

CHAPTER TWO

Teleology in Aristotle

Mariska Leunissen

2.1. ARISTOTLE ON THE BEAUTY AND GOODNESS OF NATURE

In the first book of the *Parts of Animals*—which offers a methodological introduction to the study of animals—Aristotle offers an elaborate exhortation to the study of sublunary nature.¹ For even though

¹ “Since we have completed stating the way things appear to us about those [divine] things, it remains to speak about animal nature, omitting nothing in our power, whether of lesser or greater esteem.

For even in the study of the ones [i.e., animals] disagreeable to perception, the nature that crafted (*hē dēmiourgēsasa phusis*) them likewise provides extraordinary pleasures to those who are able to know their causes and are by nature philosophers. Surely it would be unreasonable and absurd for us to enjoy studying their representations—on the grounds that we are at the same time studying the art that made them, such as painting or sculpture—while not prizing even more the study of things constituted by nature, at least when we can observe their causes.

For this reason, we should not childishly be disgusted at examination of the less valuable animals. For in all natural things there is something wonderful (*ti thaumaston*). Just as Heraclitus

the heavenly bodies are the most divine and the most honorable, and even though knowledge about the heavenly realm yields the greatest pleasure,² thereby making cosmology one of the most respectable studies, Aristotle argues that the study of animals living in the sublunary world in fact takes the prize in terms of the expanse and thoroughness of our understanding, and that their study too offers extraordinary pleasure and wonder. The heart of this exhortation, however, is formed by Aristotle's appeal to natural teleology: it would be absurd, he claims, for us to enjoy the beauty of human depictions of animals and praise the art that went into their production if we did not also at the same time and even more praise the art and goodness that went into nature's production of those animals themselves. And, as the true philosopher will recognize, the sublunary realm is *full* of goodness and natural teleology: "that for the sake of which" pervades the natural world, thereby making it a worthy and wonderful domain for study.

As the analogy with representations of animals produced by human crafts makes clear, for Aristotle, animals—just like other natural things and the processes that bring them into being—are the result of a kind of craftsmanship and goodness that is *in their case* internal to and inherent in their own natures, that is, intrinsic in the goal-directed actions of their own internal, natural "principles of motion and rest." Natural teleology for Aristotle thus means that everything that exists or comes to be "by nature" comes to be or changes, unless prevented, for the sake of an end (*telos*) or function (*ergon*) that constitutes that

is said to have spoken to those strangers who wished to meet him, but who stopped as they were approaching when they saw him warming himself by the oven—he bade them to enter without fear, "for there are gods here too"—in the same way should one approach the investigation about each of the animals without disgust, since in all of them there is something natural and good (*kalou*). For what is not by chance but rather for the sake of something is in fact present most of all in the works of nature" (*Parts of Animals* I.5, 645a4–25). Aristotle's works are referred to by title and standard Bekker page numbers. They can be found in Aristotle's *Opera Omnia*, in *Thesaurus Linguae Graecae Canon of Greek Authors and Works*, 3rd ed., ed. Luci Berkowitz and Karl A. Squitieri (Oxford: Oxford University Press, 1990). All translations in this chapter are my own.

2. *Parts of Animals* I.5, 644b22–645a4.

thing's final cause, and it has the capacities, structure, and parts that it does for the sake of that final cause.

For Aristotle, the beauty, functionality, and goodness of the sublunary natural world is as manifest as the beauty and orderliness of the heavenly realm, and these awe-inspiring features of the universe can *only* be explained by reference to teleology,³ and specifically, in the sublunary realm, they can only be explained as the products of the "crafting" actions of goal-directed natures.

2.2. ARISTOTLE'S CONCEPTION OF "CRAFTING NATURES" AND IMMANENT, NATURAL TELEOLOGY

As in the earlier exhortation, when speaking about the natural generation of animals, Aristotle often personifies the internal natural principles that produce them as "craftsmen" that act for the sake of something while following a certain *logos* or "guideline" for building. These "crafting natures"—also referred to as "formal natures" by Aristotle, and which incorporate the efficient, final, and formal causes of animals and which are to be identified with their soul⁴—are *not* to be mistaken for some kind of overarching Father Nature who providentially and

³ In fact, Aristotle repeatedly offers the *a fortiori* argument that if one agrees that animals and plants neither come to be nor exist by spontaneity but for the sake of something, then the claim that spontaneity is the cause of the heavens—which is most divine and exhibits the greatest order—must be absurd, and that one has to conclude based on this that final causality pertains to the heavenly realm as well. See *Physics* II.4, 196a24–b5; *Physics* II.6, 198a1–13; and especially *Parts of Animals* I.1, 641b10–23: "In addition, natural science can pertain to nothing abstract, because nature makes everything for the sake of something. For it seems, just as in artifacts art is present, so too in things themselves there is some other principle and such cause, which like the hot and the cold we have from the universe. This is why it is more likely that the heavens have been brought into being by such a cause—if it has come to be—and is due to such a cause, than that the mortal animals have been. Certainly the ordered and definite are far more apparent in the heavens than around us, while the fluctuating and random are more apparent in the mortal sphere. Yet some people say that each of the animals is and comes to be by nature, while the heavens, in which there is not the slightest appearance of chance and disorder, were constituted in that way by chance and the spontaneous."

