

# *Teleology and understanding*

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## **Introduction**

Why does Aristotle insist that the natural scientist should give teleological explanations? One obvious reason is that Aristotle believes that ends (*tele*) are causes (*aitiai*), and explanations (*apodeixeis*) cite causes; a putative explanation that fails to cite the final causes of the phenomena it purports to explain is, consequently, a bad explanation. However, in addition to thinking that ends are causally operative in nature, Aristotle also has reasons, from the point of view of demands on explanation, for holding that teleological explanations of natural phenomena are indispensable. These specifically “epistemological” reasons have to do with the role he believes those teleological explanations play in facilitating our understanding of natural phenomena.<sup>1</sup> As I read it, Aristotle is appealing to such reasons in a passage in *PA* I.1, a chapter devoted to discussing various methodological questions that arise about any inquiry into nature. There he is arguing, given certain reasonable assumptions about explanation and understanding, *for* giving final cause explanations and *against* giving explanations in terms of “necessity” alone, as he describes the attempts of many of his predecessors.

[A] (i) And in addition to these questions, since we see more than one cause of natural generation, e.g., both that for the sake of which and that from which the change originates, we need also to determine, about these causes, which sort is naturally first and which second. (ii) Now it is apparent that the first is the one we call “for the sake of which”; for this is the definition and the definition is the starting point alike in things composed according to art and in things composed by nature. (iii) For once the doctor has defined health, and the builder has defined house, either by thought or perception, they provide the accounts and the causes of each of the things they produce, and the reason why it must be produced in this way. Yet that for the sake of which and the good are present more in the works of nature than in those of art.

[B] And what is of necessity is not present in all natural things in the same way; yet nearly everyone attempts to refer their accounts back to it without having distinguished in how

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<sup>1</sup> In what follows, when I speak of reasons as “epistemological” or say that teleological explanations are primary “in the order of exposition”, I do not mean to suggest that these are merely pragmatic reasons, or that the explanations are first “to us”. The order of exposition of a completed science will, for Aristotle, track the causal structure of that which is in the domain of that science. What I am distinguishing here are considerations that appeal to what *makes things happen* from ones that appeal to what *makes things intelligible*. Although in Aristotle’s view these mirror one another, they are nevertheless distinguishable.

many ways “necessary” is said. That which is necessary without qualification is present in what is eternal, while that which is necessary from an assumption is present also in all that is generated, as it is in artefacts such as a house or any other such thing. It is necessary that a certain sort of matter be present if there is to be a house or any other end, and this must come to be and be changed first, then that, and so on continuously up to the end and that for the sake of which each comes to be and is. It is the same way too with things that come to be by nature.

[C] (i) But the manner of demonstration and of necessity is different in the case of both the natural and the theoretical sciences. (ii) This has been discussed elsewhere. (iii) For the starting point in some cases is *what is*, and in other cases is *what will be*. For, since health or human *is* such, it is necessary that this such and such *is* or *comes to be*. But it is not the case that since this such and such *is* or *has come to be*, that such and such from necessity *is* or *will be*. (iv) Nor is it possible to connect the necessity in such a demonstration into eternity, with the result that one says, ‘Since *this* is, therefore *that* is’. (These matters too have been determined elsewhere—in what sorts of things necessity is present, what sort of necessity converts, and owing to what cause.) (639b11-640a9)<sup>2</sup>

While there are fairly typical ways of interpreting some parts of this passage, and notorious controversies about how to interpret others, there is no “standard” reading of this entire stretch of text. On the contrary, from the way these lines are discussed, it would be easy to form the impression of it as a collection of loosely connected ideas, many of them familiar and even repetitive, with the relevance of references to discussions in other works opaque. In what follows, I will propose instead that the entire passage should be read as a tightly unified discussion, organized into sections that follow naturally upon one another. In section 1, I argue that Aristotle’s point in [A] is that teleological explanations should precede non-teleological explanations in the order of exposition. His reasoning is that the ends cited in teleological explanations are definitions, and definitions—which are not subject to further explanation—are appropriate starting points, insofar as definitions prevent explanations from going on *ad infinitum*. Moreover, I argue that Aristotle proceeds in [B] and [C] to criticize his predecessors’ non-teleological accounts for being explanatorily defective: I take Aristotle’s complaints to be that those accounts—unlike teleological explanations—neither begin from appropriate starting points (section 2) nor entail the phenomena that they purport to explain (section 3).

## **I The end is the starting point: [A]**

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<sup>2</sup> Throughout this chapter, the translation of *PA* 1.1 largely follows Lennox 2001a, though it departs most substantively in what I have labeled section [C].

The explicit aim of the first book of *Parts of Animals* is to set out and evaluate certain standards or “norms” of inquiry into nature.<sup>3</sup> Aristotle is particularly concerned to address procedural issues regarding inquiries into natural entities that are subject to generation, such as animals and other living beings. At 639b11, he raises the following question:

And in addition to these questions, since we see more than one cause of natural generation, e.g., both that for the sake of which and that from which the change originates, we need also to determine, about these causes, which sort is naturally first and which second. [A](i) (639b11-14)

Understanding (*epistêmê*), for Aristotle, is knowing *why* something is the case. That is, “unqualified scientific knowledge” consists in grasping causal explanations.<sup>4</sup> As Aristotle here in *PA* points out, given that there are multiple causes of natural phenomena, there is a question about how the natural scientist ought to proceed.<sup>5</sup> Aristotle’s answer is that teleological explanations—those that cite final causes—are naturally “first”. In support of this he makes two claims:

Now it is apparent that the first is the one we call “for the sake of which”; for this is the definition (*logos*) and the definition is the starting point (*archê*) alike in things composed according to art and in things composed by nature. [A](ii) (639b14-16)

As I read this, these two claims constitute an argument for teleological explanations being prior (in some sense here left unspecified) to other causal explanations. The first is that a teleological explanation cites the definition or account (*logos*)<sup>6</sup> of the end for which generation occurs. In

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<sup>3</sup> There is disagreement about whether these are norms for the presentation of a completed inquiry, or norms for conducting one. For example, Balme 1992 and Kullmann 1974 take these as standards for evaluating explanations, while Lennox 2021 takes them as norms for engaging in an investigation. Here I am addressing Aristotle’s argument for the priority of teleological explanations, and my concerns are orthogonal to that debate. The interpretation I offer of Aristotle’s reasoning can be accepted regardless of whether one takes it to be about how to *give* causal explanations or about how to *judge* what has been presented.

<sup>4</sup> In a completed science, these explanations are given in the form of demonstrations, which are syllogisms whose middle terms refer to the causes of the phenomena being explained.

<sup>5</sup> Although Aristotle is famous for his doctrine of *four* causes, he mentions here only two: the final cause (“that for the sake of which”) and the efficient cause (“from which the origin of movement”). At 642a1-2 and a13-14, he again refers to “two” causes. There he calls them the cause “*to hou heneka*” and “*to ex anangkês*”. This division into two types of causal explanations, those that say why something is necessary and those that say what something is for, is again illustrated in the explanation given of respiration from 642a31 to the end of the chapter. Appeals to “the necessary and/or the better” are common in Aristotle’s biological works, e.g., when he (in *GA* II.1) distinguishes two explanations of sexual dimorphism, one that cites the “necessity and first mover and what sort of matter” (731b18), and the one that cites “the better” and “for the sake of something” (718b22-3). Aristotle also claims that the natural scientist needs to give “both” the “for the sake of which” and “of necessity” cause in *Physics* II.9, 200a32ff.

