce understanding. (p. 160)

Knowledge is, very broadly speaking, on the right track. The two methods seem to play important roles in Plato's and Aristotle's respective conceptions of scientific knowledge, so it would be no surprise if the different views about division resulted from different conceptions of science. But this on its own is too vague to justify Aristotle in making the comparison, since after all, they could play quite different roles in the acquisition of knowledge. According to **Knowledge**, the gap is filled by the requirement that knowledge cannot be acquired from question-begging arguments. The reason why, it seems, is that division doesn't give the inquirer anything *beyond what she started with.*

This diagnosis, however, is still in tension with Aristotle's positive claim that division can produce knowledge:

> But it [division] is still not a syllogism, even if it produces knowledge in another way. And this is not absurd, since someone performing an induction does not demonstrate, but nevertheless makes something clear. (*APo* 91b32-35)[23]

The basic point here is that there are many non-deductive and non-demonstrative ways of making things clear. Induction clearly extends our knowledge in this way. And here in *APo* II.5, which directly refers to *APr* I.31 (91b12-15), Aristotle clearly still thinks that division begs the question, but says that it is not absurd that it produces knowledge.[24] If Aristotle

[23]ἀλλὰ συλλογισμὸς ὅμως οὐκ ἔστι, ἀλλ᾽ εἴπερ, ἄλλον τρόπον γνωρίζειν ποιεῖ. καὶ τοῦτο μὲν οὐδὲν ἄτοπον· οὐδὲ γὰρ ὁ ἐπάγων ἴσως ἀποδείκνυσιν, ἀλλ᾽ ὅμως δηλοῖ τι.

[24]In this passage, Aristotle doesn't say *how* division will produce knowledge, but in *APo* II.13, he claims that this will happen by producing an ordering of the predicates in the definition (96b30-35). Bronstein (2016), pp. 211-219 argues that division can also help discover at least some of the differentiae. However, when Aristotle considers the objection that division just "assumes everything [in the definition, i.e., genus and differentiae] straightaway"

thought division could not give us new facts, which were previously unknown, this would also be problematic for his own view of demonstration, since he claims that one will often first obtain the facts and then later seek their explanations (*APr* I.30, *APo* II.1). In such cases, the conclusion of the demonstration was something already known. What was not known was its cause. Thus, if the requirement is that division produces knowledge of *new facts*, that would seem to be just as problematic for what Aristotle has to say about demonstration as it is for division.

This point could be finessed by saying that the sort of knowledge produced by division is a different sort of knowledge (γνῶσις) than that provided *sometimes* by syllogistic (ἀποδεικτική ἐπιστήμη). Perhaps Aristotle's point is that what syllogisms, at least when they are demonstrative, get you is more intellectually rewarding than what division gets you. The scientific understanding that comes with possessing a demonstration is just a much more significant achievement than the knowledge one has from division. This would be adequate if there were demonstrative knowledge of the thing that division aims at: definitions. For then we could see how the syllogistic does something that division does not. But Aristotle denies that there are demonstrations of these kinds of definitions. **Knowledge**, in the end, seems to undermine Aristotle's justification for comparing the two methods, since division and syllogistic are, after all, aimed at acquiring different things. Division will be aimed at getting γνῶσις of essences through definitions, while demonstrative syllogisms will aim at getting scientific understanding of other propositions.[25] So, while **Knowledge** was right to look at the respective conceptions of science, it still failed to justify the comparison.

In what follows, I will reconsider the Platonic texts concerning division and use them to provide a new interpretation of Aristotle's comparison. This interpretation will make sense of both Aristotle's critical remarks about division in *APr* I.31 (unlike **Discovery**) and be consistent with his positive remarks about division as a method (unlike **Knowledge** and **Confusion**). First, I will make clear how both methods are intended to be rig-

(96b28-9), he does not deny it, but claims that what division does do is give the proper order. If he didn't think that one needed to assume all of the elements in the definition at the outset, he presumably would have said so there. Moreover, if one didn't have all the differentiae at the outset, one could not perform division in the way advised, since this requires the inquirer to select at each stage the differentia which contains all the others (96b35-97a6). If there were some differentiae missing, this procedure could not be performed.

[25]For my purposes, it does not matter whether non-demonstrative knowledge in the sense of *APo* I.3 is the same as νοῦς, as in Bronstein (2016). I only suppose that there is some kind of γνῶσις of essence which is non-demonstrative.

orous and general ways of obtaining scientific knowledge concerning the part-whole relations among kinds. Contextualizing this chapter in this way justifies Aristotle's criticism by showing how they have relevantly similar features that could form the basis of a meaningful comparison. Then I will argue that Aristotle's point in comparing the methods is to show the importance of valid arguments in this scientific enterprise. Instead of *replacing* division with syllogistic, Aristotle is showing that syllogistic is a necessary part of a scientist's repertoire that is not already covered by division.

In short, Aristotle thinks of division as a means of obtaining definitions, which are the starting points of demonstrations, or scientific syllogisms. In order for division to play this role, it is important to see how it is *not* a demonstration, since the starting points of demonstration are *indemonstrable.* What will emerge is a considerable continuity in the Platonic/Aristotelian projects. Division is not playing a sort of second fiddle to demonstration. Instead, the methods are compared because doing so will shed light on how they both contribute to a common Platonic and Aristotelian conception of what scientific understanding is and how to achieve it. This is a common way for Aristotle to deal with his predecessors: he puts their views into his framework in order to show where they go wrong or miss something. While such a procedure might sometimes lead to distortion of their views, in this case at least, I will argue that all of Aristotle's critical points can be appreciated even if division is not thought to be deductive.

In §2, I show that both methods have the properties of epistemic generality and rigor. I argue in §3 that the methods both investigate predications conceptualized in terms of part and whole, thus suggesting that the contrast drawn in §1.3 betwen identity claims and quantificational claims is nto as stark as it initially seemed.[26]

[26]Previous scholars, arguing for division's influence on the syllogistic, have vaguely gestured at each of these. See Maier (1896) (esp. II.2, pp. 56-85) on the first, Lutoslawski (1897), p. 464 on the second, and Solmsen (1929; 1941) on the third. It was the dominant position in the 19th and early 20th centuries that Platonic division influenced Aristotle's logic (see also Prantl (1853), p. 203; Jowett (1892), p. 192; Ross (1923), p. 32, although he would later change his position; de Strycker (1932a; 1932b); Bochenski (1951); Pellegrin (1981); Mignucci (2000)). Kneale and Kneale (1962) have some affinities with Solmsen. For criticism of the influence claim, see Shorey (1924; 1933); Ross (1939; 1949); Cherniss (1944); Kapp (1942; 1975); Moravscik (2004).

