

Teleological Perspectives in Aristotle's Biology¹

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Aristotle is one of the strongest proponents in the history of western philosophy of natural teleology, the view that natural phenomena are “for the sake of something” (*beneka tinos*).² Criticisms of his materialist predecessors for their failure to seek the purposes for which “nature acts” are ubiquitous in Aristotle’s corpus. However, “nature” is not equivalent to a Platonic Demiurge in Aristotle’s system, and his god is no intelligent designer. So, although hardly anyone today would claim that for Aristotle teleological explanations have merely heuristic value,³ it is difficult to determine precisely what he is committed to. For instance, we share Aristotle’s view that organisms have certain parts and features *because* having these enables them to flourish. But we think this depends on a more fundamental explanation—presumably one involving the theory of evolution. Aristotle, however, does not think teleological explanations are merely derivative. Rather, he thinks that ends or purposes are directly responsible for the occurrence and character of many biological phenomena.

¹ I am grateful to Sophia Connell, Joe Karbowski, Jim Lennox, Harvey Lederman, Tom Marré, Jessica Moss, Kara Richardson, and Nat Stein for their valuable feedback on earlier versions of this chapter.

² As is well known, Aristotle thought that there were four ways of being a cause (*aitia*). These are introduced in *Ph.* 2.3, and are standardly called the formal, final, efficient (also sometimes called the moving or productive), and material causes. Briefly, the formal cause is the “what it is” or “essence,” the final cause the “what it is for” or “end,” the efficient cause is the “whence it is” or “source,” and the material cause is “that out of which it is.” About a half century ago, some scholars who found all but the efficient cause to appear strikingly unlike any modern conception of a *cause* suggested characterizing these as different “*because*s” or different modes of explanation. (The interpretation of an Aristotelian *aitia* as an “epistemological notion” is, for instance, lauded in Annas 1982: 319ff., where one can also find references to literature advocating this view.) Today that approach is less prevalent, and scholars are more open to the idea that Aristotle recognized some types of causal relations that we, today, might not.

³ The idea that teleological explanations are, for Aristotle, “mere” explanations is nowadays only brought up in order to be dismissed. See Cameron 2010: 1100 with footnotes 8 and 9 for references to discussions of this issue.

So, what does that mean? Some of the more obvious (though implausible) ways of construing the sense in which ends are causes must, at any rate, be ruled out: Aristotle does not believe in backwards causation, and he does not believe that a divine creator assigns purposes to nature. So, whatever underwrites Aristotle's belief that ends are the reasons why biological phenomena occur in the ways that they do, it is neither a commitment to some mysterious efficient causal force from the future, nor a belief in an intelligent designer. Moreover, although he often appeals to analogies between art (*technê*) and nature (*phusis*), there is no evidence that he thinks that natures are volitional, and the fact that artists form intentions is not the important point of similarity between the natural and artistic realms.⁴

There is also no consensus as to the precise complaint Aristotle has with his predecessors' explanations—neither about *what* he thinks his predecessors failed to explain, nor *why* he thinks non-teleological explanations are defective. According to some, teleology is grounded in the “causal inadequacy” of material level factors. Alternatively, some think that while material level factors might be causally adequate to bring something about, Aristotle's complaint about giving only non-teleological explanations is that they leave something else unexplained, such as the fact that the thing being caused is *good*. For others, Aristotle's insistence on teleological explanations reflects a deep disagreement with his materialist predecessors about which phenomena stand in need of any explanation in the first place.⁵

Among natural phenomena, those associated with life exhibit apparent purposiveness to an exceptional degree. Thus it is no surprise that the idea that there are natural ends or purposes (*telê*) is a guiding assumption in Aristotle's biology, and so an examination of his use of teleological explanations in the biological treatises can provide valuable insight into his views about teleology more generally. In his biological works, Aristotle appeals to teleological explanations primarily in two domains: they explain biological processes, such as animal generation, as well as facts, such as the fact that some given kind of organisms has some particular feature. It will be helpful, consequently, to

⁴ See Kelsey 2011 for a plausible alternative reading of an argument for natural teleology at *Ph.* 2.8.199a8ff that has often been read as evincing a commitment to intentionality in nature. See also Bolton 2015: 129ff.

⁵ This last way of understanding Aristotle's complaint, which is persuasively argued for by Sauvé Meyer 1992, situates the disagreement between Aristotle and his predecessors squarely within a metaphysical debate about what the real substances (*ousiai*) are.

begin by addressing these separately, since it is useful to think of teleological explanations of processes and of facts as answers to two different questions: *To what end is this change or process occurring?* and *For what reason does this group of organisms have this feature?* When we see how Aristotle conceives of the merits of giving answers to these questions in his biology, and the deficiencies of failing to ask the questions, we can better understand both what his commitment to teleology is and why he thinks it is warranted.