<sup>6</sup> I intend for this discussion to remain neutral about both whether a *logos* here is a definition that signifies the essence of a biological kind, or merely an account that says what something is, as well as whether these are *logoi* only of kinds, or of body parts, or both. See Henry 2021a for discussion.

explanations of natural generation, one specifies what it is “for the sake of” by citing the account of that which is coming to be. The second is that this definition cited is a starting point (*archê*). Although it is true, in general, that it is “absurd to begin explaining the processes of natural generation before we have established what it is that is being generated”,<sup>7</sup> when Aristotle says that the definition is the starting point, he is articulating a specific way in which final cause explanations are primary: the definition cited in a teleological explanation is an adequate starting point from which explanation can proceed, insofar as a definition can ground the explanation, preventing it from going on *ad infinitum*. When one has specified what something is, there is no further “Why?” question to be asked. This is what I propose Aristotle means to convey by saying that the *logos* is the *archê*: a definition is a starting point of explanation.<sup>8</sup>

There are stronger and weaker readings of this, depending on how much of the formal apparatus from *Posterior Analytics* one thinks is being assumed here.<sup>9</sup> But the core idea is simply that explanations, if they are to yield understanding, must not go on indefinitely. Explanations should ultimately proceed from starting points that are self-explanatory, i.e., not subject to further explanation, and accounts saying what something is—those that cite the *logos*—are self-explanatory. Teleological explanations, because they cite *what* something is, thus provide a point past which no further explanations will be sought.

As I interpret him, Aristotle is giving a reason for teleological explanations being “naturally first” from the point of view of demands on explanation. This is not to suggest, of course, that *aitia* are merely types of explanation, as opposed to types of causal relations. I agree with the majority of interpreters who have argued that for Aristotle, there is some fact about the world—an “ontological basis”, as it has been called<sup>10</sup>—that sanctions the use of teleological explanations. However, although arguments for the existence of final cause relations also provide reasons for giving teleological explanations, there can be complimentary arguments for teleological

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<sup>7</sup> Johnson 2005:181

<sup>8</sup> I think this is echoed at 640a33ff, when Aristotle says that “most of all one must say that since *this* is “what it is to” be a human, therefore it has these things”.

<sup>9</sup> On its very strongest reading, Aristotle is relying on *APo*’s particular conception of understanding (*epistêmê*) and demonstration (*apodeixis*). According to that conception, understanding involves knowing *why* something is the case and cannot be otherwise. A complete science begins with very general axioms (such as the Principle of Non-Contradiction) as well as special principles (such as the definitions of the objects in its domain), and derives from these starting points (*archai*), through a series of syllogisms called “demonstrations”, all the other necessary facts. In order to qualify as starting points, the premises of these demonstrations must have certain features. In addition to being true, they must also be “primitive and immediate and better known than and prior to and causes of the conclusions” (*APo* I.2, 71b19-25). A premise is “primitive and immediate” (*prôtôn kai amesôn*) when there is no further explanation for it, no additional term that “mediates” the terms in the premise. (An assertion of the form “S is P” is mediated when there is some other term, R, that connects or mediates S and P. Immediate assertions, on the other hand, are such that no other term is needed to connect the terms occurring in them.) Definitions—the “indemonstrable posits” of the essence (94a9-11)—are, moreover, primitive and immediate. Since each complete branch of science must ultimately proceed from starting points that are primitive and immediate, and since definitions that signify the essence of the objects in the domain of any branch of science are primitive and immediate, those teleological explanations that cite definitions are naturally to be given first.

<sup>10</sup> Gotthelf 2012: 69 contrasts “ontological” with “pragmatic” or “epistemological” bases.

explanations as well. I propose that we read 639b11-16 as giving us one such argument, one that harnesses specifically epistemic considerations to support the priority of teleological explanations.

In contrast to the reading I am proposing, the passage is more often read as concerned with the *causal* priority of ends over efficient causal processes.<sup>11</sup> Aristotle's point is typically taken to be that the end of a process of generation is causally prior to the process of generation, being its causal origin (*archê*). This is in fact a point Aristotle makes a page later, at 640a10ff, where it is put in terms of the priority of being (*ousia*) over generation (*genesis*). In that later passage, Aristotle is asking whether the proper procedure is to try to explain how natural beings *come to be*, or whether one should also focus on the *beings* that come to be. Aristotle opts for the second: he thinks that one must investigate the beings—the ends that come to be—and not merely the processes whereby they are formed. Empedocles was wrong, Aristotle says there, to think that a vertebrate's spine is due to its twisting about during the process of generation; in fact, the process of generation involves twisting *in order to* produce that sort of backbone. In Aristotle's view, characteristics of generated beings causally determine features of their formation: generation is for the sake of being, not the reverse.

Although closely related, I do not think that Aristotle is merely anticipating that same point in section [A]. In this earlier passage, he is asking which of two different kinds of causes, the final or the efficient, is naturally "first". At 640a10, he turns to discuss the phenomena that those different kinds of causes are invoked to explain. That is, section [A] is about which type of *explanans* should be given first, whereas the later passage is about what the *explananda* should be, and these are different issues. After all, both types of causal explanations can be given for each of the two kinds of phenomena. Facts about the being (the *ousia*), such as an organism having certain parts or engaging in certain activities, are explained by citing both the purpose served (the final cause) and that which brings the part about (the efficient cause). Similarly, questions about generation (the *genesis*), such as why a process occurs in a specific way, are answered by citing both its final cause as well as its efficient cause.<sup>12</sup>

So, on my reading, Aristotle's concern here is with the order in which causal explanations are to be given, *if* one is to have unqualified understanding of living beings. Teleological explanations make understanding possible since answers to "for the sake of what?" questions are (or lead back to) statements of the essences—definitions—that are not subject to further explanation. The "for the sake of which" is the definition and the definition is the starting point.

This interpretation of the focus of the passage is supported by the analogy with artisans that he immediately proceeds to draw:

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<sup>11</sup> For example, Lennox 2001a: 125 takes the *logos* identified as the *archê* to be not the definition which serves as the starting point of explanation, but rather as the "content" of such a definition—the end—which is the causal origin of the process that will bring it about.

<sup>12</sup> In *GA* II.6, 742a16-b17, Aristotle gives teleological explanations for the order of body part development, for instance.

For once the doctor has defined health, and the builder has defined house, either by thought or perception, they provide the accounts and the causes of each of the things they produce, and the reason why it must be produced in this way. Yet that for the sake of which and the good are present more in the works of nature than in those of art. [A](iii) (639b16-21)

Here Aristotle observes that artisans begin with a definition of the product, whether that be a house or health, and from that definition proceed to give the accounts and causes of each thing they do, explaining why certain things *must* be done. That is, the artisan is depicted as proceeding from a conception of the end product, either “in thought or perception”, to the necessary means to achieving that end.<sup>13</sup> The same is true of explanations in natural science. The natural scientist, like the artisan, begins from a definition of the end and proceeds to explain what *must* occur in order for that end to be achieved.