2 Division and syllogistic as scientific methods

2.1 Epistemic Generality

Both Platonic division and Aristotelian syllogistic were intended to have a certain kind of generality that has historically been associated with logic. The sort of generality that I have in mind is that the theory is meant to apply to any sort of science one might engage in, whatever the subject matter.[27] Moreover, division and syllogistic are supposed to be general ways of coming to know about any subject matter whatsoever through reasoning, or "giving accounts". This property might seem to be too abstract and vague to count as an important similarity. But it is not. There are many scientific methodologies which have no such aspirations. Methods of medical inference from symptom to underlying cause, as was common in the Greek "rationalist" tradition, have no place in geometry. Nor does geometrical analysis have any obvious place in medicine. That is to say, neither of these methodologies aspire to be general, since there are scientific domains in which they are not applicable.[28] If Platonic division and Aristotelian syllogistic are (intended to be) general *in this sense*, that would be a striking point of similarity.

Plato claimed the method of division had this very special kind of generality. For instance, in the *Philebus*, when Socrates introduces the method of division (albeit with some unusual language, calling kinds "ones" that are discovered along the way from the genus and calling a division complete when the inquirer "knows how many the original one is"), he makes a strong statement about how widely his method is meant to apply:

> Since these things are organized in this way, with regard to everything we must always look for a single form after positing it in each case—for we will find it because it is there. And once we have grasped it, we must look for two, as the case would have it, or if not, for three or some other number. And we must treat every one of those further unities in the same way, until it is not only established of the original unit that it is one, many

[27] See, for example, MacFarlane (2002) for a defense of the centrality of this aspect of logic in Kant and Frege.

[28] This is not to say that there is no place for geometry in medicine, which even Aristotle accepted: "It is characteristic of the doctor to know *that* circular wounds heal more slowly, but it is characteristic of the geometer to know *why*" (*APo* 79a14-16). Nevertheless, while this shows that geometric results are important in medicine, Aristotle is emphatically not suggesting that doctors need to learn all the relevant geometric methods to prove this.

> and unlimited, but also how many kinds it is. [...] *The gods, as I have said, have left us this legacy of how to inquire and learn and teach one another.* (*Phlb* 16c-e, emphases mine)[29]

So far, we just have heard that this method is a divine way to inquire, learn, and teach. But soon after this, Socrates strengthens the claim:

> So at the same time they [the first music theorists] made us realize that one should investigate about every one and many in this way. For whenever you have mastered these things in this way, then you have acquired expertise there, and whenever you have grasped the unity of any of the other things there are, you have become wise about that. (*Phlb* 17d-e)[30]

This passage suggests that the method of division is a way to inquire (or learn or teach) in *any* domain and that success in the method means that you have acquired wisdom. Those who ignore it, on the other hand, are said to be eristics simply grouping things "in a chance way" (*Phlb* 16e). The same is said in the *Phaedrus*, where division is the ability in any instruction "to cut up *any kind* according to its species along its natural joints" (*Phdr* 265e). In the *Sophist,* dialectic is defined by the Eleatic stranger as the quite general skill of being able to "divide things by kinds and not to think that the same form is a different one or that a different form is the same" (*Sph* 253d1-2) and, in the *Statesman,* he claims to be teaching Theaetetus and Young Socrates about division in order to make them "better dialecticians in relation to all subjects" (*Plt* 285d5-6). We see just how serious Plato is about generality in his uncontroversial applications of the method to domains as diverse as music theory, political philosophy, and phonology.[31] The enormous range of application further motivates the thought that Plato took division to be perfectly general, in the sense that it applies to every subject matter.

Aristotle considers his syllogistic to have a similar scope. Recall that in the introduction of the method in *APr* I.30, he claims:

[29] δεῖν οὖν ἡμᾶς τούτων οὕτω διακεκοσμημένων ἀεὶ μίαν ἰδέαν περὶ παντὸς ἑκάστοτε θεμένους ζητεῖν – εὑρήσειν γὰρ ἐνοῦσαν – ἐὰν οὖν μεταλάβωμεν, μετὰ μίαν δύο, εἴ πως εἰσί, σκοπεῖν, εἰ δὲ μή, τρεῖς ἤ τινα ἄλλον ἀριθμόν, καὶ τῶν ἓν ἐκείνων ἕκαστον πάλιν ὡσαύτως, μέχριπερ ἂν τὸ κατ' ἀρχὰς ἓν μὴ ὅτι ἓν καὶ πολλὰ καὶ ἄπειρά ἐστι μόνον ἴδῃ τις, ἀλλὰ καὶ ὁπόσα· [...] οἱ μὲν οὖν θεοί, ὅπερ εἶπον, οὕτως ἡμῖν παρέδοσαν σκοπεῖν καὶ μανθάνειν καὶ διδάσκειν ἀλλήλους·

[30] καὶ ἅμα ἐννοεῖν ὡς οὕτω δεῖ περὶ παντὸς ἑνὸς καὶ πολλῶν σκοπεῖν – ὅταν γὰρ αὐτά τε λάβῃς οὕτω, τότε ἐγένου σοφός, ὅταν τε ἄλλο τῶν ἓν ὁτιοῦν ταύτῃ σκοπούμενος ἕλῃς, οὕτως ἔμφρων περὶ τοῦτο γέγονας·

[31] See Lukas (1888) for more or less explicit examples in nine dialogues.

> The method is one and the same for all things, both concerning philosophy as well as any skill or learning whatever. (46a3-4)

Aristotle claims that his syllogistic method works in the same way *for all things.* An argument will be a syllogism regardless of the epistemic status or subject matter of the premises and conclusion, and our method of looking for syllogisms and deducing validly will also be the same. Here we see a close analogy with what Plato claims for division. The similarity is clear when we look at how closely the passage above is paralleled by the end of I.31: "this way of investigation [division] is neither suitable for every inquiry, nor even useful in those very cases in which it appears to be most appropriate." It seems that Aristotle denies for division almost exactly what he affirmed about syllogistic.