Generation (*genesis*) is for the sake of being (*ousia*)

Aristotle thinks it should be evident to everyone that at least some natural processes have a regular and stable feature, namely, the reproduction of organisms of a certain kind from organisms of that same kind.⁶ For him, this regular production of human from human and ox from ox licenses, minimally, the inference that there is no mere chance connection between what he calls “seed” (*sperma*) and what comes to be out of it.

Surely it is not any chance thing that comes to be from each seed, nor a chance seed which comes from a chance body; rather *this* one comes from *that* one. (*PA* 1.1.641b26-8)⁷

So, Aristotle thinks the regularity with which organisms of some kind are generated out of organisms of the same kind is evidence that this cannot be due to chance. He also thinks the regular generation of organisms the same in kind as their generator evinces something stronger: the process of generation has the character it does because of the end (*telos*) for whose sake the process takes place.⁸ To see why Aristotle would think this is warranted, it is helpful to consider someone, perhaps

⁶ As Aristotle puts the point, “human generates human.” See *Ph.* 2.1.193b12; 2.7.198a26-7; *Metaph.* 7.7.1032a25; 7.8.1033b33.

⁷ *Ph.* 2.8: “Each principle gives rise, not to the same thing in all cases, nor to any chance thing, but always to something proceeding towards the same thing, if there is no impediment.” (199b17-18, Charlton trans.) All translations of *PA* are those in Lennox 2001a.

⁸ See Code 1997 for an argument supporting this line of interpretation. I am putting aside two exceptions: the production of hybrids and spontaneously generated organisms, both of which Aristotle

Empedocles, who acknowledges that organisms are regularly generated having parts and features that are useful for performing various functions, yet nevertheless thinks that the generative process can be fully explained in terms of the movements and interactions of the material factors involved, such as earth, air, fire and water. As Aristotle describes him, Empedocles thinks that it is sufficient to describe the causal sequence these material factors concurrently undergo, and to treat the result as something that simply falls out (*sumpesein*)⁹ as a result of “necessity”.¹⁰

Aristotle thinks this cannot be right. He acknowledges that the process of generation cannot take place without the “necessary nature” of the matter—the material basis, as it were, of the process. He has no objection to the idea that there can be necessary effects of combinations of elemental powers.¹¹ His objection is rather to the Empedoclean opponent’s failure to view these material processes as comprising a single, unified change, and unified precisely in virtue of their all being in the business of bringing about a specific sort of end.

Heat and cold (which is deprivation of heat) are both employed by nature. Each has the power, grounded in necessity, of making one thing into this and another thing into that; but in the case of the forming of the embryo it is for a purpose that their power of heating and cooling make it such, partly owing to necessity, partly for a purpose—

goes to some length to try to accommodate (*GA* 3.11 and 2.8, respectively). For discussions of these interesting cases, see Burnyeat 2001, Gotthelf 1989, and Lennox 1982.

⁹ *Ph.* 2.8.198b27.

¹⁰ It is helpful to label this “natural necessity” (*pephuken*) in order to distinguish it from other ways of being necessary, which will be discussed below. What I am calling “natural necessity” is often referred to in the literature as “Democritean”, “simple” or “material” necessity. Natural necessity is what Aristotle says “everyone” (*Ph.* 2.8.198b12) refers to, believing it adequate to account for natural phenomena such as the formation of teeth, (*Ph.* 2.8.198b24-7), and which he says is appealed to by those who think a wall comes to be formed “of necessity” because light things naturally go up, and heavy things naturally go down (*Ph.* 2.9.200a2-5). I am taking this to be the kind of necessity Aristotle describes at *A. Po.* 2.11.94b36ff as being in accordance with something’s nature (*kata phusin*).

¹¹ The particular ways in which elemental powers combine so as to produce particular qualities or dispositional properties is described in *Mete.* 4.8ff.

sinew solid and elastic, bone solid and brittle. (*GA* 2.6.743a36-b5, Peck 1942 trans., slightly modified)

In Aristotle's theory, those factors that are thought by the materialist to exhaust the factors required for generation are really just subordinate causes.¹² Those subordinate, material level causes would not be making a causal contribution towards any specific end if not for the nature, form or soul¹³ that uses them. This is just as it happens in cases of artistic production as well, when an artist uses subordinate causal processes to bring about the products of art (*technê*):

And as in speaking of an axe or any other instrument, we should not say that it was made solely by fire, so we should not say this about a foot or a hand, nor, similarly, of flesh either, because there is function of this also. As for hardness, softness, toughness, brittleness and the rest of such qualities which belong to the parts that have soul in them, heat and cold may very well produce these, but they certainly do not produce the *logos*¹⁴ in virtue of which the one is now flesh and the other bone. Rather, the movement derived from the generator who is in actuality that which the material out of which the offspring is formed is in potential [produces that *logos*]. The very same thing applies to things formed in accordance with art. For, heat and cold may soften

¹² This is an application to the case of generation of living organisms of a general principle Aristotle repeats outside of the biological treatises. See, e.g., the criticism of a materialist theory (perhaps that of some Pythagoreans) that treats “the hot” and “the cold” as causes of generation and decay as appealing to powers that are “too instrumental” (*lian organikas*) at *GC* 2.9.336a1-12.