⁴ See especially *Parts of Animals* I.1, 641a23–28; *De Anima* II.1, 412a19–21; and *Generation of Animals* IV.4, 770b17. On formal natures, see also James G. Lennox, *Aristotle's Philosophy of Biology: Studies in the Origins of Life Science* (Cambridge: Cambridge University Press, 2001),

out of his own goodness created everything for the sake of something, forcing recalcitrant matter to take on the best and most functional shapes possible.

In fact, Aristotle rejects the external, divine, and providential model of teleology as presented, for instance, in Plato's *Timaeus*. According to "the likely account" provided in this Platonic treatise, the goodness and functionality of the world and its natural components are due to the goal-directed actions of an intelligent and divine craftsman—the "demiurge"—who organized and created everything in the best and most beautiful way possible, while imitating the perfect and eternal models constituted by the Platonic Forms. On this account, the world exists and is the best it can possibly be because it is the creation of one intelligent and good God who did his very best in creating it.⁵

For Aristotle, by contrast, the teleology of nature resides *in* the individual natural beings themselves: the crafting natures are *immanent in* the individual animals they produce and maintain, and their operating power is not one of intentionality or deliberation, but rather one of a complex and dynamic "realization of pre-existing potentials for form."⁶ That is, at the physiological level, when we translate Aristotle's talk of crafting natures or of natures acting or doing something for the sake of something into the processes that he thinks actually take place, physically speaking, natural teleology involves the realization of preexisting, internal potentials for form, as specified by the definition of the substantial being of the animal, and through stages shaped by what he calls "conditional necessity." In other words, the form of each animal

182–194. These "formal natures" are to be contrasted with animals' "material nature"—that is, their elemental constitution and the kinds of food they process.

5 On teleology in the *Timaeus*, see the chapter by Johansen in this volume. On the contrast between Plato's and Aristotle's conception of teleology, see Lennox, *Aristotle's Philosophy of Biology*, 182–204.

6 See Allan Gotthelf, "Aristotle's Conception of Final Causality," *Review of Metaphysics* 30 (1976–77): 226–254 and Mariska Leunissen and Allan Gotthelf, "What's Teleology Got to Do with It? A Reinterpretation of Aristotle's *Generation of Animals* V," *Phronesis* 55, no. 4 (2010): 342 for suggestions on how to cash out Aristotle's use of craft-language with respect to the goal-directed actions of nature in nonintentional, physiological terms.

specifies the functional features that need to be realized (e.g., the substantial being of birds defines these animals as flyers), and given that the animal has to realize its form, it has to have such and such parts (e.g., wings are required for flying) and such and such differentiations of parts (e.g., broad versus narrow wings), made of such and such constitutive materials, put in such and such a structure or configuration. Aristotle explains this conditional type of necessity that acts in the service of natural teleology as follows (*Parts of Animals* I.1, 642a7–12):

For we say nourishment is something necessary according to neither of those two modes of necessity, but because it is not possible to be without it. And this is as in the conditional type (*ex hypotheseōs*). For just as—since the axe must split—it is a necessity that it be hard, and if hard, then made of bronze or iron, so too since the body is an instrument (for each of the parts is for the sake of something, and likewise also the whole), it is therefore a necessity that it be of such a character and constituted from such things, if that is to be.⁷

On this account, the fully realized form (e.g., the mature, fully developed bird with wings that allow it to fly in the way that is required for its particular way of life) constitutes the individual final cause of the process, while the good of the whole emerges from individual natures doing what is best for them. The supreme divine being of Aristotle's metaphysical system, namely the "Unmoved Mover," who is the ultimate final cause of all natural motion in the world,⁸ exhibits no concerns for the world—which is eternal and uncreated—and has as its only activity the thinking of its own thoughts.

⁷ See also *Physics* II.9, 200a10–15; *Parts of Animals* I.1, 640a33–35; *Parts of Animals* I.1, 642a7–12; *Parts of Animals* IV.10, 689a20–21; and *Generation of Animals* V.1, 778b15–19.

⁸ According to Aristotle, the whole universe is teleologically organized toward this one perfect being that everything else desires to emulate: see *Metaphysics* XII.10, 1075a11–25; cf. *On the Heavens* II.12, 292b20–25.

In addition, and importantly, on this account, generation should be understood as being for the sake of being, and not the other way around, as some of Aristotle's predecessors thought (at least according to Aristotle). Empedocles, for instance, got this priority relation wrong, and is criticized by Aristotle for explaining the "being" of animals in terms of what happened to happen to them during generation (*Parts of Animals* I.1, 640a17–26):

For generation is for the sake of being, but being is not for the sake of generation. This is why Empedocles did not speak well when he said that many things belong to animals because they turned out that way during generation—for example, that the backbone is such because it happened to get broken when it was being twisted; he failed to see, first, that the seed previously constituted must already possess this sort of potentiality, and, next, that the producer was prior not only in definition but also in time; for it is a human being who generates a human being, such that it is because the one *is* such, that the other's coming to be happens in that way.⁹

Aristotle's reference here is to Empedocles's model of zoogony that occurs under the influence of Love. According to this, first, the coincidental interactions among the four Empedoclean elements water, air, fire, and earth produce animal tissues such as blood, flesh, and bone. Next, similar coincidental interactions between these tissues produce separate animal parts, such as foreheads and arms, but also backbones constituted from several previously disjointed bones stacked together in a random way. Once Love's influence is strong enough, these parts will randomly stick together, thereby forming all kinds of animals, including hybrids. For Empedocles, the resulting animal species and their bodily features are thus the way they are because of what happened to

9 Cf. *Generation of Animals* II.1, 735a3–4.

them during the process of generation, which itself is entirely governed by what Aristotle calls material necessity (i.e., materials acting in accordance with their own material natures, such as water necessarily freezing when the temperature drops below zero) and chance. And while Aristotle does not deny the causal influence of material necessity and chance on the generation of animals (more on that in section 2.3), what Empedocles gets crucially wrong according to Aristotle is that one cannot explain the regular occurrence of good outcomes of natural processes (such as “humans giving birth to humans”) by appealing to such causes alone, as simply being the coincidental outcomes of spontaneous combinations of material elements.