While Aristotle does not think that every syllogism produces knowledge, a special kind of syllogism, demonstration, will. A syllogism requires special kinds of premises in order to be demonstrative: true, primary, immediate, better known than the conclusion, prior to the conclusion, and explanatory of the conclusion (*APo* I.2). Coming to know, then, requires the scientist to do two things: to have at hand premises of this sort and to construct syllogisms of the propositions to be demonstrated from those premises. The syllogistic is one of the crucial elements in Aristotle's theory of science as described in the *Posterior Analytics*. The theory of science there is completely general and meant to apply to any scientific or technical domain whatsoever. Thus the syllogistic too must be general.

We have found that the project of division and syllogistic are, despite appearances, very close in this respect. Both are meant to play a central role in every scientific enterprise.

2.2 Rigor

Plato and Aristotle wanted these procedures to be not only *general* but also *rigorous*. While generality regards what subject matters the procedure can be applied to, rigor is a matter of how that procedure is applied. There is no agreed upon analysis of rigor available.[32] However, I will assume here that a procedure is rigorous just in case it minimizes error in pursuit of its goal: applications of the method should result in errors as little as

[32] The current literature on rigor has focused on the case of mathematics e.g., in Burgess (2015); Paseau (2016). For the history of rigor in analytic philosophy, see Floyd (2013), who resists a univocal notion of "rigor", but does suggest its deep connections to notions of "the elimination or reduction of guesswork, *ad hocness*, haphazardness, and potential error" (p. 1011).

possible. For some types of problem there might be infallible methods, but in most situations there will inevitably be residual error. A *method,* for the purposes of this discussion, is a procedure that outputs an answer to a certain kind of question and (possibly) some fixed set of parameters. An *application* of a particular method requires specifying a particular question and the parameters (for instance, with statistical methods one must supply both the hypothesis under investigation as well as parameters such as data points and the p-value). An application of a method results in an *error* when the answer returned by the method is false. So a method is rigorous if it minimizes the proportion of false answers to the input questions with parameters. Thus, while a non-rigorous method might give a correct answer *sometimes*, it does not reliably give correct answers.

Before going on to Plato and Aristotle, let me give a few examples to illustrate rigorous and non-rigorous methods. Something like "Believe the truth" isn't a method, since it does not actually output any answer to a question. A *very* non-rigorous method is something like "Believe only what is in your horoscope". The sieve of Eratosthenes, an algorithm for finding prime numbers, is rigorous in this sense: following it guarantees that you get the right answer. While algorithms (in the technical sense used in computer science) are an important class of rigorous procedures, rigor is not only manifested in algorithms. The user of a rigorous but non-algorithmic method may need some ingenuity, but that ingenuity is either sufficiently constrained by the method or there are parts of the method that prevent errors, perhaps because there is an algorithm for checking the answer that one has.[33] The ancient method of geometrical analysis, for instance, does not work without input from the inquirer, but is rigorous in that the technique does not lead to errors. Stephen Menn puts this quite clearly:

> The method of analysis had enormous prestige, in antiquity and down to the days of Descartes and Fermat, because it was seen as the basic method of mathematical *discovery*: not simply a way for a student to discover and assimilate for himself propositions already known to his teachers, but also a way for a mature geometer to discover previously unknown propositions. While analysis is a method with clear rules for step-by-step work (though it is not a mechanical method—the geometer must apply the rules intelligently in order to succeed), it terminates when something unpredictably "clicks"; then, if and when

[33]Even non-deterministic algorithms do not require ingenuity. Rather, they make use of a random variable either to get an answer with certainty or with high probability.

> this happens, the geometer must again proceed methodically (again, not mechanically) by the method of synthesis, to confirm what has been discovered by analysis; if this succeeds, then the newly discovered proposition may be presented with a demonstration in the usual highly stylized form given in the classic Greek mathematical texts. (Menn, 2002, pp. 194-5)

What Menn is suggesting by calling analysis "step-by-step" but "not...mechanical" is exactly what I am intending by a rigorous but non-algorithmic method. The problem here is that sometimes the "steps" are not sufficiently precise that they can be run by a computer. But that does not mean that the steps don't work to reduce human error when applied with intelligence. Nevertheless, algorithms have a distinct advantage over rigorous, non-algorithmic, methods like geometrical analysis: they always terminate. *Deterministic* algorithms (and a special class of non-deterministic algorithms) have the further advantage that they always terminate with the correct answer. A non-rigorous method, by contrast, can attain its goal, but not in virtue of the method alone—it also requires luck or the inquirer's knack.

According to Plato, divisions should be done rigorously. In the *Philebus*, he gestures at the need for rigor by pointing out defective divisions:

> The gods, as I have said, have left us this legacy of how to inquire and learn and teach one another. But these days the wise guys make a one in a chance way and a many faster and slower than they ought. After the one they go directly to the unlimited and the intermediates escape them, which are what determines whether our speaking with each other is dialectical or eristic. (*Phlb* 16e-17a)[34]

According to Socrates, dividing incorrectly results in an eristical account, while his preferred method leads to a dialectical account. The difference between the dialectical and eristical accounts is not that the former must be true and the latter false. Rather, Socrates objects to the *way* that the eristic gets her account: by collecting in a chance way or dividing too quickly or slowly. I will argue below that the problem here is precisely one of rigor:

[34] οἱ μὲν οὖν θεοί, ὅπερ εἶπον, οὕτως ἡμῖν παρέδοσαν σκοπεῖν καὶ μανθάνειν καὶ διδάσκειν ἀλλήλους· οἱ δὲ νῦν τῶν ἀνθρώπων σοφοὶ ἓν μέν, ὅπως ἂν τύχωσι, καὶ πολλὰ θᾶττον καὶ βραδύτερον ποιοῦσι τοῦ δέοντος, μετὰ δὲ τὸ ἓν ἄπειρα εὐθύς, τὰ δὲ μέσα αὐτοὺς ἐκφεύγει – οἷς διακεχώρισται τό τε διαλεκτικῶς πάλιν καὶ τὸ ἐριστικῶς ἡμᾶς ποιεῖσθαι πρὸς ἀλλήλους τοὺς λόγους.

it is not about getting the correct answer on a given occasion, but using a method that minimizes the possibility of error generally.