¹³ Aristotle uses “nature” (*phusis*), “form” (*eidos*) and “soul” (*psychê*) interchangeably in this context, as they all refer to the same thing in the case of living beings. He also slides between treating as the agent of these processes the generator on the one hand, and the generator's nature, form or soul on the other, just as he does with an artisan and the art possessed by the artisan.

¹⁴ *Logos* is a difficult word to translate and so, following Peck, I leave it transliterated. A *logos* can refer to any significant unit of expression, from a word to a story or even a ratio or formula, and sometimes even means “account” or “definition”, and so sometimes elliptically refers to what that account or definition refers to (i.e., an essence). See Peck 1942: xliv for a helpful note on this point.

and harden the iron, but they do not produce the sword. This is done by the movement of the tools, which has the *logos* of the art. For the art is the principle and form of the thing being made, but in another. But nature's movement is in [the product being formed], derived from another natural being having the form in actuality. (*GA* 2.1.734b28-735a4, Peck 1942 trans., modified)

So, Aristotle finds it just as implausible to attribute the generation of a living being to the material factors involved (even if they are necessarily involved) as it would be to say the materials that an artist employed were responsible for the resulting artifact. Rather, just as an artist (or, as Aristotle will sometimes say, the *techné* possessed by the artist) is responsible for the products of art, a living being (or the form or nature possessed by the living being) is responsible for the process of generation.¹⁵

Unlike human artistic practices, however, many biological phenomena do not involve volitions or intentions, and it is natural to wonder whether we can make sense of end-directed processes without these. One influential approach addresses this worry by conceiving of what it is to be for the sake of something in terms of powers or potentials (*dunamis*) for given outcomes: An organism comes to be for the sake of something if it is the realization of a potential for an organism of that form.¹⁶ The acorn—the oak seed—is something that has an internal potential for generating an oak tree, and the generative process is the realization of that potential for generating an oak. It is in that sense that the oak tree is that for the sake of which the process occurred: its generation is the realization of a potential for an oak.

Once it is put this way, however, one might wonder why we are not merely saying something about the *efficient* cause, namely, that efficient causes are in the business of bringing about specific sorts of effects. Proponents of the “potential for form” approach have in fact been accused of conflating efficient and final causes, of treating the end as merely a “feature” of an efficient cause, or even of reducing teleology to a type of efficient causation.¹⁷ Instead, some have thought that the distinctive contribution of Aristotle's “cause as *telos*” resides in its being something good. One version of this

¹⁵ For a helpful discussion of Aristotle's invocation of an *art* as a cause in certain contexts, rather than an artisan, see Menn 2002.

¹⁶ See Gotthelf 1976/1977 for a sustained defense of this interpretation.

¹⁷ See, e.g., Bolton 2015: 133 and Charles 2012: 232-8.

view advocates understanding Aristotle's natural teleology on the model of intentional action. In actions, the end or goal serves as a cause in virtue of an agent being "sensitive" to the goodness of the goal and of the means to achieve it, where this involves the agent being guided by an awareness of the goodness of the goal and goodness of the means to it.¹⁸

Although it is true that Aristotle thinks ends are good, it is not clear whether this can ultimately yield a fruitful way to understand the way in which ends are responsible for the processes leading up to them in the absence of any rational agent. In fact, the treatment of final causation as analyzable in terms of potentials for particular outcomes might be more plausible than some critics claim. That there should be a close connection between the cause "whence the motion"—the efficient cause—and cause "as end" is unsurprising, at any rate, since Aristotle is explicit that these two causes are correlative with one another.¹⁹ Efficient causes are not, for Aristotle, "aimless," but are the sources or origins of motion for specific changes. His teleology is not contrasted with mechanism or mechanical necessity, but rather with chaos.²⁰

Natural Purposes

So far, we have been discussing Aristotle's insistence that the end of the generative process is responsible for the character of that process. Contrary to what someone such as Empedocles thinks, "coming to be (*genesis*) is for the sake of being (*ousia*)," and not the reverse:

That is precisely why Empedocles misspoke when he said that many things are present in animals because of how things happened during generation—for example, that the backbone is such as it is because it happened to get broken through being twisted. He failed to understand, first, that seed already constituted with this sort of potential must be present, and second, that its producer was prior—not only in account but also in time. For one human being generates another; consequently, it is on account of that

¹⁸ This approach is defended in Charles 1988 and more recently in Charles 2012.

¹⁹ The final cause "lies opposite" the efficient cause. (*Metaph.* 1.3.983a30-1).