As Aristotle explains here, the core of his theory of teleology in natural generation is the fact that whatever organism comes to be already possesses its corresponding form in potentiality (where the process of generation is for the sake of realizing that form or the being of that animal), and that it receives that potentiality for form from something that already possesses that form in actuality. The process of natural generation involves the eternal replication of form (I will return to this in section 2.4), and this can only be explained through the assumption of nature—always or for the most part—operating as an internal efficient cause that acts for the sake of realizing those forms.

2.3. ARISTOTLE’S DEFENSE OF NATURAL TELEOLOGY

Aristotle argues for nature as an internal efficient cause being “among the causes that are for the sake of something” (*Physics* II.8, 198b10–12)—that is, for nature acting goal-directedly in natural productions—most explicitly in the following passage:

There is a difficulty: what prevents nature not to act for the sake of something or because it is better, but in the way Zeus rains, not in order to make the crops grow, but of necessity (for it is necessary that that which has gone up cools down, and what cools down

becomes water and falls down: when this has happened, it turns out that crops grow), and in the same way also that if someone's crops are ruined on the threshing floor, it does not rain for the sake of this, in order that they be spoiled, but that it happened to come about. So what prevents also parts in nature from being this way, for example, that teeth shoot up of necessity, the ones in the front sharp, with a fitness for tearing, the molars broad and useful for grinding down food—not because they came to be for the sake of this, but because they turned out that way. And similarly about the other parts, in as many as “that for the sake of something” seems to be present. Wherever then all [the parts] turned out in a way they would also [have done] if they had come to be for the sake of something, those survived, having been organized in a fitting way by spontaneity. As many as did not [turn out] in such a way perished and continue to perish, as Empedocles says about the man-faced ox progeny. This then is the argument about which one might be puzzled, and there may be others just like it. (*Physics* II.8, 198b16–34)

In this so-called “rainfall passage,”¹⁰ Aristotle raises a puzzle concerning the causal relation between natural processes and the goodness or badness of their outcomes, put in the mouth of a hypothetical materialist predecessor. That is, Aristotle's imaginary materialist objector conceptualizes the relationship between natural processes—such as the growth of crops, the coming to be of teeth in a way that is fitting for their function, or even the coming to be of complete, functional living beings—and their outcomes—such as their goodness or fittingness or functionality as an *accidental* one: natural things come to be due to

¹⁰ On this famous passage, see especially Lindsay Judson, “Aristotelian Teleology,” *Oxford Studies in Ancient Philosophy* 29 (2005): 341–366; Diana Quarantotto, *Causa finale, sostanza, essenza in Aristotele: Saggio sulla struttura dei processi teleologici naturali e sulla funzione dei telos* (Naples: Bibliopolis, 2005); Margaret Scharle, “Elemental Teleology in Aristotle's *Physics* II.8,” *Oxford Studies in Ancient Philosophy* 34 (2008): 147–183; and David Sedley, “Is Aristotle's Teleology Anthropocentric?,” *Phronesis* 36 (1991): 179–197.

material necessity and by chance they have outcomes that happen to be “good” (or “bad”). Aristotle, however, thinks that it is impossible that the outcomes of natural processes mentioned by the materialist are due to chance:

It is impossible that things are that way. For those things, and all things that are by nature, come to be that way either always or for the most part, and none of them belongs to things that are due to luck or spontaneity. For it does not seem to be due to luck or spontaneity that it rains often in wintertime, but [it does] when [it rains] during the dog days. Nor do heatwaves [seem that way] during the dog days, but [they do] when they occur in winter. If, then, it seems that [these things] are either by accident or for the sake of something, [and] if it is not possible that these things are by accident or by spontaneity, they are for the sake of something. But *that* such things are by nature, even the people who make this argument would claim this. There is thus that for the sake of something among the things that come to be and are by nature. (*Physics* II.8, 198b34–199a8)

For Aristotle, if natural processes produce certain outcomes either always or for the most part, that excludes the possibility of their being due to chance: instead, they must be for the sake of something.¹¹ The issue is not that material necessity cannot be responsible for the coming to be of regular or good outcomes. For instance, Aristotle too believes that the evaporation cycle that produces rain is a regular, materially necessary process,¹² and that the materials from which teeth are formed come to be of material necessity:

¹¹ That is, of course, based on Aristotle's *own* definition of chance, which he provides in *Physics* II.4–6.

¹² See *On Generation and Corruption* II.11, 338a14–b19; *Posterior Analytics* II.12, 96a2–7; and *Metaphysics* VI.2, 1026b27–35.

