

Uses of *aporiai* in Aristotle's *Generation of Animals*

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Given what Aristotle says about *aporiai* in *Metaphysics B*, one might expect them to play an important methodological role in his biology.¹ In *Metaphysics B*, we learn that going through *aporiai* enables us to identify the ‘knots’ binding us, to know the direction in which we should proceed, to recognize it when we have found what we are seeking, and to be competent judges of competing accounts.² These achievements would seem, at any rate, to be equally necessary for both first- and second-order causal inquiries. Moreover, one might expect not only for there to be something significant in Aristotle's use of *aporiai* in biology, but also for the *aporiai* in this empirically grounded domain to share some distinctive features. One might suppose, for example, that the puzzles would be generated by a lack of observable evidence as opposed to being due to some conceptual difficulty.³

It is difficult, however, to draw any general conclusions about Aristotle's use of *aporiai* in the biological treatises. Although these treatises contain many instances of *aporia* language—i.e., uses of the noun and its verbal cognate—there seems to be no single purpose for which Aristotle raises them, no common structure, and no shared source of puzzlement. In what follows I will attempt to demonstrate this negative thesis by looking closely at the

¹ Michael Boylan (“The Digestive and ‘Circulatory’ Systems in Aristotle's Biology,” *Journal of the History of Biology*, vol. 15, no. 1, Spring 1982, 89-118 at 118) goes so far as to claim that Aristotle's biological methodology in *Generation of Animals* is based on the procedure of moving from problems to their solutions, and indeed that the biological treatises are organized around problems. According to Gareth Matthews, Aristotle “normalizes perplexity in the practice of philosophy” and extends the scope of this practice to deal with “puzzles in such sciences as cosmology and biology.” (Gareth Matthews, *Socratic Perplexity*, Oxford University Press, 1999, 118-9.)

² See Buddensiek's essay in this volume (Chapter 7).

³ Terrence Irwin, for instance, claims that for “empirical puzzles” the “source of our puzzles is empirical ignorance leaving us at a loss to say what happens or why it happens” (*Aristotle's First Principles*, Oxford University Press, 1988, 32). Irwin also claims that in Aristotle's “empirical inquiries—those in which he surveys empirical appearances—Aristotle characteristically raises these empirical puzzles” (*ibid.* 42). If *Generation of Animals* is considered by Irwin to be an empirical inquiry, then he is an example of a scholar who thinks the *aporiai* in that treatise have a distinctive character, namely, that they share a common source.

use of *aporia* terminology in *Generation of Animals*. For ease of presentation, I will follow Aristotle in referring to what he calls an *aporia* by that name. One upshot of this discussion, however, is that caution may be warranted in assuming that there is any single kind of puzzle or difficulty being picked out by the use *aporia* language.

For what purpose is an *aporia* raised?

If one thought that the raising and resolving of *aporiai* were an integral feature of Aristotle's methodology in biology, a natural way to yoke them together might be by reference to the purpose for which they are raised. Unfortunately, as I will show in this section, there is no one purpose for which they are raised.

(i) In some cases, Aristotle states that some phenomenon "has much *aporia*" where that announcement introduces a survey of existing views that are all equally problematic. Such "puzzles" appear to be raised in order to establish the superiority of Aristotle's own theory, by showing that it avoids problems that confront the alternatives. These *aporiai* perform what we might call a 'refutative' function.

A prime example of a refutative *aporia* is Aristotle's discussion of bee generation in *GA* III.10. Aristotle's own tentatively proposed account⁴ is that bees generate without copulating, just as certain fish do.⁵ This is the only possible explanation, he thinks, given what has been observed. He demonstrates this by going through the problems with all of the prevailing alternative accounts:

Bees cannot gather their young from outside the hive, as some say.⁶ If they did, these young bees would have to be either (a) spontaneously generated, or (b) produced by another kind of animal. Aristotle says that it is absurd, however, to think they are spontaneously

⁴ The proposal is only tentative, because Aristotle believes that this explanation should be rejected if new facts are discovered, since "one must believe in perception more than arguments (*logôn*)" (*GA* III.10, 760b31-2). The observable facts about bee generation, Aristotle says, have not been sufficiently grasped. For a discussion of Aristotle's argumentation in this chapter of *GA*, see Joseph Karbowski, "Empirical *Eulogos* Argumentation in *GA* III.10," *British Journal for the History of Philosophy*, 22, 1, 2014, 25-38.

⁵ The way bees generate is unique, despite its similarity to how it goes for some fish. The kinds of fish that generate with copulating produce other fish of the same kind, whereas only the king bee produces other kings (760a4-9).