²⁰ The assumption that efficient causes should be conceived of on the model of billiard balls is a modern one, and it has no place in Aristotle's thinking about the cause he calls the *arché*—the beginning, source, or origin—of change. Efficient causation is not "mechanism" or "mechanical" causation.

one being such as it is that this one's generation turns out a certain way. (*PA* 1.1.640a19-26)

But for what purpose does an animal have the sort of backbone it does? To what use are these particular structures put by this kind of animal? To what end do these animals engage (or not engage) in this sort of activity? His commitment to there being answers to such questions is one of the most distinctive features of Aristotle's inquiries into the living world.

For Aristotle, in order to know why some body part or organ is present or why it has the features it does, one must have some grasp of what it *does*. He thinks that “nature makes the organs for the functions” (*PA* 4.12.694b13) and that “the parts are for the sake of the functions in relation to which each of them has naturally developed” (*PA* 1.5.645b19-20).²¹ His predecessors went wrong because they did not appreciate this, and thus offered improbable and even conflicting accounts of biological phenomena.

The very cause of those people not speaking well about these things is both their being inexperienced with the internal parts, and their not grasping that nature does everything for the sake of something. For, those inquiring for the sake of *what* respiration occurs in animals and focusing in on the parts, e.g. on the gills and the lungs, would discover the reason more quickly. (*Resp.* 3.471b23-29)

Aristotle's biological research, on the other hand, revolves around the search for ends. He appeals to purposes to explain why a certain group of organisms—sometimes one that lacks a common name, such as the “lung possessors”²²—have some characteristic or feature. Purposes also explain variations among parts, such as variations in size, shape, and position, and even in material

²¹ I translate *ergon* as “function” here, though to the extent that it suggests a designer who assigned functions to parts, it is misleading. It would be better to render it “work,” which is etymologically related to *ergon*. “Work,” like *ergon* (as Aristotle uses it), is neutral between processes and products. For instance, Aristotle says both that a plant has no other *ergon* or activity (*praxis*) except the generation (*genesis*) of seed (*GA* 1.23.731a24-6), and also that the *ergon* of animals (and of plants) is what results from that process, *viz.* seed and fruit (*GA* 1.4.717a21-2).

²² On the significance of “nameless” kinds, see Lennox 1987.

composition. Moreover, while there is usually a single use for each part, Aristotle will occasionally point to a second way an organism makes use of its parts as well. For instance, teeth are primarily for the sake of nourishment (i.e., to assist in breaking up the food the animal eats), though in some animals they are also useful for strength and defense (*PA* 3.1.661a36-b6).

The purposes cited are typically activities or functions: lungs are present in the creatures that have them for the sake of breathing (*PA* 3.6.669b8-9). In some cases, however, a part is not used to perform some vital function, but rather contributes to an organism's life in some other way. Some parts are useful as a means of protection or defense, such as hair (*PA* 2.14.658b6-8), horns (*PA* 3.2.662b27) and stingers (*GA* 3.10.759b1-5). And some have no other purpose than to provide assistance, as the kidneys assist with the functioning of the bladder (*PA* 3.7.670b23-7).²³

Purposes are cited not only to explain why certain kinds *have* certain parts, but also why certain kinds *lack* parts that one might reasonably expect them to have. For example, although snakes move on land, unlike other land-dwellers, they lack feet; if they had feet, their movement would be too slow, given their body length.²⁴ It would be pointless for snakes to have feet, and “nature does nothing in vain, but always out of the possibilities what is best for the being concerning each kind of animal” (*LA* 2.704b15-7).²⁵ This “optimality principle”—the idea that nature does nothing in vain or pointless—is stated explicitly several times, but it is often implicit: Aristotle will often say that some part or feature, while present in organisms in the wider kind, would be unnecessary or pointless for some particular group of animals. For instance, octopuses do not have proboscises (unlike cuttlefish and squid) because they have feet instead for the functions that other “soft-bodied” organisms use proboscises to perform (*PA* 4.9.685b2-3).

There is a risk of misunderstanding Aristotle's view, however. For one thing, most scholars do not think that the nature who does nothing pointless is some overarching Dame Nature,

²³ Leunissen 2010, Ch. 3 argues that there are two distinct kinds of teleological causation at work, which she calls “primary” and “secondary” teleology. On this interpretation, parts that are products of primary teleology are those necessary for performing essential functions (“vital and essential parts”), whereas the products of secondary teleology either contribute to necessary functions or perform non-necessary functions (“subsidiary” and “luxury” parts). See Frey 2012 for a critique.

²⁴ *LA* 8.708a9-20.