We must say what the character of the necessary nature is, and how nature according to the account *has made use* of things present of necessity for the sake of something. . . . For the residual surplus of this sort of [earthen] body, being present in the larger of the animals, is *used* by nature *for* protection and advantage, and [the surplus, which] flows of necessity to the upper region, in some animals it *distributes* to *teeth* and tusks, in others to horns. (*Parts of Animals* III.2, 663b22–35)¹³

Rather, the issue for Aristotle is that the regular *presence* of good outcomes requires the regular activity or intervention of goal-directed efficient causes. The rainfall passage illustrates exactly this: in the case of rain and crops, it is the intervention of humans—in particular of farmers who possess the art of agriculture and who play the role of goal-directed agents in agricultural processes such as these—that ensures that the regular occurrence of winter rain that happens of material necessity results in the good outcome that is the growth of crops.¹⁴ For Aristotle, art is ontologically secondary to nature: it imitates or completes natural goals, which it achieves through means congenial to nature, and given that artistic processes are (visibly and ostensibly) for the sake of something, based on nature's ontological priority to art, so too Aristotle argues must natural processes.¹⁵

The natural case is more complicated, but essentially similar: the regular presence of good and functional features in nature is the result

¹³ Cf. *Generation of Animals* II.6, 745a18–745b9 and *Generation of Animals* V.8; on the role of teleology and material necessity in the generation of teeth, see Leunissen and Gotthelf, “What’s Teleology Got to Do with It?”

¹⁴ Aristotle’s claim that winter rain is for the sake of growing crops is thus an illustration of artificial teleology (the goals of which are necessarily human-centered), and not of a natural teleology that is allegedly anthropocentric; for this latter view, see Sedley, “Is Aristotle’s Teleology Anthropocentric?”

¹⁵ This is Aristotle’s second argument in defense of natural teleology: on this, see *Physics* II.8, 199a8–20 and Sarah Broadie, “Nature and Craft in Aristotelian Teleology,” in *Biologie, logique et métaphysique chez Aristote*, ed. Daniel Devereux and Pierre Pellegrin (Paris: Editions du Centre National de la Recherche Scientifique, 1990), 389–403.

of formal natures producing materials, through conditional necessity, and organizing them for the sake of realizing preexisting potentials for form, *or* the result of formal natures (actively) adapting or (passively) co-opting features that come to be of material necessity for the sake of promoting the well-being and overall functionality of living beings.

These are both cases of natural teleology (both are natural processes “governed” by the goal-directed actions of immanent natures), but the first is a case of “standard” or of what I call “primary” teleology, while the second is a case of what I call “secondary” teleology.¹⁶ The primary type of teleology involves the realization of preexisting, internal potentials for form through stages shaped by conditional necessity. This type of teleology is responsible for the coming to be and presence of parts and features that are necessary for the performance of the vital and essential functions of each living being, as specified by the definition of its substantial being. The secondary type of teleology involves formal natures *using* materials that happen to be available (usually residues that have come to be of material necessity and that are not conditionally necessitated) for the production of parts that serve the animal’s well-being. The presence of these parts is not a necessary prerequisite for the realization of the animal’s form; instead, their presence is said to be “for the better.” For instance, as in the passage from the *Parts of Animals* quoted earlier, Aristotle believes that large land animals often have a surplus of earthen material, which, because of its hard potential, nature then uses for the production of teeth and tusks in some males, and horns in other males, which all serve the (nonnecessary though useful) function of defense. In these cases, functional features emerge as it were from the potentials of the materials that happen to

¹⁶ See Mariska Leunissen, *Explanation and Teleology in Aristotle’s Science of Nature* (Cambridge: Cambridge University Press, 2010). On alternative distinctions between Aristotle’s conception of teleology, see Thomas K. Johansen, “The Two Kinds of End in Aristotle: The View from the *De Anima*,” in *Theory and Practice in Aristotle’s Natural Science*, ed. David Ebrey (Cambridge: Cambridge University Press, 2015), 119–136, and Monte R. Johnson, *Aristotle on Teleology* (Oxford: Oxford University Press, 2005).

be available, and the operation of the formal nature is secondary to the operation of material necessity that produced the materials.

In sum, what Aristotle does, then, in his defense of natural teleology through the rainfall passage, is to have his materialist opponent come up with cases that in Aristotle's own view represent increasingly stronger cases of teleology: moving from artificial teleology in which human artists are the external goal-directed agents, to secondary, natural teleology, in which natures are the internal, immanent goal-directed "agents" that are responsible for using materials that come to be of material necessity for something good, to primary natural teleology, in which the goal-directed actions of the internal natures are responsible for the coming to be and presence of complete functional living beings.

2.4. TELEOLOGY IN ARISTOTLE'S ACCOUNT OF ANIMAL GENERATION

Animal generation, according to Aristotle, is a natural teleological process that involves the transmission of the species-form from parent to offspring and that has as its end the (eternal) replication of the species, and thereby, ultimately, the participation in the eternal and the divine in the only way possible for mortal beings:¹⁷

For the most natural among the functions for living beings—for as many as are perfect and not deformed or whose generation is spontaneous—is to produce another one like oneself, an animal [producing] an animal, a plant a plant, such that they can participate in the eternal and the divine to the extent that is possible. For