In the *Statesman*, we get some explicit reasoning why going too fast is problematic when Young Socrates divides herd-rearing too quickly into rearing of human herds and beast herds. This is exactly the same kind of mistake mentioned in the *Philebus* passage. The Eleatic Visitor explains the problem:

> Visitor: Ah, yes. You've made a very zealous and courageous division! However, we should try not to have this happen ever again! ... For it is most fine to separate off the object of inquiry from the others straightaway, should you do it correctly, just as a moment ago, when you thought that you had the division, you rushed the account, seeing that it was headed towards humans. But my friend, it is not safe to do such fine work. Instead, cutting through the intermediate stages is safer and one would more encounter ideas. This makes all the difference in investigations. (*Plt* 262a-b)[35]

We could formalize such a norm that the Visitor mentions in the following way. Assume that we start from kind K and are aiming to define a target kind T. Then, he would be saying, of these two divisions:

$$\begin{array}{ccc} K & \qquad\qquad & K \\ \uparrow & & \uparrow \\ \cdots & & \cdots \\ \uparrow & & \uparrow \\ k_n & & k^m \\ \uparrow & & \uparrow \\ T & & T \end{array}$$

one should prefer the former to the latter if $n>m$. That is, one should prefer a division with more "intermediates". As defined here, this norm is non-trivial and gives significant advice to the one dividing. While it certainly

[35]ΞΕ. Παντάπασί γε προθυμότατα καὶ ἀνδρειότατα διῄρησαι· μὴ μέντοι τοῦτό γε εἰς αὖθις κατὰ δύναμιν πάσχωμεν. ...κάλλιστον μὲν γὰρ ἀπὸ τῶν ἄλλων εὐθὺς διαχωρίζειν τὸ ζητούμενον, ἂν ὀρθῶς ἔχῃ, καθάπερ ὀλίγον σὺ πρότερον οἰηθεὶς ἔχειν τὴν διαίρεσιν ἐπέσπευσας τὸν λόγον, ἰδὼν ἐπ' ἀνθρώπους πορευόμενον· ἀλλὰ γάρ, ὦ φίλε, λεπτουργεῖν οὐκ ἀσφαλές, διὰ μέσων δὲ ἀσφαλέστερον ἰέναι τέμνοντας, καὶ μᾶλλον ἰδέαις ἄν τις προστυγχάνοι. τοῦτο δὲ διαφέρει τὸ πᾶν πρὸς τὰς ζητήσεις.

does not amount to anything like an algorithm, it does provide concrete actionable steps for an inquirer to take. If an inquirer makes several attempts at a division, for example, she could look at them all and reject those that have fewer or no intermediates. Indeed, this norm my seem to be too strong to be plausible. As will be seen below, however, the Visitor does have an argument for accepting it.

To illustrate the mistake, the Visitor gives two other divisions that reach the same end point but do so more quickly (266c9-11) and more slowly (265b8-e2). In introducing them, he claims that the faster route will resemble the problematic division of Young Socrates:

> Now it seems that there are two routes to be seen stretching out in the direction of the part towards which our argument has hurried, one of them quicker, dividing a small part off against a large one, while the other more closely observes the principle we were talking about earlier, that one should cut in the middle as much as possible, but is longer. (*Plt* 265a1-5)[36]

Since the slower, longer route satisfies the rule of not chopping off little bits while the other does not, it seems that the faster one is problematic. This suggests we should prefer that longer route because it is "safer."[37] The safety of the Visitor's method is meant to guard against a particular sort of error that the fast method could not: missing *ideas*, the explanatory natural kinds that should be in one's definitions. This constitutes evidence that Plato is arguing that slow division is more rigorous than fast division in the sense that it minimizes error. Indeed, it seems that the notion of "safety" in these passages should be understood precisely as rigor in the sense defined above.

Plato not only wants a rigorous method of division, he also proposes two norms to promote it: 1) divide slowly and 2) divide into the smallest number of subkinds possible (*Plt* 287b-c, *Phlb* 16d). We saw his statement of the first norm above. The second is made explicit later on in the dialogue:

> Visitor: So do you recognize that it is difficult to cut them into

[36]Καὶ μὴν ἐφ’ ὅ γε μέρος ὥρμηκεν ἡμῖν ὁ λόγος, ἐπ’ ἐκεῖνο δύο τινὲ καθορᾶν ὁδὼ τεταμένα φαίνεται, τὴν μὲν θάττω, πρὸς μέγα μέρος σμικρὸν διαιρουμένην, τὴν δέ, ὅπερ ἐν τῷ πρόσθεν ἐλέγομεν ὅτι δεῖ μεσοτομεῖν ὡς μάλιστα, τοῦτ’ ἔχουσαν μᾶλλον, μακροτέραν γε μήν.

[37]Some, such as Gill (2012), think that the long route is too long. If that were so, we would have expected the Visitor to have corrected himself, since that is what he tends to do in this dialogue. He nowhere repudiates it, even though he makes other adjustments to this stretch of the division later on. Note also the parallel to "safer" causal explanations in *Phaedo* 100d. These explanations are safe precisely because they do not lead to errors.

> two? The cause, I think, will become more evident if we proceed....Then let's divide them limb by limb, like a sacrificial animal, since we can't do it into two. For we must always cut into the nearest number so far as we can. (*Plt* 287b10-c5)[38]

The last sentence of this passage makes clear another norm, which is that one should minimize the number of proximate subkinds that one divides into. Although he does not think that all good divisions need to be dichotomous, he stills holds on to a weaker norm that, if one is presented with two divisions of some kind K:

$$\begin{tikzcd} & K & \\ k_1 \arrow[ur] & \dots \arrow[u] & k_n \arrow[ul] \end{tikzcd} \qquad\qquad \begin{tikzcd} & K & \\ k^1 \arrow[ur] & \dots \arrow[u] & k^m \arrow[ul] \end{tikzcd}$$

the former should be preferred to the later if $n<m$. This too is paralleled in the *Philebus*, where Socrates says "after the one, one ought to seek two, if that's now many there are, or else three or some other number" (*Phlb* 16d3-4).[39] Here we seem to get the advice to first look for two subkinds, then three, and so on. Such a procedure would be equivalent to looking always for the smallest number of dividentia.