If we read the analogy as supporting the priority of teleological explanations, as I have just done, the analogy is between how the artisan reasons and how the *natural scientist* proceeds. If instead we were to read the analogy as supporting the priority of final causation, this analogy would be between the artisan and *nature*. But on that reading, it is not clear how apt the analogy would be. For, in the example, the end is depicted as guiding the artisan’s reasoning, and it is difficult to see what is meant to be playing an analogous role in the case of nature’s operation. Nature is not a quasi-intentional agent, in Aristotle’s view, and so there is no obvious candidate for something in natural objects corresponding to the artisan.<sup>14</sup> It is more straightforward, for this reason, to take Aristotle to be comparing the artisan and natural scientist here, his point being simply that definitions are appropriate starting points of a natural scientist’s reasoning, just as they are for artisans.<sup>15</sup>

## II Necessity is “on an assumption” (*ex hupotheseôs*): [B]

After giving this argument for the priority of teleological explanations, Aristotle next raises a complaint about attempts to reduce explanations to “necessity”. His remarks are directed at those who try to explain natural generation by identifying temporally prior states of matter as the causes of what results “of necessity” from them. He elsewhere describes these theorists as holding that “because the hot and the cold and each of those things is naturally such as it is, therefore certain

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<sup>13</sup> This part of artistic production Aristotle elsewhere calls *noesis*: reasoning from a grasp of the end to be achieved (or from the form in the artist’s soul) to the steps one can take to produce it. See, e.g., *Metaph.* VII.7 1032b15-17 and *passim*.

<sup>14</sup> This issue is noted by Lennox 2001a: 126 and Kullmann 2007: 282-3. Lennox *ibid*: 132 proposes that the analogous element is the *dunamis* for producing an organism, present in the seed from the beginning. If we were compelled to identify something in natural beings that is analogous to the artist’s operation, this would be an attractive proposal. On my reading, however, we are not so compelled.

<sup>15</sup> This is the explicit point of analogy between craft and nature in *Physics* II.9: the end (*telos*) is the starting point (*archê*) not of activity (*praxis*) but of the reasoning (*logismos*) (200a22-24).

things are and come to be of necessity” (*Phys.* II.8, 198b12-16). Usually (*malista*), he says, the search for the causes of generation involves finding “what comes to be after what, and what first acted or was affected, and so always in succession” (*Phys* II.7, 198a34-5).<sup>16</sup> In Aristotle’s view, people “nowadays” incorrectly believe that because what is heavy naturally goes down and what is light naturally goes up, something else then results “of necessity” (cf. *Phys.* II.9, 199b35-200a5).

Although he thinks these people are mistaken about something, Aristotle also thinks that many natural changes are due to the nature of the matter involved, and often describes changes that are due to matter as being “due to necessity”.<sup>17</sup> Elsewhere he describes this way of being due to necessity—often called “material necessity” by interpreters—as being “in accordance with nature and impulse” (*APo* II.11, 94b37-95a1) or being “thus in respect of their character and nature” (*PA* I.1, 642a34-5). So, given his recognition of necessity as a cause, Aristotle is surely not objecting to their appeal to material necessity, as such. Nevertheless, there is something objectionable about their attempts to explain natural generation by appealing to it, which he proceeds to describe at 639b21:

And what is of necessity is not present in all natural things in the same way; yet nearly everyone attempts to refer their accounts back to it without having distinguished in how many ways “necessary” is said. That which is necessary without qualification is present in what is eternal, while that which is necessary from an assumption is present also<sup>18</sup> in all that is generated, as it is in artefacts such as a house or any other such thing. It is necessary that a certain sort of matter be present if there is to be a house or any other end, and this must come to be and be changed first, then that, and so on continuously up to the end and that for the sake of which each comes to be and is. It is the same way too with things that come to be by nature. [B] (639b21-30)

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<sup>16</sup> Although it is unclear whether it is an explanation that anyone had actually put forward or not, in *GA* II.1, 734a25-33 Aristotle calls “absurd” an account of the production of animal body parts which would involve mistaking the coming to be after (*meta*) something for coming to be *because of (dia)* something. A body part, or anything else, can only come to be *because of (dia)* something which has the form (in actuality) of whatever is being produced.

<sup>17</sup> To forestall possible confusion: I do not mean to suggest that Aristotle thinks that temporally prior states of matter necessitate later ones. (As will be discussed in the following section, this is at the heart of his subsequent criticism, beginning at 639a30.) For example, saying that fire “necessarily” goes up, or that it has a certain sort of effect when it interacts with other elemental powers “of necessity”, is expressing the idea that the latter is something that follows—logically, so to speak, not temporally—from the *nature* of fire. Thus, Aristotle describes this way of being due to necessity as being in accordance with something’s nature.

<sup>18</sup> Peter Isépy (Munich) is currently preparing an edition of *PA* based on the entire independent Greek, Latin and Arabic tradition, and his research shows that we need not retain the *kai*, translated “also” here. Stemmatically, either omitting or retaining it are possible. Without the *kai*, this sentence suggests that necessity in the realm of generated phenomena is exclusively *ex hupotheseôs*. (Balme 1972/92: 84 claims that the *kai* means “actually”, yielding the same idea, and as Isépy pointed out to me, the majority of modern translators simply translate as if it were not there.) With the *kai* retained, the sentence leaves open that both types apply to what is generated. If this is how we are to take it, then on the proposed interpretation of this contrast that I will offer, a natural thought is that the *haplôs* necessities would be those expressed by the definitions that serve as the indemonstrable principles of explanation. Alternatively, the *kai* could be connecting the *ex hupotheseôs* necessity in natural things with that present also in artefacts.

The criticism here is that “nearly everyone” overlooks a distinction between two ways something can be said to be “necessary”. Some things are necessary “absolutely” or “unqualifiedly” (*haplôs*) and others are<sup>19</sup> necessary “from an assumption” (*ex hupotheseôs*).<sup>20</sup> Because of their failure to recognize this distinction, there is some mistake those he is criticizing are making.

The way it is typically read, Aristotle is criticizing his predecessors for their failure to appeal to the *right* kind of necessity. They ought to appeal to necessity *ex hupotheseôs*, but they do not. That reading presupposes that Aristotle’s reference here to necessity *ex hupotheseôs* is to the type of necessity that Aristotle describes in passages such as the following:

We call the necessary that without which, as a condition, a thing cannot live, e.g. breathing and food are necessary for an animal -- for it is incapable of existing without these—and the conditions without which good cannot be or come to be, or without which we cannot get rid or be freed of evil, e.g. drinking the medicine is necessary in order that we may be cured of disease, and sailing to Aegina is necessary in order that we may get our money. (*Metaphysics* V.5,1015a20-26, Ross trans, modified)<sup>21</sup>

The type of necessity Aristotle describes here is usually called “hypothetical<sup>22</sup> necessity” or “conditional necessity” in the literature, and is presumably what Aristotle has in mind when explaining phenomena that are necessary *for an end*.<sup>23</sup> This kind of necessity is, for this reason, sometimes even described as a “special kind of necessity operative in teleological explanation.”<sup>24</sup> According to a reading of [B] which assumes this is what necessity “*ex hupotheseôs*” refers to, Aristotle’s complaint here is that his predecessors failed to recognize that there is a type of necessity associated with teleology that differs from the unqualified necessity applicable in other domains. As a result of their failure to recognize this other type of necessity, they use the wrong kind of necessity: they should be appealing to necessity *for an end*, but do not. This amounts to the charge that his predecessors ignored the cause “for the sake of which” and are being faulted for that neglect.