¹⁷ On the role of teleology in Aristotle's account of reproduction, see especially Devin Henry, "How Sexist Is Aristotle's Developmental Biology?," *Phronesis* 52 (2007): 251–269; Devin Henry, "The Cosmological Significance of Animal Generation," in Ebrey, *Theory and Practice*, 100–118; and also Karen Nielsen, "The Private Parts of Animals: Aristotle on the Teleology of Sexual Difference," *Phronesis* 53 (2008): 373–405.

everything desires this and does whatever it does in accordance with nature for the sake of this. . . . Since then it cannot take part in the eternal and the divine with an uninterrupted continuation, for the reason that nothing among the perishables can remain the same and one in number, each—to the extent that it can take part in it—participates in it, some more and some less, and it remains not as oneself but as something like oneself, and as not one in number, but as one in form. (*De Anima* II.4, 415a27–b7)

In other words, the process of generation consists in the production of another one like oneself by living beings who are biologically speaking only capable of participating in the divine through this process of “eternal replication of form” and not through living for eternity themselves as individuals.

Physiologically speaking, Aristotle often speaks of embryogenesis as a form of matter being concocted and thereby being “refined” and “informed”—and thereby perfected—to an appropriate degree. In most animals, this process of “concoction” takes place through sexually differentiated parents, where each parent supplies its own principle(s) of reproduction: the male supplies the form and the source of movement, usually via his semen, while the female supplies the matter in the form of her menses, which already possess the species-form in potentiality. Now, even though in sexually differentiated animals the end of reproduction similarly lies in the production of viable offspring of the same species (or, more specifically, in the replication of their form in another living being that also has the capacity to successfully engage in reproduction and subsequently replicate its form), and hence not in the production of *male* offspring per se (forms are not sexually differentiated), Aristotle holds that reproduction is “most natural” when the motions of the father and male go together and those of the female and mother go together,¹⁸ and is best when the male principle is able to “dominate”

¹⁸ *Generation of Animals* IV.3, 768a21–25.

and is able to transmit the species-form into the matter *in exactly the same way* as it is realized in him.¹⁹

As a consequence of this, reproduction in sexually differentiated animals is deemed to be the least disturbed and the least departed from the form when reproduction results in *male* offspring resembling its father in all of his formal aspects, because in that case only the male principle will have succeeded in transmitting its own particular and distinctive form.²⁰ The offspring that results when the process remains undisturbed is thus a perfect formal replica of that which already has that very same form in actuality and which “happens to be” the father—i.e., a *male* individual of the same species. In this way, Aristotle characterizes the birth of a male offspring that is identical to its male parent as a kind of success—i.e., as a natural teleological process running its course. In contrast, Aristotle characterizes the birth and existence of female offspring (or even of male offspring resembling its female parent) as forms of imperfections, as deviations or departures from the replication of form, and as resulting in deficiencies. Aristotle believes that with regard to whatever extent the male principle does not succeed in leading the female menses to its own proper form (that is, to the species-form *in the way that it is realized in him*), the developing embryo ends up with a deficiency, the most important of which is the incapacity to concoct seed. It is as a result of this latter incapacity that the embryo

19 See especially *Generation of Animals* IV.3, 767b5–23: “For even the one who does not resemble his parents is already in a way a monster: for in those cases nature has in a way departed from the form [that is being replicated]. The first [departure] is that a female is born and not a male—but this is necessary in accordance with nature: for the kind that has been separated into female and male needs to be preserved. . . . And when the spermatic residue in the menses has been properly concocted, the motion of the male produces a form in his own likeness. . . . Therefore when it [i.e., the motion of the male] dominates, it will produce a male and not a female, and it will resemble its father but not its mother; and when it is dominated, with regard to whichever capacity it does not dominate, it produces the corresponding deficiency.”

20 For Aristotle, the causal factors involved in sexual differentiation are the same as the ones involved in familial resemblances.

develops female reproductive organs and hence becomes anatomically speaking female.²¹

For Aristotle, the existence of the female is conditionally necessary for the preservation of the species,²² and he certainly thinks that females are functional, capable beings. However, he also believes that their coming to be and existence is a product of the nonstandard, secondary type of teleology sketched earlier:²³

That the male and female are principles of generation has been said earlier, and also what their capacity is and the definition of their substantial being.

The cause on account of which there come to be and exist the female and the male, that it is, on the one hand, *of necessity and because of the first mover and the quality of the matter*, is necessary to try to show in the following account, but, that it is, on the other hand, *on account of the better and because of the for the sake of something*, takes its principle from further away. . . .

Now it is impossible for the animal to be eternal as an individual—for the substantial being of the things that are in the particular; and if it were such it would be eternal—but it is possible for it [to be eternal] as a species. That is why there is always a continuous

21 *Generation of Animals* IV.1, 766a22–28; *Generation of Animals* IV.3, 767b22–23 and 768a2–11. It is also in these contexts that Aristotle infamously characterizes female offspring as being somehow “like a disabled male” (*Generation of Animals* II.3, 737a27–28) or “like a natural deformation” (*Generation of Animals* IV.6, 775a15–16).