²⁵ Cf. *GA* 5.8.788b20-2.

providential deity, or cosmic craftsperson.²⁶ Rather, “nature” is typically taken as referring collectively to the particular *natures*—conceived of as non-volitional sources of change—of individual organisms.²⁷ Moreover, his outlook is certainly not as Panglossian as “nothing in vain” may misleadingly suggest. For instance, despite his saying that “each of the parts of the body is for the sake of something” (*PA* 1.5.645b14-5), Aristotle elsewhere makes clear that he does not think that absolutely each and every part or feature of an organism must be present for a purpose.²⁸ In addition to those characteristics that are for the sake of something, there are some that are formed during the process of generation, and whose causes need to be located in the “putting together itself” (*en autê tēi sustasei*) (*GA* 5.1, 778b15). He says, for example, that a kind of animal may have eyes for the sake of something, since animals must have eyes if they are to see, when seeing is essential to animals of that kind. However, a particular color of eyes need not be for the sake of anything (*GA* 5.1.778b16-9).

Furthermore, he recognizes that some phenomena are not merely indifferent, but may actually deleterious. Bile, for instance, is simply a “useless” residue, which like many other phenomena, is produced “from necessity” (*PA* 4.2.677a15-8). However, Aristotle’s views about necessity—and in particular how it is related to teleology—are complex.

Necessity

In addition to the “nature” that does nothing in vain or without a point—which is sometimes referred to in the literature as the “formal nature”—Aristotle thinks that living organisms also have a “necessary nature” or “nature as matter.”²⁹ This “material nature” (as it is sometimes called) is occasionally said to be responsible for what occurs when “things are thus in respect of their character and nature” (*PA* 1.1.642a34-5). In such cases, Aristotle says the cause is “necessity”:³⁰

²⁶ Balme 1987: 275; Henry 2013: 230-1; Johnson 2005: 80-1; Judson 2005: 361; Lennox 1995 as reprinted in Lennox 2001b: 183-4.

²⁷ As Lennox observes, Aristotle’s metaphorical use of language from human craft to describe the agency of an organism’s nature should not be taken as implying that natures or souls are only metaphorically *agents*. See Lennox 1995 as reprinted in Lennox 2001b: 202-3, fn. 14.

²⁸ Such parts are discussed in *GA* 5.1. See Gotthelf and Leunissen 2010.

²⁹ See, e.g., *Ph.* 2.2.194a13-5.

³⁰ See note 10.

Therefore there are these two causes, the cause for the sake of which and the cause from necessity; for many things come to be because it is a necessity. (*PA* 1.1.642a1-3)

As an illustration, he describes how someone might appeal to this way of being necessary to explain how breathing works:

For it is necessary for the hot to go out and enter again upon meeting resistance, and for the air to flow in. This is directly necessary; and it is as the internal heat retreats during the cooling of the external air that inhalation and exhalation occur. (*PA* 1.1.642a35-b2)³¹

Natural necessity, i.e., the sort of necessity whereby earth will naturally sink towards the center of the universe, is sometimes thought to stand in contrast to teleology. Aristotle's predecessors, for instance, are described in *Physics* 2.9 as maintaining that natural phenomena occur merely "of necessity" and not, as Aristotle thinks, for the sake of something. Caution is needed, however, since Aristotle does not think that natural necessity is incompatible with teleology. In giving biological explanations, he will often combine explanations by appeal to natural necessity with teleological ones. Many biological phenomena are said to occur both because of natural necessity and "for the sake of the better" or "for the sake of something."³² For instance, a membrane is formed around the developing fetus "of necessity" because the surface is solidified by heating, but also is for the sake of something, since the fetus needs to be kept separate from the surrounding liquid.³³ This is also how he makes sense of the abundance of hair on human beings' heads:

With respect to the head, mankind is the most hairy of animals, *from necessity*, on account of the moistness of the brain and on account of the sutures (for where there

³¹ This does not seem to be the way that *Aristotle* understands breathing (cf. *Resp.* 21.480a25-b6). However, it does suit his purposes here, since it is an explanation that invokes natural necessity, i.e., what occurs because it is in accordance with the nature of, e.g., hot and cold.

³² A list of examples from the biological treatises can be found in Connell 2016: 331.

³³ *GA* 2.4.739b26-30.

is much moisture and heat there must be much growth), and *for the sake of* protection, so that it may provide a covering, warding off the extremes of both cold and heat. (*PA* 2.14.658b2-7)

There is another use of “necessity”, however, that is commonly used in conjunction with teleological explanations. This other way of being necessary is to be such that something or other is not possible without it—it is *needed* for some end.³⁴ For example, it is necessary for axe blades to be made of bronze or iron since they need to be hard, and necessary for them to be hard since they need to perform the function of an axe, namely, to split wood.³⁵ Aristotle illustrates being needed as follows:

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. (*PA* 1.1.639b26-30)

Being needed for an end—which is often referred to as “hypothetical” or “conditional” necessity³⁶—is sometimes contrasted with “the better,” as when Aristotle says that “nature does everything either on account of the necessary or on account of the better” at *GA* 1.4.717a15-6. Here the contrast is between a) what occurs because something else could not otherwise obtain, and b) what occurs because it is optimal. In this particular passage in *GA*, Aristotle is explaining why an organism has testicles by appeal to the fact that, although not needed, it is better to have them. He knows that testicles have something to do with reproduction, but he does not think they are needed: If they were needed, they would be present in all male animals, but he thinks fish and serpents lack them. Rather than being needed, they are present because they “make the movement of spermatic residues steadier”

³⁴ I borrow this way of referring to this kind of necessity from Jacob Rosen (ms.). As Rosen argues, it is not clear that by saying something is necessary “on an assumption” (*ex hypothesēs*) Aristotle means it is necessary *for an end*, which is the idea meant to be captured with “needed”.