Moreover, in the first case, he explicitly defends the norm by arguing that it minimizes the possibility of error (*Plt* 261e-264b). He shows this by arguing that, if one does not follow the norm, there is a *possibility of error* that would have been excluded by following the norm. This is made clear in the examples he uses following Young Socrates' division. Young Socrates was not rigorous in his division of animals into humans and beasts because it was possible, using the same kind of reasoning, to divide humans into Greeks and Barbarians or numbers into 10,000 and not-10,000 (*Plt* 262c-e). Such divisions, the Visitor claims, obviously would have been erroneous, since they would have missed fundamental kinds along the way—in the case of numbers, odd and even and in the case of humans, male and female.[40] While he does not claim that Young Socrates himself missed a fun-

[38]{ΞΕ.} Οἶσθ' οὖν ὅτι χαλεπὸν αὐτὰς τεμεῖν δίχα; τὸ δ' αἴτιον, ὡς οἶμαι, προϊοῦσιν οὐχ ἧττον ἔσται καταφανές. ...Κατὰ μέλη τοίνυν αὐτὰς οἷον ἱερεῖον διαιρώμεθα, ἐπειδὴ δίχα ἀδυνατοῦμεν. δεῖ γὰρ εἰς τὸν ἐγγύτατα ὅτι μάλιστα τέμνειν ἀριθμὸν ἀεί.

[39]μετὰ μίαν δύο, εἴ πως εἰσί, σκοπεῖν, εἰ δὲ μή, τρεῖς ἤ τινα ἄλλον ἀριθμόν.

[40]It is a common assumption in the literature that the problem noted in this passage has to do with Young Socrates dividing into "negative kinds". See, for example, Frede (1967), pp. 93-4 Moravscik (1973); Cohen (1973); Wedin (1987); Fine (1993), p. 111; Berman (1996);

damental kind in his division, he objected to the *way* he was dividing because it *could* lead to errors. Here the Visitor is showing concern not just for the truth, but at arriving at the truth "safely". He claims that dividing slowly, by which he means dividing with many intermediate steps, reduces the possibility of this kind of error. That is because there could be a kind more general than the kind that you divided into that was passed over in the fast division and this will not be part of the account, as you will already be dealing with smaller classes. Thus you will not meet your goal of having a complete account of the essence. Applying these norms helps make division rigorous by preventing some important kinds of errors, even if they are not sufficient for eliminating every possible kind of error.[41]

One might worry that dividing too quickly does not just *risk* an error, but *is itself* an error. Here we should distinguish between the idea that there is an error in the output from the idea that there is an error or mistake in the method. I am claiming that Young Socrates does make a mistake in the method that does not, in this one case, lead to a mistake in the output. So much seems to be demanded by the very language of safety, which does not by itself imply that there was an error in the resulting definition, but only greater *possibility* of such an error. But how is it that Young Socrates *didn't* make a mistake in the output if he skipped over a kind? He did not make an error in the output because the long conjunction of descriptions "two-footed, non-interbreeding, hornless, terrestrial, tame animal" is just a further spelling out of "human". Thus, when Young Socrates said that

Gill (2012), p. 182; Ambuel (2013). Dissenters to this assumption include Lane (1998), p. 76 and Crivelli (2012), p. 212, who makes the crucial point that "[i]n the *Statesman* Plato is not concerned with the existence of kinds matching negative predicables, but with the correctness of divisions." Further evidence for this point comes from the fact that, when the Visitor goes on to illustrate divisions that are not problematic in the way that Socrates' was, he uses negative kinds: horn*less*, *non*-interbreeding. This would be very strange if the problem was the use of negative kinds. Gill suggests that the problem is only using a negative kind at the last stage of the division, but there is no textual evidence for this. Indeed, nothing corresponding to "negative" can be found in the passage at all. While there is a concern in this passage for the distinction between parts and kinds, there is no suggestion that sometimes a negation always results in a mere part.

[41] For the norm of dividing into the smallest number of subkinds, there is no explicit justification. We could imagine one very close to the one he game for the other norm, however. Suppose that you violate Minimization. Then there could be a kind which belongs to the essence of the target kind and is the genus of several of the kinds divided into. However, this will not be included, as you divided directly into its subkinds. Thus you will not meet your goal of having a complete account. Aristotle gives a different justification for the same norm in *Top* 109b13-29. In this passage, he argues that arguments based on such divisions proceed more quickly, since they deal with a small number of large groups instead of a large number of small groups.

statecraft was a kind of herding of humans, he was not saying anything inconsistent with the Visitor's definition. Nothing essential was missed in the account because Young Socrates got lucky when using the term "human", which builds in the long description given by the Visitor. In the case of the number 10,000, by contrast, one would have missed the essential property of *evenness*.

Rigor is manifested in Aristotle's syllogistic at two points in the method. Recall that the goal of his method is to produce a syllogism of a desired conclusion. As was mentioned above, the first stage of the method (discovering the syllogism) is algorithmic. If a set of premises contains a syllogism, Aristotle's procedure is guaranteed to find it and following the procedure will never lead to one giving an argument that is not a syllogism. This method is completely rigorous. Not only is the method for finding syllogisms rigorous, so too is the syllogism itself.[42] Valid argumentation is plausibly more reliable than invalid argumentation, simply because, whereas the only way for a valid argument not to result in a true conclusion is if one of the premises is false, invalid argumentation may not result in a true conclusion both when one of the premises is false and when they are true. These two points together make the entire procedure described in *APr* I.31 rigorous, since that method consists in *both* the search for syllogisms *and* giving those syllogisms.

In both cases, we are demanding of the methods that they minimize the possibility of error. However, while there is residual error in Plato's method, Aristotle's has two advantages: his method always terminates and does so with the correct answer, so long as the inputs were themselves correct.[43] Because they are different methods it will turn out that rigor is manifested differently in each case, but they have a similar spirit. Moreover, very few methods are both rigorous and general. Most rigorous scientific methods of which we are familiar have a very limited domain of applicability, and likewise very general methods have, on the whole, a large room for error. For instance, the so-called "Socratic elenchus" can be used on any question whatsoever, but has a wide margin of error, if one seeks positive results with it.

[42]According to Malink (2015), this kind of rigor is one of the distinguishing marks of the treatment of syllogisms in the *Analytics* as opposed to the *Topics*.

[43]The method specified in *APr* I.27-30 does not give an algorithm for generating the lists of predications, so there may be some residual error in syllogizing the target conclusion if and only if there is no completely rigorous way of generating those lists.

3 Investigating Mereological Relations

Finally, the two methods are parts of a common project not only in *how* they investigate, but also in *what* they investigate: mereological relations between kinds.