Although Aristotle does think that their failure to recognize that ends are causes in nature is a mistake, it seems his point is different here. For, as I will argue, necessity *ex hupotheseôs* does not refer to a special type of “teleological” necessity, i.e., being necessary *for an end*.

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<sup>19</sup> Or “are also”. See previous note.

<sup>20</sup> The apparent implication of this is that *only* necessity *haplôs* is applicable to what is eternal. I read this as restricted to eternal *natural* phenomena. On the interpretation I am going to propose, both types of necessity can apply to what is eternal but non-natural. For instance, mathematical theorems are necessary “from an assumption”, while mathematical axioms are necessary without qualification. However, Aristotle argues in *GC* II.11 that eternal natural phenomena, such as the cyclical rotation of celestial bodies, occur of necessity *haplôs*. (I will briefly return to this point in Section III.) I thank James Allen for urging me to clarify this.

<sup>21</sup> See also *PA* I.1, 642a7-8 and 642a32-4.

<sup>22</sup> Note that Aristotle does not use the phrase “*ex hupotheseôs*” when he describes this type of necessity.

<sup>23</sup> That Aristotle thinks ends necessitate what they are assumed to explain seems clear, but how that is supposed to work is notoriously difficult. See Stein 2016 for an illuminating discussion of these issues.

<sup>24</sup> Johnson 2005: 58

Consequently, the objection in [B]—that people overlook a distinction between ways “necessary” is said—is not to their failure to appeal to that teleological necessity. Accordingly, the bad result of their overlooking the distinction between ways “necessary” is said is not that they use the wrong kind (or that fail to use the *right* kind) of necessity. Instead, I will propose an alternative understanding of the distinction that Aristotle is referring to in [B]. On my proposal, the criticism of his predecessors is that their explanations are not grounded in starting points that are not themselves subject to further explanation. This construal of the distinction and the reading of [B] it yields thus connects this part of the passage with section [A]: “nearly everyone’s” explanations of generated natural phenomena that appeal to “necessity” alone fail to meet the demands on explanation that Aristotle has just claimed that final cause explanations *do* meet.

Before offering this alternative understanding of the phrase “necessity *ex hupotheseôs*”, I want to emphasize that I am not denying that Aristotle thinks being necessary for an end is a way of being necessary. Although there are many questions about why being needed for the sake of an end should render something *necessary*, it seems clear that Aristotle thinks it does. The proposal I am making is merely about what Aristotle is referring to when he qualifies necessity with the phrase “on an assumption” (*ex hupotheseôs*) and about how that way of being necessary differs from being necessary “without qualification” (*haplôs*). (On the construal I will suggest, what is necessary for an end is rather a *subset* of what is necessary *ex hupotheseôs*.)

Instead of seeing these phrases as contrasting a teleological, “conditional” or “hypothetical” necessity with a non-teleological, “unconditional” necessity, I propose we understand them to be contrasting the two ways of being necessary that Aristotle distinguishes in *Metaphysics* V.5, several lines after describing being necessary for the sake of an end:

Of some things the cause of being necessary is something different; of other things something different does not cause their necessity, but other things are necessary because of these things. (1015b9-11)

The difference expressed here has to do with *why* something is necessary. Some things, including generated phenomena, owe their being necessary to something else. These are necessary from an assumption (*ex hupotheseôs*), or as I will call it, “dependently” necessary. Geometrical theorems are a prime example of such dependent necessities: they owe their necessity to those definitions and axioms from which they follow. Other things, such as axioms and definitions, do not owe their necessity to anything else. These are simply (*haplôs*) necessary, or as I will call it, “independently” necessary.<sup>25</sup> On this view, the difference between the two ways of being necessary is not one of degree, and dependent necessities are no less necessary than independent necessities. Just as theorems of mathematics are necessary, though dependent for their being necessary on the self-grounded necessity of the axioms they are derived from, dependent necessities, in general, are

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<sup>25</sup> Stein 2016 refers to these as “derived” and “underived” necessities, and (in my view) correctly claims that being necessary for an end is a type of derived necessity. However, Stein does not suggest, as I do here, that we take this contrast to line up with that alluded to in the six passages where necessity *ex hupotheseôs* is explicitly mentioned.

dependent on independent necessities. The status of something's necessity is neither impugned by its being so "on an assumption" nor does it signal any demotion with respect to its being "incapable of being otherwise".

While a thorough defense of this construal of the distinction will require separate treatment, I will note here some of the reasons to doubt that necessity *ex hupotheseôs* is necessity for an end. There is nothing about the grammar of the phrase "*ex hupotheseôs*" that requires that we understand it to mean "for an end". On the contrary, as Jacob Rosen has argued, it is doubtful that the phrase *could* mean that.<sup>26</sup> More typically, Aristotle's use of the adverbial expressions "*ex hupotheseôs*" and "*haplôs*" tend to signify how something possesses a property, and has nothing to do goals or ends. In *Politics* III.5, 1278a3-6, for instance, children are said to possess their citizenship *ex hupotheseôs*, unlike adult men who are citizens *haplôs*. Moreover, relative to the frequency of the expression "hypothetical necessity" in the literature about Aristotle's teleology, there are extremely few instances of *ex hupotheseôs* used to qualify "necessity" in Aristotle's extant corpus—only *six*, in fact.<sup>27</sup> And although he gives numerous explanations of phenomena that are necessary for an end in *PA*, Aristotle never uses the phrase *ex hupotheseôs* to qualify "necessity" after this first chapter.

Nevertheless, we might think that necessity *ex hupotheseôs* must be closely associated with teleology, for Aristotle, since it appears in contexts where he is criticizing those predecessors who did not, as he did, appeal to ends in their explanations of natural phenomena. Moreover, the examples of dependent necessities that he gives are also often things necessary for ends. For instance, later in *PA* I.1 (642a2-13), Aristotle says that nourishment is necessary *ex hupotheseôs*, since it is not possible to live without it, using the same example as he does in *Metaphysics* V.5. This would appear on the surface to support the idea that necessity *ex hupotheseôs* is indeed necessity for an end.

However, we need not take this as conclusive evidence of that standard interpretation. For, on my proposed construal, it is natural to see why dependent necessity is related to Aristotle's belief in natural teleology: In the cases where something is necessary for an end, the ends are the upon which the necessity depends. So, it comes as no surprise that we find the majority of Aristotle's explicit references to a distinction between *haplôs* and *ex hupotheseôs* necessity in *Physics* II.9 and *PA* I.1. However, as I think, Aristotle's purposes in referring to this distinction are not the ones they are typically taken to be. For the same reason, it is not surprising that things necessary for ends are given as examples of things said to be necessary *ex hupotheseôs*, since these are obvious and salient instances of dependent necessities.

In fact, the passage (at 642a2-13) in which we find the second and only other occurrence in all of *PA* of the phrase "necessity *ex hupotheseôs*" is unclear in several respects, making it hard

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<sup>26</sup> See Rosen 2008.