³⁵ *PA* 1.1.642a9-11.

³⁶ It is important to keep in mind that although these are sometimes called cases of “conditional” necessity, they are not mere necessary conditions, as Stein 2016 discusses.

by pulling down and twisting the spermatic passages (*GA* 1.4.717a29-36). Thus the presence of testicles is better for the organisms that have them.

There are, then, at least two things Aristotle calls “necessity” in his biological explanations.³⁷ There is one that is closely allied with teleology insofar as being necessary in this way is needed *for some end*, and there is another that is associated with material elements and their natural tendencies to interact in particular ways.

But ‘necessity’ sometimes signifies that if that—i.e. that for the sake of which—is to be, it is necessary for these things to obtain, while at other times it signifies that things are thus in respect of their character and nature. (*PA* 1.1.642a32-5)

However, there are some appeals to necessity that appear to complicate this neat picture. For instance, there are cases where something is not needed for an end, but where it does not seem as though the necessity in question is natural necessity, either. For instance, a certain type of octopus has only a single row of suckers, rather than the more typical double-row. Aristotle says this is so not because it is best that they have only one row, but because it is “necessary owing to the distinctive account of their substantial being” (*PA* 4.9.685b15). For these slender octopuses, the single row of suckers is said to be necessary on account of “the length and thinness of their nature” (*PA* 4.9.685b12-3). Having suckers is useful for the octopus, since this is the means by which they grasp things; they are for “strength and other protective purposes” (*PA* 4.9.685b10-11). So, presumably, having more suckers would be better. But the size and shape of this particular slender octopus, here considered parts of its substantial being (*ousia*) or “what it *is*,” prevent this.³⁸ In his commentary on this passage, Lennox calls

³⁷ I say “at least” two, because some scholars think that what I have called natural necessity conflates two different types: the one which is operative in contexts where there is not also teleology (“simple”) and one which is operative alongside teleology. For references to distinctions between different kinds of necessity outside of the biological works, see *Metaph.* 5.5 and *A. Po.* 2.11.94b36ff. It is uncertain how the types of necessity mentioned in those two passages are related to each other or to those in the biology. See Cooper 1987: 259-60, Balme 1972/92: 100, and Lennox 2001a: 148-9 for discussion of the issues.

³⁸ One might wonder why Aristotle deems it legitimate to treat some features or aspects of the body as simply part of an organism’s nature, and others as requiring an explanation, and what the principled

this “definitional” necessity, since it seems to follow directly from a feature which is included in the definition of the organism.³⁹ It is not obvious how such a case should be categorized, since it is neither clearly a case of a part or feature being required by some functional demand, given some vital activity, nor clearly a case of something being due to the necessary nature of the matter, since Aristotle seems to think it follows from a constraint imposed by the substantial being of the organism.⁴⁰

The Scope of Teleology

At the very end of his summary of the four causes in *Ph.* 1.7, Aristotle describes a teleological explanation as one that says that something occurs “because it is better thus, not simply, but in relation to the being of each thing” (198b8-9). This has been called his “basic teleological axiom,”⁴¹ and many scholars read this as restricting the use of teleological explanations to explaining those parts and features that are “useful or advantageous from the animal’s viewpoint.”⁴² Although there are some remarks in the *Pol.* and *Metaph.* that suggest that Aristotle countenances teleological relations across kinds,⁴³ there is not much indication of this within his biological treatises. On one occasion he mentions that a feature of one kind of organism is of use to *another* kind of organism,⁴⁴ but otherwise

difference could be between parts whose presence does not require further explanation and parts whose presence does. However, it is worth keeping in mind that Aristotle is not trying to determine why each organism has the particular features it does, full stop, but how those features it does have serve the organism in carrying out its distinctive life. It would perhaps be understandable if he took some part that has no obvious function, such as size, as simply a given fact about some kind, whereas something such as the elephant’s trunk would appear to him to demand an explanation.

³⁹ Lennox 2001a: 341.

⁴⁰ See Gotthelf 1985 for discussion of Aristotle’s treatment of features such as size and shape as part of the essence or being of organisms.

⁴¹ Lennox 2001a: 341.

⁴² Balme 1987: 277. See also Johnson 2005: 93; Judson 2005: 359-62; and the remarks in Balme 1972/1992: 96.

⁴³ *Pol.* 1.8.1256b7-22 and *Metaph.* 12.10.1075a11-25.