To see this in Plato's case, it will be helpful to start with an example: *Skill*, a general kind, divided into *Production* and *Acquisition*. The relation between *Skill* and, e.g., *Production* is one of whole to part. This is suggested by the language of division itself: as a part is standardly defined as that into which a whole is divided. Plato also has the Eleatic Visitor state the claim dogmatically:

> That whenever there is a species of something, it is necessarily also a part of whatever thing it is said to be a species of, but it is not at all necessary that a part is a species. You must always assert, Socrates, that this is what I say rather than the other way around. (*Plt* 263b7-10)[44]

Here the Visitor says that *A* being a species of *B* implies that *A* is a part of *B*, but not vice versa. Since division here and more generally in Plato is into kinds, this passage shows quite clearly that Plato thinks of the relationship between kinds in mereological terms. So, although definitions, the ultimate goals of division, may be identities, the method of division approaches definitions by first discovering mereological relations between kinds.[45]

Mereology comes into Aristotle's method through his account of predication. The method, as he develops it, relies on a distinction between four kinds of definite propositions:

- Universal Affirmative: b belongs to (or is predicated of) every a. (Equivalent to saying "Every a is b")
- Universal Negative: b belongs to no a. ("No a is b")

[44] Ὡς εἶδος μὲν ὅταν ᾖ του, καὶ μέρος αὐτὸ ἀναγκαῖον εἶναι τοῦ πράγματος ὅτουπερ ἂν εἶδος λέγηται· μέρος δὲ εἶδος οὐδεμία ἀνάγκη. ταύτῃ με ἢ 'κείνῃ μᾶλλον, ὦ Σώκρατες, ἀεὶ φάθι λέγειν.

[45] The notion of structured wholes on which this account relies may be distinctive of late Platonic metaphysics. Some have argued that there is a transition in Plato's thinking about forms, beginning with the idea that they are simple and partless (e.g., in the *Phaedo* and *Republic*) and moving towards a view on which they have mereological structure after the *Parmenides.* See, e.g., Rickless (2007), pp. 240-250. Since I am only looking at the relationship between the late dialogues and Aristotle, I can stay neutral about the question of Platonic development on this issue. For more on structured wholes, see Harte (2002).

- Particular Affirmative: b belongs to some a. ("Some a is b")
- Particular Negative: b does not belong to some a. ("Not every a is b")

The rules in Aristotle's method for deducing conclusions and finding premises for deduction are entirely determined by which of these categories the propositions fit into. This distinction is therefore crucial to his method. I will argue that the four types of proposition used in the syllogistic are defined by Aristotle in terms of a mereological predication relation. It is widely agreed that in the *dictum de omni et nullo* syllogistic propositions are defined in terms of predication. It is disputed whether they are defined in terms of a notion of predication different from universal affirmative.[46] While I will stay neutral with respect to the dispute between these two readings, the former reading is usually associated with a view of predication akin to Frege's, which takes predication to be a relation between two different syntactic types.[47] It might be objected that the mereological interpretation only fits with the heterodox interpretation. While it is true that the heterodox interpreters generally place more emphasis on mereology, it seems to me that the orthodox interpreter can perfectly well accommodate the mereological language by simply pointing out that the subset relation satisfies all of the axioms of standard mereological theories. Thus "All a is b" would express a part/whole relation between a and b because the extension of a is a subset of the extension of b.[48] The mereological claim is quite plausible in cases where the terms refer to substances. However, Aristotle believes predications like "All swans are white" are true, but is it right to say they express a mereological relation?

Three reasons for a positive answer have been suggested in the literature. 1) Aristotle's terminology for predication is steeped in mereological language.[49] He marks his phrase for universal predication ("belongs

[46]See Corcoran (1972, 1973); Ebert (1995); Barnes (2007), for the view that they are different, but Morison (2008, 2015); Malink (2013), following Michael Frede for the view that they are the same. There has been a vast literature on the *dictum de omni et nullo* and its importance for understanding the perfect syllogisms, the details of which are not essential to the present argument. See also Patterson (1993); Ebert (2015); Marion and Rückert (2016); Crubellier et al. (2019).

[47]This view has been discredited by Mignucci (2000); Malink (2009); Corkum (2015). See Crager (2015) for a version of the Corcoran/Barnes reading that does not use the Fregean conception of predication.

[48]For an influential mereological reconstruction of set theory, see Lewis (1991).

[49]See Stekeler-Weithofer (1986); Mignucci (2000); Malink (2009); Corkum (2015). This was also the view of the ancient commentators: Alex Aphr *in APr* 25.24, Phlp *in APr* 47.23-48.2, 73.2-23, 104.11-16, 164.47.

to all") as equivalent to "is in as a whole" (*APr* 24b26-8) and his terms for different kinds of propositions "universal" (*katholou*) and "particular" (*kata meros* or *en merei*) are themselves derived from the language of whole (*holon*) and part (*meros*). While this point alone might seem to be decisive, one might wonder whether the terminology is meant seriously or is just a metaphor. Without knowing what kind of philosophical or logical work it does, this claim cannot be evaluated. 2) When discussing the genus-species relation, Aristotle frequently refers to their relation as one of whole and part (*Metaph* V.25, 26).[50] This point seems to have the drawback that it gives no clear reason to think "All swans are white" is true, since that is not a species-genus relation. 3) The minimal formal structure of the part-whole relation is sufficient for giving semantic clauses for all the syllogistic propositions and defining a consequence relation that is sound and complete for his deductive system.[51]

Together, these pieces of evidence give good reason for attributing to Aristotle the mereological conception of predication. 1 and 2 provide direct textual support for Aristotle for thinking along these lines, while 3 shows that the mereological conception is not merely metaphorical language but can accomplish significant philosophical work for Aristotle's logical theory. With these points in place, we can respond to the objection that "All swans are white" does not seem to capture a mereological relation. While it certainly is *not* a species-genus relation, Aristotle explicitly says that it is equivalent to the claim that "Swan is in white as a whole" (see 1 above). Secondly, this equivalence does logical work, since it explains why, e.g., "All swans are colored" follows from it and "All white things are colored", viz the transitivity of part-hood. Finally, it is worth remembering that the *Platonic* notion of part-hood is also broader than the species-genus relation, since the *Statesman* passage above clearly shows that there are cases of parts that are not kinds. The Platonic and the Aristotelian mereologies of kinds agree on this point. Thus both Plato and Aristotle would agree that "All swans are white" is a mereological claim, because for them the part-whole relation between kinds is more inclusive than the species-genus relation. This shows that both Platonic division and Aristotelian syllogistic are in the business of investigating mereological claims between kinds. Thus, in addition to being similar *ways* of investigation (namely, general and rigorous), the two methods investigate the same kind of *content.*

[50] Malink (2009).