<sup>27</sup> The contrast between necessity *ex hupotheseôs* and *haplôs* occurs twice in *PA* I.1, twice in *Phys* II.9, once in *de Somno*, and once in *GC* II.11. Not all occurrences are universally considered to be referring to "hypothetical" necessity. Lennox ("Are Aristotelian Species Eternal?" in Lennox 2001b: 138), for instance, denies that this is what is meant in *GC* II.11.

determine the purpose for which it appears there at all. Here, we are told that there are two causes, the “for the sake of which” and “of necessity”. (Given that contrast, “of necessity” here is unlikely to be necessity for an end.) Aristotle then turns to a “puzzle” that someone might raise (*an tis aporêseie*): what kind of necessity do they mean when they say “of necessity”? However, it is not clear whether “they” refers to Aristotle’s own explanations, to Plato’s discussion in the *Timaeus*, to Democritus, or someone else. Whoever’s appeals to necessity he has in mind, Aristotle says it cannot be one of those ways of being necessary<sup>28</sup> from the “philosophical discussions” (*en tois kata philosophian*), though it is not clear whether he is referring to discussions found in *Posterior Analytics*, *Metaphysics*, or *Physics*, to “scientific treatises in general” (Louis 1957), or to something else, perhaps a lost treatise, *On Philosophy*. Aristotle next points out that in generated things, there is “the third” kind of necessity, which is then illustrated by the example (nourishment) that was also used in the *Metaphysics* V.5 discussion of necessity. It is at the point that Aristotle adds that “this” (*touto*) is “*hôsper*” a necessity *ex hupotheseôs*, though it is not certain whether “this” refers back only to the last example (nourishment), or to the third kind of necessity being introduced in this passage. (As Ogle (*ad loc*) rightly notes, read in the latter way, it is “strange” that he is introducing this as if it were something new, given that Aristotle has already spoken about this, in our passage [B].) Whatever “this” is, is Aristotle articulating what “necessity *ex hupotheseôs*” means, or instead claiming that nourishment is an *instance* of it? That is, does *hôsper* indicate (as I think the Greek suggests) that something is “example of” or “just like” a necessity *ex hupotheseôs*, or that it “may be called” (Ogle) or is, “as it were” (Balme, Lennox) one? The passage deserves more scrutiny, since this is one of our key pieces of evidence, but it is far from certain that Aristotle means for this to be an “exposition of his theory” of necessity *ex hupotheseôs*.<sup>29</sup>

Further, whereas it would seem mysterious, as Rosen points out, why Aristotle would use the expression “*ex hupotheseôs*” to mean “for an end”, I think there is a plausible explanation for Aristotle’s use of it to indicate that something’s status is “dependent” in the way I am suggesting. Although we most often call a proposition an “hypothesis” in English to indicate that it stands in need of proof or is itself something to be tested, that is neither the case for uses of *hypothesis* in Greek, generally, nor true, in particular, of Aristotle’s uses of it. For instance, he refers to the starting points of reasoning (*archai*) in theoretical sciences as *hypotheses* (*EE* II.11, 1227b29). Such starting points of science are not considered provisional or in need of confirmation.<sup>30</sup> In many cases, an *hypothesis* seems to refer to something “set down” in order to examine or establish something else, as for instance in the Greek mathematicians’ practice of reasoning “from a

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<sup>28</sup> If one of the rejected kinds of necessity includes “material” necessity, Aristotle’s statement here seems flatly contradicted by his practices throughout the remainder of *PA* (as discussed by Lennox 2001:150 and Cooper 1987: 266ff). This is yet another puzzling features of this passage, which Balme 1992:100 described as “one of Aristotle’s clearest statements that all natural necessity is reducible to teleological necessity”, a claim he later retracted (Balme 1987:285) while nevertheless maintaining that the view is “suggested” (*ibid.*, n.33) by the passage.

<sup>29</sup> As Cooper 1987: 267 describes it.

<sup>30</sup> In *NE* VII.8, 1151a17, *hai hupotheseis* in mathematics, just as the *to hou heneka* in actions, are the starting points (*archai*). And again, *hai hupotheseis* of *apodeixeis* are called the *archai* “from which the things (*pragma*) are first known” (*Metaph* V.1, 1013a14-16).

hypothesis”. Much about this practice is disputed, but we know that Plato was familiar with it, and Aristotle refers explicitly to procedures (such as “analysis”) with which this practice was associated.<sup>31</sup> As Plato seems to use the phrase, a proposition is an *hypothesis* not because it is held only tentatively, but because it stands in relation to some other proposition—one said to be “from a hypothesis”—as its grounds or support.<sup>32</sup> It is plausible that when Aristotle uses the qualifying phrase *ex hupotheseôs*, there is an expectation that it be heard as conveying this notion of being “dependent upon” something else.

This construal of necessity *ex hupotheseôs* and *haplôs* as dependent and independent necessity is also supported by *Physics* II.9, where we find Aristotle’s most extended discussion of *ex hupotheseôs* necessity. Most of the literature on that chapter has focussed on his examples, such as walls, saws, and houses, which are the products of goal-directed artificial processes. However, far less attention has been paid to the mathematical examples used in the second part of *Physics* II.9. These examples are mentioned just after Aristotle rejects the prevalent view that natural outcomes come to be as a result of the matter’s natural propensities to behave in certain ways. That view, he says, is as absurd as believing that an artifact, e.g., a wall, comes to be of necessity, in virtue of the fact that heavy things such as bricks and stones naturally move downward, and light things such as wooden beams naturally go up. The comment Aristotle then makes, whose significance is not often registered, is that necessity in mathematics and in what is naturally generated is “in a certain way similar” (*tropon tina paraplêsiôs*) (200a16). Clearly, this does not mean that in both cases necessity is for an end, since Aristotle does not think that there are ends or goals in mathematics. So, what does this mean?

The similarity Aristotle goes on to describe has to do with a certain asymmetry exhibited in both domains. In natural and artificial generation, the ends are not necessary because of the presence of the matter and its changes, rather the reverse is true: the matter’s presence and its changes are necessary on the assumption that certain ends will come to be. In other words, the matter is *dependently* necessary. That is true, moreover, despite the fact that *if* the matter and its changes were not present, those ends would not come to be. No saw or house would come to be, if not for the presence of iron and stones (200a28-9). Similarly, in mathematics, geometrical definitions and axioms are not necessary because of the truth of the theorems that follow from them, rather the reverse is the case: theorems are necessary on the assumption that the definitions and axioms from which they follow are true. Aristotle illustrates this point with the theorem stating that the internal angles of a triangle sum to “two rights”. That theorem—2R—owes its being necessary to the geometrical principles—the hypotheses, definitions and axioms—from which it is derived, e.g., that parallel lines never meet.

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<sup>31</sup> For discussions see Robinson 1941, Huffman 1993a, Menn 2002, Morrison 2015 and Malink 2017.

<sup>32</sup> Robinson 1941 (chapters VII-X) provides a good entry into the variety of uses of “hypothesis” and the “hypothetical method” in Plato, arguing that Plato “regarded an hypothesis as a proposition posited in order to prove something else and not a proposition posited in order to be itself tested” (1941: 112). That idea is supported by the meaning of the verb *hupotithemai* from which it is derived, which according to Robinson is “to posit as a start, as a preparation for future activity, for something else” (*ibid*). One might also treat the proposition posited—the *hypothesis*—as the proposition to be tested, but that is not necessary.