⁴⁴ At *PA* 4.13.696b27ff., Aristotle says that the placement of the dolphin and selachian mouth “appears” to have been made by nature for the sake of the preservation of the prey, since it requires

Aristotle's teleological explanations are "organism-centred".⁴⁵ This would also appear to be what he is recommending in his methodological introduction to *PA*:

Hence it would best to say that, since this is what it is to be a human being, on account of this it has these things; for it cannot be without these parts. If one cannot say this, one should say the next best thing, i.e. either that in general it cannot be otherwise, or that at least it is good thus. And these things follow. And since it is such, its generation necessarily happens in this way and is such as it is. (This is why this part comes to be first, then that one.) And in like manner one should speak in precisely this way about all of the things constituted by nature. (*PA* 1.1.640a33-b4)⁴⁶

For the most part, the teleological explanations in the biological treatises follow that pattern. Some aspect of an organism's *ousia*, e.g., how it procures food or mates, is the reason why it performs some vital function in a specific way. That vital function, in turn, either requires or is made better by some particular part or organ. That part or organ, moreover, might need to have some specific quality, which requires a specific sort of material, which in turn might give rise to some other need, and so on and so forth.

Aristotle's discussion of eyelids in *PA* 2.13.657a29ff is a nice illustration of this. Crook-taloned birds, he says, hunt their prey from up high. So, unlike fowl and other such birds that feed on the ground, they need to have sharp vision. For reasons he gives elsewhere, Aristotle thinks that sharpness

time to turn over and thus allows the prey to escape. (That placement is also said to be for counterbalancing the "gluttonous" ways of these creatures, as it keeps them from overeating.)

⁴⁵ See Henry 2015 for this terminology. Henry 2015 cites Aristotle's explanation of sexual dimorphism in *GA* 2.1 as a possible exception to the more typical, organism-centred perspective. Sedley 1991 argues that Aristotle does countenance teleological relations across kinds of organisms, and that his teleology is to be understood as anthropocentric. Sedley's arguments are compelling, but they do not speak against the point made here, which is solely about the kind of teleological explanations that are found in Aristotle's biological treatises.

⁴⁶ For divergent interpretations of this passage see Balme 1972/1992: 87; Code 1997: 139-142; Cooper 1987: 254-5; Gotthelf 1987 as reprinted in Gotthelf 2012: 175, and Gotthelf 1985 as reprinted in Gotthelf 2012: 219-220; Johnson 2005: 189; Kullman 1974: 37; Lennox 2001a: 134-5.

of vision requires eyes that are moist as opposed to hard.⁴⁷ However, because the high-flying raptors' eyes are moist, they are prone to injury, which they would not be if they were hard. So, these birds' eyes have protective coverings, namely, eyelids. In this way, Aristotle's biological explanation for the presence of eyelids interweaves functional demands, given a creature's way of life, with physical constraints, given the features of the material out of which their body parts are made.⁴⁸

As in almost every other example found in the biological treatises, here the organism's own being is ultimately what is preserved or maintained by the presence or character of the part or feature. It is interesting to observe, however, just how rich and subtle his conception of the individual's *being* is. Nostrils are for the sake of respiration, but the elephant's long nostril is for the sake of respiring in the particular way an elephant must, given that it procures its food in water (*PA* 2.16.659a29-33). The attachment and bending of legs is for progression, but for crocodiles and other crevice-dwellers, the bending is oblique to enable them to crawl easily into the holes (*LA* 15.713a15-25). Although Aristotle consistently demands an explanation of the fit between morphology and purpose, he never does so for the fit between a kind's morphology and the features of its natural dwelling place. He often claims that some kind of organism has some part or feature because it is useful, given where it lives, or needed, given how it hunts, or better, given what it eats. He does not think organisms evolved, however, so it is not as though he thinks they adapted to their environments over time. Rather, Aristotle seems to think of the activities that comprise the life of a kind of organism—its “being” (*ousia*)—as essentially involving the features which it interacts with in its environment.⁴⁹ An elephant is not simply a breather, for instance, but a breather-of-air-while-in-water.

⁴⁷ The connection between moist or fluidity of eyes and sharpness vision is discussed in *GA* 5.1.779b26ff.

⁴⁸ For the proposal that these material constraints should be understood as part of the essence of the kind, given their role in explanation, see. Gotthelf 1997a. See Gelber 2015b for a critique of that proposal.

⁴⁹ The precise nature of this involvement is not totally clear. According to Lennox, these are all aspects of an animal's “way of life” or *bios*, and this *bios* is what does the job of integrating all of an organism's vital functions and activities. (This is argued for in Lennox 2009 and 2010.) Alternatively, there is a case to be made for the idea that these are related to essential functions by being built into the very activities themselves. So, e.g., there is a generic description such as “walker” that is shared by

When one reads the biological treatises, one does not get the impression that Aristotle was ever concerned with providing reasons for their being the variety of organisms that there are. He does not ask why there is a kind of creature with this configuration of body parts at all, but rather “how does having this configuration promote the flourishing of that particular life form?”. Of course, this question might be absent because the local context is about biological kinds themselves and why certain animals have the parts and features they do, and thus he isn’t there taking a wider perspective. However, if Aristotle does think that there is a further purpose for the existence of the kinds of organisms there are—either because they promote some cosmic good or the good of humanity—this is not the perspective one finds him taking in his biology.