22 See *Generation of Animals* IV.3, 767b8–10 and *Politics* I.2, 1252a26–28.

23 Similarly, Aristotle believes that female menses come to be “of necessity” and are then used by nature “for the better” and are thus a product of secondary teleology (*Generation of Animals* II.4, 738a33–b5): “Thus the coming to be of this residue [i.e., the menses] among females is the result of necessity, because of the causes mentioned. Because her nature is not capable of concoction, it is necessary that residue must come to be, not only from the useless nourishment, but also in the blood vessels, and that they must overflow, when there is a full complement of it in those very fine blood vessels. And nature uses it for the sake of the better and the end for this place, for generation, in order that it may become another creature of the same kind as it would have become. For, even as it is, it is in potentiality the same in character as the body of which it is the secretion. In all females, then, residue necessarily comes to be.”

generation of humans, animals, and plants. And since the principles of these are male and female, male and female will be present for the sake of generation in each of the things that possess them. But the primary moving cause is better and more divine in its nature than the matter, insofar as the definition and the form belong to it, *and it is better that the superior cause be kept separate from the inferior one. It is on account of this that (in those species where this is possible) the male is separated from the female.* . . . However, the male comes together and combines with the female in order to perform the function of reproduction, for this is something common to both. (*Generation of Animals* II.1, 731b18–732a11)

In specifying the final cause of the coming to be and existence of the male and the female, Aristotle takes for granted as facts that sublunary beings are mortal and can only participate in the divine by engaging in a continuous cycle of reproduction and that the principles of reproduction are two—one formal-efficient principle called male, one material called female. The reason why these two principles are separated, when this is possible, is because it is a general teleological principle of nature that it is better to keep the superior separated from the inferior.²⁴ Sexually differentiated species thus exist for the better: for it is better, *when possible*, for nature to separate the superior cause of reproduction from its inferior one and put them in separate beings. One part of the explanation Aristotle provides for sexual differentiation is thus explicitly teleological.

However, this separation is in fact possible because the process of reproduction is complex, and achieving the “perfect concoction,” so to speak, of the female menses by the male principle is difficult.²⁵ So this is where the “of necessity” and “the first mover and the quality of the matter” figure into the explanation: for when the female menses

²⁴ Cf. *On the Heavens* II.8, 290a29–b11.

²⁵ *Generation of Animals* II.6, 743a26–32.

are too copious or too cold (that is, when the quality of the matter is suboptimal), or when the male principle is not hot enough or too hot (that is, when the first mover is not strong enough or produces “excessive concoction”), the male principle will fail to dominate the female menses and will produce “defects” in the offspring.²⁶ And the same problems can occur due to any kind of material-efficient disturbance that happens, of material necessity, during the process of embryogenesis, such as due to changes in climate or due to the particulars of the mother’s diet. Due to these possible influences of material necessity on the process of reproduction, the process of concoction—and hence the offspring—achieves varying degrees of perfection. Some offspring are mostly perfect, possess the relevant species-form, and are capable of concocting blood into semen; some offspring are less perfect, and while they possess the relevant species-form, they are incapable of concocting blood into semen due to a lack of heat; and, finally, some offspring constitute monstrosities that lack the relevant species-form and the ability to reproduce (and they are therefore “not usable by nature” as a container for a principle of reproduction). However, given the availability of two usable types of “vehicles for reproduction” and the fact that in animals who possess both perception and the capacity for locomotion the two principles of reproduction *can* be separated without there being any practical problems for them to reunite, nature matches, as it were, the superior principle with the superior body (males carry the male principle) and the inferior principle with the inferior body (females carry the female principle).

In sum, since perfect concoction is difficult and since therefore, of material necessity, materially less perfect beings will come to be with some regularity, nature, as a good craftsman, uses these beings for something good, namely for the containment of the inferior principle

²⁶ Cf. Aristotle’s explanation of the dysfunctional eyes of moles in terms of a deformity that happens during generation in *History of Animals* I.9, 491b27–34 and IV.8, 533a11–12 and their characterization as “imperfect” in *History of Animals* I.9, 491b27 and *De Anima* III.1, 425a9–11.

of reproduction. In this way, nature achieves a general teleological good, for in these beings the superior and inferior principles of reproduction are separated.

2.5. TELEOLOGY IN ARISTOTLE'S EXPLANATION OF THE PARTS AND FEATURES OF ANIMALS

The process of embryogenesis and the coming to be of the parts and features of animals is thoroughly teleological, and Aristotle likes to conceptualize it as involving the goal-directed actions of crafting natures who use the hot and the cold as the tools of their craft.²⁷ For instance, Aristotle describes the actions of nature in producing the body of the developing embryo as being analogous to those of painters:

The upper half of the body, then, is first marked out in the order of development; as time goes on the lower also reaches its full size in the blooded animals. All the parts are first marked out in their outlines and acquire later on their color and softness or hardness, exactly as if nature were a painter producing a work of art, for painters, too, first sketch in the animal with lines and only after that put in the colors. (*Generation of Animals* II.6, 743b18–25)²⁸

Later on in the same chapter, Aristotle sketches a hierarchy of parts in which he links the ontological status of a part (i.e., whether it is necessary for the sake of vital or essential functions or whether it is “merely” instrumentally necessary for other parts) to the quality of its constitutive material and its place in the sequence of coming into being. He

²⁷ See, e.g., *Generation of Animals* II.6, 743a36–b1.