⁶ Aristotle also notes that since *no* bee larvae are gathered from outside the hive, it is also not possible for only *some* to be generated and others gathered.

generated. For, he reasons, in this case we should have found spontaneously generated bees that are not collected remaining in the places where other bees would have collected them. However, this is not something we observe. Aristotle also rejects (b), the idea that bees could collect offspring that are produced by another kind of animal. For, animals generate offspring that are the *same* in kind as themselves, and so this would violate a principle that holds of animals, generally.⁷ Finally, against both (a) and (b), he notes that while it makes perfect sense for bees to collect honey, since honey is their food, it is absurd to think that bees would collect anything that is not food.

It cannot be that bees are produced by the copulation of drones and worker bees, as others claim, either. Generation by copulation requires both male and female principles. So drones and worker bees would have to exhibit sexual differentiation. But it does not seem as though worker bees can be either male or female: Worker bees cannot be female, because they have stingers, and nature does not assign weapons to females. Worker bees cannot be male, since worker bees tend to the young, and in Aristotle's view, males never do that.⁸ In fact, generation by copulation seems to be impossible not only on the assumption that two different kinds of bees, such as workers and drones, copulate with each other to generate all of the kinds, but also on the assumption that the members of the same kinds of bees copulate with each other to produce another individual like themselves. This is apparent, Aristotle claims, since young drones are produced when no drone is present, and worker bees are only produced when king bees are also around.

The only viable option, Aristotle concludes, is that worker bees are hermaphroditic and generate drones without copulation, and that king bees generate both worker bees and kings. Although it is a bizarre theory, it is the only one that makes sense of all of the empirical evidence and coheres with his zoological principles. Consequently, Aristotle thinks it is the best theory, given what we have observed.

⁷ Aristotle knows about hybrids such as donkeys, however, although he does not acknowledge such exceptions here.

⁸ For discussions of Aristotle's use of such principles having to do with males and females, e.g., that nature does not give weapons to females and that males do not tend to their offspring, see G.E.R. Lloyd, *Science, Folklore, and Ideology: Studies in the Life Sciences in Ancient Greece*, Cambridge University Press, 1983, 94-105.

(ii) At other times, an *aporia* is presented not for the purpose of rejecting other theories, but rather because doing so will advance Aristotle's own inquiry in some way. These *aporiai* move the investigation forward by making clear *that* there is a genuine problem or question needing to be addressed, and by making explicit what the constraints on any adequate theory or explanation are. I will label this a 'zetetic' use of *aporia*.

(ia) In some cases, Aristotle advances the inquiry by motivating the introduction of something unobservable that would make sense of the phenomenon being discussed. One such motivating, zetetic *aporia* is raised in order to justify positing the presence of *pneuma* in the male's *sperma*.⁹ At *GA* II.2, 735a29-736a23, he says that someone might be puzzled¹⁰ about the nature of *sperma*, since it does not behave in the way that either watery or earthy substances do. Unlike watery substances, it does not thicken (*pachunetai*) when cooled. Unlike earthy substances, it does not thicken when boiled, as milk does. But according to *Meteorology* IV.4, the moist and the dry (referred to as 'watery' and 'earthy' in the *GA* passage) are the passive potentials out of which *all* uniform bodies are made.¹¹ So it seems that it must be one or the other.

Aristotle begins his resolution of this *aporia* by asking: "or have we not distinguished all of the things that occur (*sumbainonta*)?" (735b7-8). He points out that in addition to watery and earthy moistures, there are also those made up of water and *pneuma*, for example foam, oil, and lead-ore. So, he now introduces a further feature of his account: Semen is a

⁹ *Sperma* in this discussion clearly refers to the male semen, although Aristotle will sometimes use this term to refer to the female spermatoc residue, as well as the mixture of male and female residues—the "seed".

¹⁰ It is not entirely clear whether the expression *aporeseien an tis* means that "someone might be puzzled" or that "someone might raise a puzzle." The same is true about the use of the noun *aporia*; it is not clear whether *aporia* refers to a state of puzzlement or the difficulty that gives rise to puzzlement. Consequently, it is not as obvious to me as it is to Garreth Matthews that for Aristotle "an *aporia* is not a *state* of puzzlement at all; it is rather a puzzle or conundrum or difficulty that produces, or is likely to produce, a state of puzzlement." ("The Normalization of Perplexity in Aristotle," in May Sim (ed.) *From Puzzles to Principles?: Essays on Aristotle's Dialectic*, Lexington Books, 199, 125-136 at 130)

¹¹ "We must discuss the forms of the passive potencies, the moist and the dry. The passive principles of bodies are moist and dry, whereas other things are combinations from these, and a body in its nature consists more of whichever of the two is more—for instance, some things consist more of dry, others of moist." (*Meteor.* IV.4, 381b23-5)

compound of *pneuma* and water, and *pneuma* is warm air.¹² This accounts for the properties of *sperma*, and more importantly, the presence of *pneuma* is now a feature of the embryological account that he can appeal to in explaining other phenomena.¹³