For, since the straight is *this*, it is necessary that the angles of a triangle should equal two rights. (200a16-18)

As with other geometrical theorems, 2R is *dependently* necessary, for it is necessary on the assumption that the axioms and definitions hold.<sup>33</sup> That is true, moreover, despite the fact that those definitions, axioms, and hypotheses would not be true if the theorems derived from them were not also true (200a29-30).

On the construal of the distinction I am proposing, necessity is “in a certain way similar” in this respect: in mathematics, the *archai* make what follows from them necessary, though the *archai* are not made necessary by the conclusion; in generation, the ends make the matter and its changes necessary, but are not made necessary by the matter and its changes. On this reading, all mathematical theorems are necessary *ex hupotheseôs*, but this does not impugn the necessity of those theorems.<sup>34</sup> It rather indicates a way in which theorems are distinct from the indemonstrable definitions and axioms on which they depend. And this is a point of similarity between mathematics and the subject of investigation by the natural scientist.<sup>35</sup>

This interpretation of the distinction requires more argument than I am giving here, but I hope to have shown that it is at least possible. It is also, I think, preferable. This interpretation provides a reading of [B] that is attractive in at least the following three respects: First, according to this interpretation, when Aristotle complains here that theorists do not appreciate that necessity is “from an assumption”, the emphasis is not on *what* that assumption is that makes something necessary—ends or goals—but on the fact that *there is* an assumption that makes it necessary. Unlike the standard reading, this renders Aristotle’s criticism in [B] compelling even to someone who does not believe that there are ends in nature, since he is not simply saying that those accounts have not cited the goal that the other things are only necessary *for*. That would not be heard as an objection at all by someone who does not think there are goals. Rather, Aristotle is merely assuming here that explanations—if they are to yield knowledge—cannot go on *ad infinitum*.

Second, if we take this to be the intended contrast between the ways of being necessary referred to in [B], Aristotle’s first criticism is building on his preceding remarks. He just argued (in section [A]) that teleological explanations are naturally first because they proceed from self-explanatory starting points. Implicit there was the thought that explanation, if it is to yield understanding, must begin with something that is self-explanatory, something not subject to further

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<sup>33</sup> Although Aristotle does not call 2R “necessary *ex hupotheseôs*” in *Physics* II.9, in *de Caelo* I.12, 2R is given as an example of something impossible *ex hupotheseôs*: “It is impossible for a triangle to have two rights, if such and such (*ei tade*)” (281b5-6). Since, for Aristotle, “impossible” is equivalent to “necessarily not” (*APr.* I.13, 32a22-4; *De Int* 13, 22a19-20, 22b5-6), one might take this to suggest that theorems are necessary (or necessarily not) *ex hupotheseôs*.

<sup>34</sup> I have not found any evidence that Aristotle thinks all mathematical truths are necessary *haplôs*. He does say that all *haplôs* necessities are eternal (*NE* VI.2, 1139b23-4), though that is compatible with there being eternal truths (such as mathematical theorems) that are *not* necessary *haplôs*.

<sup>35</sup> There is, however, an important respect in which things are “reversed” in mathematics and natural science, as I will mention in the next section.

explanation. Aristotle is now, in [B], criticizing those who treat all necessity as if it were alike. In particular, such theorists are faulted for overlooking the difference between independent and dependent necessity. Dependent necessities are not self-explanatory, since there is some *other* reason why they are necessary. Further, much of what occurs “of necessity” in generation—both of natural and of artificial products—does so only on an assumption. For example, foundations are laid of necessity, but only on the assumption that a house will be constructed. So, since the “necessities” these theorists appeal to are dependent, those who attempt to “refer their accounts back” to necessity wrongly posit as an *archê* something that is not an *archê*. What is necessary only dependently is not an adequate starting point for explanation, and thus their attempts at explanation cannot yield understanding.

Third, this reading of the complaint—that something that is not really an *archê* is being treated as if it were an *archê*—is one that Aristotle also makes elsewhere. On this proposal, Aristotle’s claim in *PA* that his predecessors do not recognize that naturally generated phenomena are necessary *ex hupotheseôs* amounts to the charge that they begin their accounts from something that is not really an *archê*: Since there is some other cause for those putative starting points of explanation being “necessary”, they are not indemonstrable or self-explanatory. In *GA* II.6, Aristotle criticizes people such as Democritus, who treat the fact that things are “always” a certain way as if it were an *archê* of explanation. However, as Aristotle points out, many things that are “always” a certain way are not thereby self-explanatory, but in fact are demonstrable. For instance, although geometrical theorems are always true, one can explain why they hold by showing that they follow from definitions and axioms:

Yet on this line of argument, on the strength of which they undertake to dispense with trying to discover the cause, there will be no demonstration of any single one of the eternal things. It is obvious, however, that demonstrations of many of these (some of them things which always come to be, some things which always are) do exist. For instance, the angles of a triangle are always equal to two right angles, and the diagonal of a square is always incommensurate with the side; in both of these cases we have something eternal, yet there is a cause for them and they are demonstrable. (*GA* II.6 742b23-29, Peck trans.)

He also raises this criticism of Democritus’ account of the existence of motion:

And, in general, to think that this is a sufficient principle (*archê*), that something always is or comes to be in this way, is an erroneous assumption. It is to this that Democritus reduces natural explanation, saying that this is how things happened in the past also. He does not think it is requisite to seek a principle of what is always the case. It is right to say this for some cases, but wrong to say it for all. For instance, a triangle always has its interior angles equal to 180 degrees; but all the same there is some further cause of its being everlasting. (*Physics* VIII.1, 252a32-b4, Graham trans.)

On the alternative proposed, Aristotle is making the same criticism in *PA*. Just as saying that something is “always” the case is not thereby to provide an *archê*, neither is saying something is “necessary”. For many natural phenomena, that which is necessary is so dependently, i.e., it is dependent on some assumption that makes it necessary. In such cases, one will not have offered an explanation that begins from an *archê* without citing that assumption. In Aristotle’s view, one does this by beginning ultimately from items such as definitions, as he claims that teleological explanations do. That is why teleological explanations are naturally to be given first.

### III The *tropos* of demonstration and necessity is different: [C]

As I have proposed we read [B], Aristotle criticized his predecessors’ attempts to explain natural generation on the grounds that explanations, if they are to yield understanding, must not go on indefinitely. Those explanations that appeal only to necessity do not proceed from indemonstrable starting points, at least not when the necessity cited is “on an assumption”. Next, in section [C], Aristotle raises a second criticism of accounts that appeal solely to necessity, again from the point of view of demands on explanation. In short, *explananda* are expected to be entailed by the *explanantia*,<sup>36</sup> and those explanations being criticized fail to fulfill this expectation. This section begins with a claim whose meaning is far from obvious:

“But<sup>37</sup> the manner (*tropos*) of demonstration and of necessity is different in the case of both the natural (*physikê*)<sup>38</sup> and the theoretical sciences (*tôn theoretikôn epistemôn*). [C](i) (639b30-640a2)

Interpreters of these lines disagree about nearly every point of detail, as well as its overall argumentative purpose and its relation to the surrounding context. There is general agreement that

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<sup>36</sup> As with the assumption that explanations must begin from self-explanatory starting points, there are stronger and weaker readings of this idea, depending on how much of Aristotle’s own formal theory of explanation one thinks is being imported here. In *Posterior Analytics*, the idea that the *explanandum* is necessitated by the *explanans* is exemplified by the fact that a demonstration is a type of syllogism, in which the conclusions are entailed by the premises. But Aristotle also treats as widely shared the idea that understanding involves knowing why something “is not possible to be otherwise” (*APo* I.2, 71b9-12). For instance, he takes for granted that explanations ought to entail what they purport to explain when he complains that theorists such as Democritus “do not state the necessity of the ‘why’ (*dia ti*)” (*GA* II.6, 742b18).