²⁸ Cf. *Generation of Animals* II.4, 740a28–9; *Parts of Animals* II.8, 654a24–6; *Parts of Animals* II.14, 658a21–3; *Parts of Animals* II.14, 658a31–5. For the male principle or the animal's soul being depicted as a craftsman, see, e.g., *Generation of Animals* I.22, 730a32–b32, *Generation of Animals* II.1, 734b20–735a29; *Generation of Animals* II.4, 740b25–741a4; and *Generation of Animals* II.6, 743a36–b5.

then fleshes out this picture by comparing nature to a good housekeeper: according to the image drawn, nature uses the best materials to make the most important parts of the body, and makes those first, just as in a household, the housekeeper gives the best food to the most important members of the household, who are fed first. The other parts, namely those that are subsidiary to the first category of parts, are made out of inferior nutriments, and only come to be if and when nature has enough left over to spare.²⁹

Aristotle provides similar descriptive comments about the teleological actions of natures involved in the production of parts in his *Parts of Animals*, which provides an impressive collection of mostly teleological explanations for why animals have (or lack) the parts and features they have. In many cases, especially when explaining the presence of parts that are necessary for one of the vital or essential functions a given animal has, Aristotle simply identifies that function. The larynx, for instance “is naturally present for the sake of breath; for through this part animals draw in and expel breath when they inhale and exhale.”³⁰ In other cases, Aristotle points out how a part is necessary given the need for the performance of a certain function that is specified in the definition of the substantial being of that animal. For instance, “it is on account of being swimmers” that fish “have fins”: “being swimmers” technically constitutes the formal cause of the presence of fins, but it includes the specification of its final cause, namely “swimming.” Fish thus have fins for the sake of swimming.³¹

Most of these features are due to what I have called primary teleology, and there is no need for Aristotle to specify that in these cases nature acted for the sake of something or that the necessity involved in their production is conditional necessity rather than material: the fact

²⁹ See *Generation of Animals* II.6, 744b11–27 and my discussion of this image in Leunissen, *Explanation and Teleology*.

³⁰ *Parts of Animals* III.3, 664a17–20.

³¹ *Parts of Animals* IV.13, 695b17–26. Cf. *Parts of Animals* IV.8, 684a14–15; IV.9, 683b16–23; and IV.12, 694b10–12.

that a part is necessary for the sake of an essential or vital function is presumed to imply that its constitutive materials have been produced by conditional necessity and that nature produced and organized these parts in the way they are for the sake of realizing those essential or vital functions.

However, the situation is different and more complicated for parts and features that are due to secondary teleology: in those cases, Aristotle often identifies material necessity as the cause for the coming to be of the part and characterizes nature as having used that material for some function that makes the animal somehow better off. Take, for instance, Aristotle's explanation for why animals have an omentum:³²

The generation of this part [i.e., the omentum] occurs of necessity in the following way; when a mixture of dry and moist is heated, the surface always becomes skin-like and membranous, and this location is full of such nutrient. . . . The generation of the omentum, then, occurs according to this account, and nature makes use of it for a good concoction of the nutrient, in order that the animals may concoct their nutrient easier and faster; for what is hot is able to concoct, and what is fat is hot, and the omentum is fat. (*Parts of Animals* IV.3, 677b22–32)

There does not appear to be a function for the sake of which the omentum is conditionally necessary; rather, the presence of dry and moist materials that make up the stomach and intestines—combined with the presence of heat—results of material necessity in the solidification of the materials on the outside of the stomach, and nature then uses this fatty “sheet” or membrane to make the process of food concoction more efficient (for what is fat is hot, and what is hot aids in concoction).

³² The omentum is an apron-like, membranous double layer of fatty tissue that hangs down from the stomach and that covers the intestines and organs in the lower abdominal area.

Sometimes Aristotle's descriptions of nature as using features for something good pick out even more subtle forms of teleology, as in the case of nature's *reusing* entire parts that are said to be already present for the sake of some necessary function. A nice example of such a reused part is the elephant's trunk.³³ In a long passage (*Parts of Animals* II.16, 658b32–659a36), Aristotle first explains why elephants have the specific nose they have. Elephants have *a* nose in virtue of being a breather of air (that is, noses are a necessary prerequisite for the performance of the necessary function of cooling, which happens according to Aristotle through the circulation of air), but they have the *specific, long* nose they have because they need an organ for breathing air while being in the water looking for nourishment: long noses function for elephants like snorkels do for human divers. However, in order for trunks to be so long, they have to be—of conditional necessity—soft and flexible, and Aristotle goes on to explain how nature makes use of these material potentials of the trunk in order to *make up* for the uselessness of their feet for grasping food:

Since [the trunk] is such [i.e., soft and flexible], *nature, as it is used to, uses* [*parakatachrētai*] *the same parts for several things*, [here using] it in place of the use of front feet. For four-footed animals with many toes have front feet in place of hands, not merely for the sake of supporting their weight. And the elephants are members of this group; that is, they have feet that are neither cloven nor solid-hoofed. But since the size and weight of their body are great, their feet are only for the sake of support, and because of their slowness and their natural unsuitability for bending, they are useless for anything else. . . . And the use of its feet having been taken away, nature,

³³ See Allan Gotthelf, "The Elephant's Nose: Further Reflections on the Axiomatic Structure of Biological Explanations in Aristotle," in *Aristotelische Biologie: Intentionen, Methoden, Ergebnisse*, ed. Wolfgang Kullmann and Sabine Föllinger (Stuttgart: Franz Steiner, 1997), 85–95.

as we said, also makes use of this part *for the service that would have been provided by the feet*. (*Parts of Animals* II.16, 659a20–36)