[51] Vlasits (2019).

4 Resolving the Puzzle

Let us return to our original puzzle: why did Aristotle compare division with the syllogistic when these are such different methods? In the previous sections I showed how these methods were both meant to contribute to general, rigorous scientific methods aimed at understanding mereological relations between kinds. This common project makes sense of Aristotle's comparison. Even though the goal and methods are very different, they were both intended to be general and rigorous ways of attaining scientific knowledge (§2). Despite the fact that the syllogistic yields quantificational claims and division definitions, both investigate the mereological relations between kinds (§3).

The foregoing similarities between division and syllogistic as general, rigorous methods investigating mereological relations between kinds explain why Aristotle can criticize the method of division in the way that he does. Although he thinks that division is successful when it comes to searching for essences, it is not successful at demonstrating anything, with the exception of disjunctive propositions devoid of scientific interest. Aristotle's syllogistic, by contrast, can demonstrate *everything* of scientific interest that can be demonstrated. If one only has scientific knowledge (ἐπιστήμη) when having a demonstration, this shows a weakness of division, since this was its goal. Of course, division could still make a substantial contribution to this goal, even if it does not reach the final step by itself. Syllogistic, on the other hand, requires definitions as inputs (43b1-9). Seeing the scientific project common to both allows us to appreciate why this *is* a weakness in division that the defenders of division should take seriously. The argument relies on central Aristotelian premises, especially that scientific knowledge requires demonstrations and that a demonstration is a certain kind of syllogism. These premises, however, while controversial, are nevertheless fair game. This is because Aristotle has independent motivations for them, stemming from his observations of successful scientific practice as well as general considerations of the nature of explanation.

The problem remains, however, that Aristotle is treating division in the chapter as a putative demonstration and thus a syllogism, which despite this common project still seems uncharitable on his part. That is, instead of having some neutral background to assess both methods, Aristotle takes the syllogism in these passages to be the standard against which division is evaluated and division seems to be criticized precisely for not being a syllogism. In what follows, I will argue that Aristotle's important points in the chapter do not rely on these claims and in a connected passage already discussed (*APo* 91b32-35), Aristotle in fact acknowledges that the mere fact that division isn't syllogistic is *not* sufficient to show that it is not scientifically valuable. Rather, his strategy in the chapter is to show the limitations of division and the power of syllogistic within the common project—points that could be appreciated even bracketing the question of division's demonstrative character.

Doing so will show exactly how **Confusion** can be avoided. Aristotle assimilates division to syllogistic here *not* because he is confused about the differences between them, which he is clear about, for instance, in *APo* II.5. When Aristotle says that his opponents think that divisions are demonstrations, we should understand him to be using "demonstration" in his usual technical sense and thus claiming that his predecessors were wrong about the potential of division. In particular, they were wrong to think that one could achieve scientific knowledge with only division and without the syllogistic. But this need not be the result of any confusion on the part of the Platonists either because the criticisms that Aristotle levels against them all concern their common scientific project. Even if we suppose that Aristotle is right, their mistake was the very non-obvious one that deductive arguments play a special role in science.

Identifying division and syllogistic allows Aristotle to straightforwardly ask the question whether division can make the same contributions to science that Aristotle has just claimed syllogistic can make. By seeing that it cannot play the syllogistic's role, however, Aristotle need not and does not conclude that division thereby plays no role whatsoever. In I.31, Aristotle does not set out to show that only the syllogistic, and not division, is a necessary part of the scientific enterprise. This is important, because Aristotle seems to accept the use of division in any science:

> But it is necessary, *whenever* one is dealing with some whole, to divide the genus into the indivisibles in species... (*APo* 96b15-16)[52]
>
> Divisions according to the differences are useful for going about in this way [i.e. investigating the essence]. (*APo* 96b25-26)[53]

Aristotle also wants division to be rigorous, since he argues that:

> Further, only in this way [i.e. using the rules for division that he described] is it possible to leave nothing out in the what it is

[52] Χρὴ δέ, ὅταν ὅλον τι πραγματεύηταί τις, διελεῖν τὸ γένος εἰς τὰ ἄτομα τῷ εἴδει...

[53] αἱ δὲ διαιρέσεις αἱ κατὰ τὰς διαφορὰς χρήσιμοί εἰσιν εἰς τὸ οὕτω μετιέναι·

[the essence]. (*APo* 96b35-97a1)[54]

These texts strongly suggest that Aristotle does not reject division as Plato conceives of it. What Aristotle wants to do in I.31 is highlight the most important feature of arguments produced by the syllogistic method: *validity*.[55] Let's return to his criticisms once more:

1. Divisions are not deductions of the definitions they seek, because the definition does not follow of necessity from the assumptions. (46a31-b25)
2. Division cannot demolish. (46b26)
3. Division cannot deduce features that are not definitional. (46b27-8)
4. Division is useless in solving open problems. (46b28-35)

Each of these corresponds to an innovative feature of the syllogistic:

1. The syllogistic leads to arguments whose conclusions follow from the premises *of necessity*.
2. The syllogistic allows one to refute a claim, since a refutation is just a syllogism of the contradictory of a given claim. (42b40 ff)
3. The syllogistic can be used in all sorts of problems, not just definitional ones.
4. The syllogistic can be used in situations of ignorance.

The most important of these features to Aristotle seems to be the first. He isolated a notion of *following of necessity* in his account of the syllogism and developed a method that leads to arguments that must have this property. As was argued in §1.3, these precise claims are the route to understanding why division is like a "weak syllogism" and a small part of the syllogistic method. The syllogism is weak because it is unable to *force* its desired conclusion, but instead only a disjunctive conclusion. This weakness of the syllogism in turn implies that division is "a small part" of the syllogistic method.

[54] Ἔτι πρὸς τὸ μηδὲν παραλιπεῖν ἐν τῷ τί ἐστιν οὕτω μόνως ἐνδέχεται.