<sup>37</sup> It is unclear why this sentence begins with an adversative connective (*alla*). In line with the interpretation I will suggest, it could be intended to correct a misconception one may have formed, given Aristotle’s immediately previous description of the continuous (*ephexês*) causal sequence of matter’s necessary changes. The thought would be that although it must be the case (*dei*) that various changes take place in a certain order (i.e., that something occurs first, then something else, and so on until the end is brought about), one should not mistakenly take this to imply that the direction of causation and explanation goes from what happens earlier to what happens later.

<sup>38</sup> The unexpressed noun being modified by *physikê* might be *apodeixis* or *anangkê* instead of *epistêmê*. As far as I can tell, it would make no difference for my interpretation.

it concerns the “manner” or “mode” of explanation, and most interpreters have understood Aristotle’s claim that this is “different” to mean that there are different models of explanation applicable to different domains of inquiry. But there is neither any consensus about what those domains are, e.g., whether he is distinguishing natural science from a “theoretical” science such as mathematics, nor about what those models are or how they differ from one another.<sup>39</sup> Since natural science is elsewhere classified as a type of theoretical inquiry (e.g., *Metaphysics* 1025b24ff), some scholars think it is unlikely that Aristotle here is contrasting the two. Moreover, although this difference in “manner” of demonstration is assumed to be related to the comments about necessity made in [B], it is neither easy to see how a division between two kinds of inquiries aligns with the distinction between ways of being necessary (on anyone’s construal of that distinction), nor clear how such a division coheres with the examples (“health” and “human”) given in the lines that follow.

Rather than taking Aristotle to be contrasting the manner of explanation in natural science with the manner of explanation in theoretical sciences, it is possible to understand him to be contrasting these both with *something else*. In my view, that third thing from which the manner of “demonstration and necessity” in natural science and theoretical inquiries differs is what those predecessors mistakenly take it to be. That is, Aristotle is not contrasting different but equally acceptable types of explanations, but rather he is contrasting the *correct* ways of explaining natural generation with the *incorrect* attempts to do so. As I read [C], Aristotle is continuing the critique of certain non-teleological explanations offered by his predecessors that he began in [B]. Implicit here in [C] is the thought that successful explanations must necessitate what they explain, and those theorists who attempt to offer explanations that appeal to antecedent states of matter fail, for that reason, to give good explanations. For, in Aristotle’s view, inferences cannot proceed in the temporal direction in which these other people think that they can.

Aristotle immediately goes on to remark, in [C](ii), that he has already discussed this point about the manner of “demonstration and necessity”. I take him to be referring to his discussions in *Posterior Analytics* II.12<sup>40</sup> and *Generation and Corruption* II.11. In these chapters, Aristotle denies that what is temporally prior can entail what is temporally posterior.<sup>41</sup> In *APo* II.12, Aristotle

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<sup>39</sup> Some options can be found in Ogle 1912, Pellegrin 1982, Balme 1992, Düring 1980, Grene 1985, Gotthelf 1987b, Charles 1988, Lloyd 1996, Lennox 2001a, Lennox 2010d, Johnson 2005, Kullmann 2007, Leunissen 2010b.

<sup>40</sup> Leunissen 2010b:50-2 also takes this as a reference to *APo* II.12, though for different reasons than mine. In Leunissen’s view, Aristotle is concerned in *APo* II.12 to extend his theory of demonstrations (a theory that treats mathematics as its paradigm) to explanations of changes, i.e., to explanations whose relata are not simultaneous, but occur in a temporal sequence. This extension is then relevant in *PA* 1.1, where Aristotle is establishing various methodological procedures for inquiry into the natural world, especially those inquiries about subjects that are generated. In Leunissen’s view, the *APo* II.12 discussion provides the “blueprint” for further modifications to the theory of demonstrations that are needed for explaining such naturally generated subjects. (Although I see the relevance of *APo* II.12 differently, her reading provides a compelling response to Lloyd’s charge that the theory as presented in *APo* leaves us unprepared for a “variety of modes of demonstration” (Lloyd 1996: 32) of the sort that many take Aristotle to be introducing in this passage.)

<sup>41</sup> Whether Aristotle is consistent on this point is disputed. For instance, Williams 1982: 200 claims that although this view is expressed here in *PA*, as well as in *APo* II.12, 95a27-31 and *Phys.* II.9, 199b34-200b8, Aristotle “seems to

argues that while there can be deductions from what is posterior (*apo tou husterou*), there cannot be deductions from what is prior (*apo tou proterou*): One cannot say that since this so and so (earlier) has come to be, this (later) so and so has come to be (*APo* 95a27-31).<sup>42</sup> In *GC* II.11, he brings up this idea in connection with a question concerning whether anything that comes to be (later) is made necessary by something earlier. Although both chapters are difficult, it is clear that Aristotle is preoccupied in these discussions with the illegitimacy of inferences from the temporally prior to posterior. Consequently, those discussions in *APo* and *GC* are relevant to Aristotle's purposes here in *PA*, where he is rejecting the idea that temporally antecedent material conditions can explain what occurs later in time.<sup>43</sup>

However, the relevance of the discussions in those chapters to Aristotle's treatment of methodological norms in *PA* I.1 is rarely acknowledged. Although it is widely observed that the issue under consideration has something to do with the temporal order of the explanatory relation, the fact that he is rejecting altogether the legitimacy of inferences that go from earlier to later is not. According to some interpreters, for instance, the cross-reference at 640a2-3 is to *Physics* II.9, where Aristotle claims that things are "reversed" (200a19) in mathematics and natural science.<sup>44</sup> In that *Physics* passage, Aristotle refers to the changes that lead up to the end (and which are derived from it) as "things before" (*ta emprosthen*). This might suggest that the discussion there has to do with the temporal relation between *explanans* and *explanandum*. But there are no temporal relations in mathematics, and on closer examination, the fact that the conclusions in natural science are the "earlier things" is not relevant to the point he is making in *Physics* II.9. There, the sense in which natural science and mathematics are "reversed" is that in the former, the matter is the conclusion, and in the latter, the matter is the starting point. That is, in explanations in natural science, the matter is the conclusion derived from the *telos*,<sup>45</sup> whereas in mathematics, the definitions, axioms, and hypotheses are the "matter" of the geometrical theorems they entail.<sup>46</sup> But that difference between mathematics and natural science is not in view in *PA*. Rather, [C] is

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envisage" the opposite in *Metaph.* E.3, 1027a29-b16. According to Williams, that opposite view is "not without support from other passages in the corpus" (*ibid*), though he gives no reference to any passage.