Further Reading

For a helpful typology of interpretive controversies concerning Aristotle’s natural teleology, see:

Gotthelf, A. 1997. “Understanding Aristotle’s Teleology,” in R. Hasking (ed.), *Final Causality in Nature and Human Affairs*, Washington D.C.: Catholic University Press, pp. 71–82. A revised, updated, and expanded version of this article is reprinted in A. Gotthelf, *Teleology, First Principles, and Scientific Method in Aristotle’s Biology*, Oxford: Oxford University Press, 2012, pp. 67-89.

On the connection between efficient causation and teleology, the following are helpful:

Tuozzo, T. 2014. “Aristotle and the Discovery of Efficient Causation” in Tad Schmaltz (ed.) *Efficient Causation: The History of a Concept*, Oxford University Press, 23-47.

Kelsey, S. (ms.) “Efficient Causality in Aristotle”.

For discussions of Aristotle’s appeal to the principle that “nature does nothing in vain,” see:

Gottlieb, P. and Sober, E. 2017 (online). “Aristotle on ‘Nature Does Nothing in Vain’ ” in *HOPOS: The Journal of the International Society for the History of Philosophy of Science*.
<https://doi.org/10.1086/693422>

Henry, D. 2013. “Optimality Reasoning in Aristotle’s Natural Teleology” in *Oxford Studies in Ancient Philosophy* XLV, 225-63.

organisms at one level of generality, but the particular form that walking takes for the cliff dweller is very different than that for the marsh dweller. See Gelber 2015a for the latter interpretation.

Lennox, J.G. 1997. "Nature does nothing in vain..." in *Beiträge zur antiken Philosophie. Festschrift für Wolfgang Kullmann, Herausgegeben von Hans-Christian Günther und Antonios Rengakos (mit einer Einleitung von Ernst Vogt)*, Stuttgart: Franz Steiner Verlag, 199-214. Reprinted in Lennox, 2001, *Aristotle's Philosophy of Biology: Studies in the Origins of Life Science (Cambridge Studies in Philosophy and Biology)*, Cambridge: Cambridge University Press, 205-223.

Leunissen, M. 2010. *Explanation and Teleology in Aristotle's Science of Nature*, Cambridge: Cambridge University Press, chapter 4.2. (Chapter 4 of Leunissen's book also contains a detailed survey of the various patterns of teleological explanation found in Aristotle's biology.)

For discussions of teleology and necessity, see:

Cooper, J. 1987. "Hypothetical Necessity and Natural Teleology," in A. Gotthelf and J. G. Lennox (eds.), *Philosophical Issues in Aristotle Biology*, Cambridge: Cambridge University Press, pp. 243–274.

Charles, D. 1988. "Aristotle on Hypothetical Necessity and Irreducibility," *Pacific Philosophical Quarterly*, 69: 1–53; reprinted in T. Irwin (ed.), *Classical Philosophy. Collected Papers*, New York/London: Routledge, pp. 27–80.

Rosen, J. (ms.) "The varieties of necessity in Aristotle's *Physics* II.9".

A sustained defense of a "global" interpretation of Aristotle's teleology can be found in:

Sedley, D. 1991. "Is Aristotle's Teleology Anthropocentric?" *Phronesis* 36: 179–197.

Sedley, D. 2000. "Metaphysics Lambda 10" in D. Charles and M. Frede (eds.) *Aristotle's Metaphysics Lambda: The Proceedings of the Fourteenth Symposium Aristotelicum*. Oxford University Press, 326-350.

Sedley, D. 2010. "Teleology, Aristotle and Plato," in R. Bolton and J. G. Lennox (eds.), *Being, Nature, and Life. Essays in Honor of Allan Gotthelf*, Cambridge: Cambridge University Press, pp. 5–29.

Responses to Sedley's interpretation are found in:

Bodnár, I. 2005. "Teleology across Natures," *Rhizai*, 2: 9–29.

Henry, D. 2015. "Aristotle on the Cosmological Significance of Animal Generation" in *Theory and Practice in Aristotle's Natural Science*, D. Ebrey (ed), Cambridge.

Judson, L. 2005. "Aristotelian Teleology," in *Oxford Studies in Ancient Philosophy* 29: 341–365.

Charles, D. 2015. "Teleological Causation" in *The Oxford Handbook of Aristotle*, C. Shields (ed.), Oxford.

Wardy, R. 1993. "Aristotelian Rainfall or the Lore of Averages," *Phronesis* 38: 18–30.