[55] Not every argument produced by the syllogistic method will be sound, since it is possible to choose one's premises *in accordance with opinion* when doing dialectic, but these may not be true.

Aristotle is not claiming that there is a problem with division *per se* not leading to such arguments. However, the three applications he then discusses (refutation, non-definitional problems, and situations of ignorance) are all better served by syllogistic than division *because* it produces valid arguments. Valid arguments can be used to establish or refute any sort of claim whatsoever, unlike division, which can only plausibly be used to establish definitions. Many claims in science are not definitional, so it would be important to say something about them. In a situation of ignorance, a valid argument can allow the reasoner to put together pieces of knowledge that she already had to find out something she before did not. Division, even if it is illuminating, requires that the inquirer know at every point in the division where to put the target kind. Otherwise, she is stuck. Syllogisms, because they involve putting together multiple independent claims in new ways, can lead to new, surprising results.

More generally, valid arguments are important in both dialectical encounters and scientific demonstration. In dialectical encounters, it is useful to be able to force a conclusion on an interlocutor, for instance, to refute her. Using division, like using an inductive argument, cannot sway a recalcitrant opponent with the same force as a valid argument. Part of what it is to know *p* scientifically, according to Aristotle, is to know that *p* is necessary. If this is the case and there is some plausible way to know that certain fundamental principles of a science are necessary, then valid argumentation will be of great use in coming to know derivative scientific truths, since the necessary consequences of a set of necessary truths are themselves necessary.

Note, however, that while syllogistic is useful in science, it also cannot be the whole story. It cannot be used to demonstrate these first principles, since those are precisely what must be taken for granted. One particularly important kind of indemonstrable principle, for Aristotle, is the definition (*APo* I.2). Here, it seems, is where Aristotle thinks division can be of service. Because it is non-demonstrative, inquirers can use division to hunt for and establish the definition of a target kind (*APo* II.13).

This is where **Knowledge** went wrong. Recall that, according to **Knowledge**, division could not be a way of acquiring knowledge because it is not possible to use question-begging arguments for acquiring knowledge. On the view suggested here, division's power is, paradoxically, also its weakness. It is a bad way of acquiring certain kinds of knowledge because it is not a syllogism and thus not a demonstration. But knowledge cannot always be got through demonstrations (*APo* I.3). Indeed, Plato designed the method of division to hunt for definitions, one of the three kinds of indemonstrable principle in Aristotle's philosophy of science. Thus nothing in *APr* I.31 rules out division being of crucial importance in attaining such knowledge. In the end, Aristotle will argue that division is quite important in discovering the internal structure of essences. In *APo* II.5 and 13, passages closely connected to *APr* I.31 (see 91b14-15, 96b26-7 for back references), Aristotle affirms the utility of division for hunting essences, in particular, by determining the correct order of the elements of a definition:

> Divisions according to differences are useful for proceeding in this way [hunting essences]. How they show has been said earlier. But they could be useful for syllogizing the "what it is" in this way alone. And they might be thought to be of no use at all, but straightaway to assume everything, just as if someone assumed at the beginning without the division. But the order in which the predicates are predicated makes a difference, e.g. animal tame biped or biped animal tame. (*APo* 96b25-32)[56]

Here is not the place to say why Aristotle deems this so important—suffice it to say that he does. Aristotle's affirmation of the utility of division in this endeavor is consistent with his claim in *APr* I.31 that division *is not useful* for the things that it seemed most fitted to (46b35-6), since in the context of that discussion, Aristotle is restricting his attention to the use of division for deducing particular elements in the definition, claiming (correctly) that it cannot do that.

This positive role also explains why Aristotle stresses that his predecessors were wrong to call division a demonstration of the essence: because it is so important that division is not demonstrative *in his sense*. He sets up his predecessors as insensitive to the difference, so that when he makes the distinction between them, it shows up as a significant advance. This point is supported by *APo* II.5, where, immediately after repeating the *APr* I.31 criticisms of division, he claims that it would not be strange at all if division made the essence known in another way, as induction does.

Now we are in a position to see why Aristotle makes the strong claims that he does. His opponents are insensitive to the fundamental Aristotelian distinction between what is and what is not known by demonstration.

[56] αἱ δὲ διαιρέσεις αἱ κατὰ τὰς διαφορὰς χρήσιμοί εἰσιν εἰς τὸ οὕτω μετιέναι· ὡς μέντοι δεικνύουσιν, εἴρηται ἐν τοῖς πρότερον. χρήσιμοι δ' ἂν εἶεν ὧδε μόνον πρὸς τὸ συλλογίζεσθαι τὸ τί ἐστιν. καίτοι δόξειέν γ' ἂν οὐδέν, ἀλλ' εὐθὺς λαμβάνειν ἅπαντα, ὥσπερ ἂν εἰ ἐξ ἀρχῆς ἐλάμβανέ τις ἄνευ τῆς διαιρέσεως. διαφέρει δέ τι τὸ πρῶτον καὶ ὕστερον τῶν κατηγορουμένων κατηγορεῖσθαι, οἷον εἰπεῖν ζῷον ἥμερον δίπουν ἢ δίπουν ζῷον ἥμερον.

While Aristotle and the "Platonists" broadly agree about the need for generality and rigor in investigating mereological relations between kinds, they disagree about what is necessary to fill that role. And while division is an important part of the Aristotelian story, he has good reason to think that it isn't the *whole* story. He presents his opponents as thinking division is a demonstration because that provides a foil to make clear *just how useful* his proposed method is for the larger scientific project.

The interpretation of I.31 on offer gives Aristotle a clear, important point to be making in his critical comparison between division and the syllogistic. Through it, Aristotle also gives an unexpected explanation of the importance of a central logical notion: *validity*. It is equally important, however, to see how Aristotle situated this explanation. The method of division proves to be a helpful foil precisely because it shares so much of what else Aristotle thinks is important about his method: its generality, rigor, and ability to yield claims about the mereological relations between kinds.

Acknowledgements

I'm grateful for feedback from Michael Arsenault, Adam Bradley, Timothy Clarke, Klaus Corcilius, Shamik Dasgupta, Pieter Sjoerd Hasper, John MacFarlane, Marko Malink, Emily Perry, Katja Vogt, and Daniel Warren on various versions of his paper, which has also benefited from extraordinarily helpful comments from three anonymous reviewers.

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