<sup>42</sup> The reasoning there is not easy, and it is not clear how the point about inferences is connected to claims about causality. Kelsey (ms.), e.g., reads Aristotle as making a claim about causality (*viz.*, that what is in the past does not cause what is in the future) *by way of* a claim about deductions. Alternatively, in Leunissen's view, Aristotle countenances causation of later by earlier, but denies there are corresponding valid inferences from those (earlier) causes to their (later) effects. Such inferences are not valid, on her interpretation, because "there will always be a moment when the cause has occurred but not yet its effect, such that at that intermediate time inferences from cause to effect will be false" (Leunissen 2010b: 43).

<sup>43</sup> On this point I disagree with Leunissen 2010b, who takes Aristotle to be allowing in *PA* I.1 that explanations of eternal, non-teleological phenomena can begin from temporally prior starting points. The lesson from *APo* II.12 being applied in *PA* I.1 does not seem to me to be that inferences from earlier to later are acceptable *in certain cases*, but rather that they *never* are.

<sup>44</sup> E.g., Balme 1972/92: 84-5, Cooper 1987: 269 n.29, and Gotthelf 1987b: 197.

<sup>45</sup> As already mentioned, Aristotle makes it explicit here (at 200a24) that the *telos* is the *archê* of the reasoning (*logismos*) in natural science.

<sup>46</sup> Aristotle says this explicitly in *Phys* II.3, 195a16-19. See Malink 2017 for illumination of this claim.

reflecting Aristotle's concerns about some particular issues that arise for explanations of non-simultaneous happenings, such as natural generation.

For the starting point in some cases is *what is*, and in other cases is *what will be*. For, since health or human *is* such, it is necessary that this such and such *is* or *comes to be*. But it is not the case that since this such and such *is* or *has come to be*, that such and such from necessity *is* or *will be*. [C](iii) (640a3-640a6)

Here, in *PA*, he points out that some explanations might begin from what *is* the case and proceed to legitimately infer that something else *is* the case, and some might begin from what *will be* in the future and proceed to legitimately infer that something else *has* or *will have* come to be (earlier).<sup>47</sup> In no case, however, can explanations of natural generation begin from what is or has come to be earlier and proceed to infer what will be later.<sup>48</sup> That is, Aristotle is denying that inferences can proceed from the prior to the posterior, and registers this now as his second complaint: these theorists who cite the “necessity” of the matter and its changes to bring about certain effects get the temporal direction of inference all wrong. Aristotle is reminding us here that antecedent conditions do not necessitate later ones, as he discussed in *APo* and *GC*.

In fact, in [C] Aristotle immediately makes a second reference to *APo* II.12 and *GC* II.11, now because those passages also address certain exceptions to the rule that Aristotle has just been criticizing others for violating:

Nor is it possible to connect the necessity in such a demonstration into eternity, with the result that one says, ‘Since *this* is, therefore *that* is’. (These matters too have been determined elsewhere—in what sorts of things necessity is present, what sort of necessity converts, and owing to what cause.) [C](iv) (640a6-9)

On my interpretation, Aristotle has just censured explanations that proceed from what is temporally prior on the grounds that they do not entail what they purport to explain. For, as discussed in *APo* and *GC*, one cannot legitimately reason that something is or will be of necessity, given that something else is or has come to be. However, there are certain exceptional cases—namely, eternally recurring, cyclical processes—that are also discussed in those same chapters of *APo* and *GC* and to which he is alluding in [C]. In *GC*, sequences of happenings that occur eternally and cyclically, such as winter and summer solstices, are conceived of as importantly different from

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<sup>47</sup> I read the *tois men/tois de* clause as indefinite, rather than as corresponding to either the two *epistemai* just mentioned or to their corresponding *apodeixeis*. (In either case, as noted by Lloyd 1996: 31, one would expect feminine articles *tei* or *tais* instead of the neuter *tois*.) These describe two different but equally legitimate ways that explanations can proceed: in some cases (*tois men*) the starting point is “what is”, and in some cases (*tois de*) the starting point is “what will be”.

<sup>48</sup> This would imply that Aristotle's own explanatory appeals to material and efficient causes should not be understood as inferences from what is earlier to what is later. Although beyond the scope of this chapter, that is a welcome result, in my view.

non-cyclical processes, such as natural generation, that occur “in a straight line” (*GC* II.11, 338b11). In *APo*, Aristotle appears to envision explanations of these cyclical phenomena as taking the form of circular proofs; even if the necessity with which any member of a cyclical sequence occurs is dependent on something else occurring later, the necessity can be “connected to eternity” since it will “come round in a circle” (*APo* II.12, 96a6). Explanations of cyclical and eternal phenomena are exceptional in that they can involve, in a certain way, inferences from the prior to the posterior. In fact, in these specific cases, inferences can be viewed as proceeding in both directions, i.e., from later to earlier as well as the reverse. But, as I understand Aristotle’s reasoning, that is because any stage that is “later” than another stage in an eternal cycle is also going to be “earlier” than it, and so there is “conversion”. Since in demonstrations of cyclical phenomena, what is “earlier” is also “later” and vice versa, there is thus a sense in which it is possible for the later to be deduced from the earlier.

So, there are some cases, namely cyclical and eternal phenomena, in which an appeal to what is earlier are permissible. However—and this is the point he makes in 640a6-9—natural generation is not among those cases. In explanations of natural generation, the earlier and later stages do not “convert”, as they might in explanations of eternal and cyclical phenomena. So, as Aristotle argues here, those who try to account for generation by appealing to antecedent states of matter have not succeeded in giving explanations of the sort required for understanding.

#### **IV Conclusion**

This chapter advanced a reading of 639b11-640a9 that treats the passage as a unit, in which Aristotle is pursuing a single aim and is proceeding with a particular preoccupation that fits the local context. This passage begins by arguing that teleological explanations ought to be given first. As I understand his argument, it is that teleological explanations are to be given first because they proceed from self-explanatory starting points, namely, the definitions of the phenomena being explained. Consequently, teleological explanations serve to ground the whole body of causal explanations that ultimately constitute each branch of natural science. In addition, in this passage Aristotle identifies two specific epistemological defects of certain non-teleological explanations: First, those who appeal only to “necessity” are being charged with offering explanations that are not properly grounded. They appeal to “necessity” as if that were an adequate *archê* of explanation, i.e., as if it were self-explanatory. But what is “necessary” is not always self-explanatory. Many cases of necessity, especially as it applies to naturally generated phenomena, are only necessary “on an assumption”. Second, Aristotle thinks that an explanation should show why what is being explained cannot be otherwise: an *explanandum* ought to be entailed by the *explanans*. But those accounts of natural generation that appeal to material necessity alone are defective in this respect as well. For, these accounts cite antecedent conditions, such as the presence of a certain type of matter, as reasons for the occurrence of natural phenomena. However, antecedent conditions do not necessitate later ones, and thus do not explain them.

On my reading, we can see criticisms of Aristotle’s predecessors that are not often visible. Aristotle is not merely faulting others for not doing what *he* does. He is not criticizing them because they fail to give teleological explanations, but instead arguing that their attempts to explain natural phenomena do not satisfy some rudimentary conditions on explanation and understanding. Understood in this light, the passage at 639b11-640a9 provides us with valuable insights into why Aristotle insists upon the indispensability of teleological explanations. In this passage, he is driven by concerns about the possibility of applying the ideals for scientific understanding to a world in which there is contingency, and in which things do not occur simultaneously, but unfold over time.<sup>49</sup>

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