Typically, four-footed animals with many toes have feet that are capable of providing both support for their bodies and means to transport food to their mouths: the form “many-toed four-footer” is “normally” realized by giving these animals four supporting, but bendable, feet. However, in elephants, this use of feet is taken away, and so their natures have to assign a second function to the elephant’s trunk, but without having to change any of its features. Although physically, the “design” of elephants thus does not undergo any changes, Aristotle claims that their nature had to move the function of grasping food—which was “supposed to be” performed by its feet—to the trunk.³⁴

Even more complicated are cases where the functions for the sake of which a part (or its differentiation) is present is not immediately discernable, either because the operation of a part is hidden from view (dissection can be helpful, but does not offer observations of the part while active), or because multiple parts can be observed to be associated with a given function and it is unclear what role is played by the part in question, or because what is needed is an explanation not of why a part is present but instead of why a part that one could reasonably expect to be present in a given animal is in fact absent. In these cases, Aristotle often appeals to teleological principles such as “Nature does nothing in vain, but always, given the possibilities, does what is best for the substantial being of each kind of animal,” or “Nature does everything either because it is necessary or because it is better,” or “Nature always places the more valuable parts in the more valuable locations, where nothing greater prevents it.” These principles are empirical hypotheses, belonging properly to the science of nature,³⁵ and

34 See also *Parts of Animals* II.16, 659a34–660a2; III.9, 671a35–b2; IV.10, 688a19–25; IV.10, 689a5–7; IV.10, 689b34–690a4; and *On Respiration* 7, 473a23–25.

35 See *Progression of Animals* 2, 704b12–705a2 and *Generation of Animals* V.8, 788b20–5.

they posit certain “rules of action” formal natures “always” or “never” follow when producing animals.³⁶ Aristotle uses them as heuristic devices:³⁷ by conceptualizing nature as an intelligent, creative designer, Aristotle is able to engage in a kind of thought experiment that reveals “for the sake of what” such an intelligent designer would have made that particular design choice and therefore made the animal the way it is. Take, for instance, Aristotle’s appeal to a teleological principle in the following text:

Now if nature does everything either because it is necessary, or because it is better, this part [i.e., testes], too, must be because of one or the other. That it is not necessary for generation is evident: for it would be present in all that generate, but as it is, neither the snake nor the fish has testes (for they have been seen coupling and with the channels full of semen). It remains then that they are for the better in some way. . . . Those who need to be more temperate have in the one case [of nutriment] intestines that are not straight, and in the other case [of sexual reproduction] their ducts twisted to prevent their desire being too violent and hasty. The testes are contrived for this; for they make the movement of the spermatic secretion steadier. (*Generation of Animals* I-4, 717a11–31)

In this passage, Aristotle seeks to explain why it is that some males who reproduce sexually possess ducts for semen, testes, and a penis, whereas others only possess ducts. All parts are associated with the function of reproduction, and observation does not straightforwardly reveal their specific functional differentiation. However, assuming that nature only produces parts if they are either necessary for the performance of a certain function or if they are for the better, one can derive from the

³⁶ On the scientific status and use of teleological principles, see Lennox, *Aristotle’s Philosophy of Biology*, 182–194, and Leunissen, *Explanation and Teleology*.

³⁷ Aristotle discusses the importance of the heuristic use of teleology in *On Respiration* 3, 471b24–29.

fact that ducts are the only reproductive parts present in *all* sexually reproductive males that these must be necessary, while having testes and a penis must “merely” be for the better. And whatever their *specific subsidiary* function is, it must be related to the specific nature of the male animals in which these parts are found. As it turns out, these latter parts are present only in the most passionate and intemperate of males, and their function, then, must be to *slow down* reproduction in these animals.

Let me conclude with my favorite example:

In snakes the cause of why they are footless is, both that nature does nothing in vain, but always from among the possibilities, [does] what is best for each thing, preserving the proper substantial being of each and its essence; and, in addition, that which we stated before, namely that no blooded animal can move itself at more than four points. For from these [two principles] it is evident that of the blooded animals whose length is out of proportion to the rest of the nature of their body, like snakes, none of them possibly can have limbs. For they cannot have more than four feet (since in that case they would be bloodless), and *if they had two feet or four they would be almost completely immobile*: so slow and useless would their movement necessarily be. (*Progression of Animals* 8, 708a9–20)

Observation shows that all blooded animals that live on land have four feet: they share to a certain extent the same form, and their design can therefore be expected to share certain coextensive features like the possession of a maximum of four feet. The snake, however, possesses all the typical properties that belong to blooded land-dwellers, except for feet. Aristotle explains this absence by pointing out that the presence of four feet in snakes *would have been* in vain, on account of the snake’s disproportionate dimensions (and giving more than four feet is impossible, as this would violate the substantial being of blooded animals). A quick thought experiment reveals that no blooded animal whose

length is out of proportion to the rest of their body would be able to move swiftly with either two or four feet, and in order to remedy that design problem, nature “decided” not to produce feet in such animals.³⁸

What these examples show, then, is that for Aristotle, the theory of natural teleology is not an a priori assumption, but a scientific hypothesis that he uses to make as much sense of the natural world around him as he possibly can and thereby to locate the good and show that “there are gods here too.”

³⁸ See also *Parts of Animals* II.13, 658a6–10; IV.11, 690b14–18; IV.12, 694a16–18; IV.13, 696a10–15; *Progression of Animals* 2, 704b12–18 and 4, 705b25–29; *On Respiration* 10, 476a11–15; and *Generation of Animals* V.1, 781b22–28.