(iib) Another type of zetetic use of *aporia* occurs when Aristotle wants to make some corrections or revisions. Some of these zetetic *aporiai* are raised in order to correct what has been (wrongly) taken to be the empirical facts. He says, for instance, that someone might be puzzled about the growth of eggs (*GA* III.2, 752a24ff). Eggs do not have an umbilical cord, he says, so they do not receive nourishment in the way that animals that are born live do. They also do not simply use themselves as nourishment in the way that larvae do.¹⁴ How, then, does the nourishment get inside the egg in the first place, when that egg is hard and lacks anything like the umbilical cord?

Aristotle resolves this by wheeling in some empirical data that has been overlooked (*lanthanei*): at the outset the egg is soft, though it quickly hardens once released. If it were not soft, egg-laying would be painful. That initial, soft egg has a very small umbilical-like ‘pipe’ protruding from the pointed end, by which it was attached to the uterus. This is difficult to see, but Aristotle says it has been observed in aborted chicken eggs.¹⁵

(iic) Other zetetic, corrective *aporiai* are raised when qualifications or modifications to the explanation that Aristotle has offered need to be made. For instance, in the course of explaining what happens just after fertilization in *GA* II.4, Aristotle says that while all of the parts are “potentially” present in the *keuêma*, which is the first mixture of male and female

¹² For the same reasons, Aristotle calls the nature of olive oil *aporôtata*: if it were mostly water, it should be solidified (*pégnumsthai*) by cold, and if it were mostly earthy, it should be solidified by fire (*Meteorology* IV.7, 383b20ff). As it is, neither heat nor cold solidifies it, and both thicken it. His solution to the puzzle is to point out that oil is full of air (*aer*). For a discussion of the “olive oil *aporia*”, see James Lennox, “Aristotle on the Emergence of Material Complexity: *Meteorology* IV and Aristotle’s Biology,” *HOPUS: The Journal of the International Society for the History and Philosophy of Science*, vol. 4, Fall 2014, 272-305 at 288ff.

¹³ See Peck’s discussion in his Loeb edition of *GA*, Appendix B for an overview of the role of *pneuma* in Aristotle’s accounts of movement, nutritive soul activities and sensation.

¹⁴ As Aristotle explained in *GA* II.1, 732a32, it is only a part of the egg that becomes the living organism, and the rest is used as the nourishment for growth. See also the discussion in *GA* III.9.

¹⁵ cf. *HA* 559b16

spermatic residues,¹⁶ the first part to be actually present is the heart. The heart has to be present first, because it is the source (*archê*) of all the other parts, both homoeomerous and heterogenous. The new fetus, while still incomplete, and still only potentially an animal, needs nourishment from elsewhere. Thus the heart sends off blood vessels (the umbilical cord) to the uterus to procure the nourishment, just as seeds in the ground send off roots and shoots. But about this, Aristotle says that someone might be puzzled.

“Someone might *aporêseie*, if on the one hand the blood is nourishment, but on the other hand the heart—being bloody—comes to be first, but nourishment [comes from] outside (*thurathen*),¹⁷ from where does the first nourishment enter?”(740b2-5)

Aristotle has just said that the growing fetus gets its nutriment from the uterus, to which the heart sends vessels. Now he points out that this cannot be the way the heart gets its initial nourishment. So how does the heart receive it? To answer this, he makes a qualification to the theory:

“Or is this not true, that all [nourishment comes from] outside, but rather just as in the seeds of plants there is some such thing that first appears milky, so also in the matter of animals there is residue for the assemblage straightway.”(740b5-8)

So, there is something not quite correct after all about the idea that nourishment comes from outside the heart.

(iid) The previous two examples of zetetic *aporiai* are ones that allow Aristotle to make a correction, either to his own theory or to what is taken to be the empirical data about

¹⁶ “Well then, among those animals not having separate males and females, for these the *sperma* is like the *kuêma*. I mean by *kuêma* the first mixture from the female and the male.” *GA* I.20, 728b32-4

¹⁷ The idea that nourishment must come from something *outside* is not explicitly mentioned by Aristotle in *GA*. As far as I know, the closest he comes to saying this is the claim (at 724b34) that nourishment (*trophê*) is manifestly *epeisakton*.

some phenomenon. A further purpose for which zetetic *aporiai* arise is to motivate not merely a correction but rather what we might think of as a radical change in focus. An extended discussion in *GA* II.1 is a good illustration of the type of use I have in mind. Aristotle's purpose in raising this *aporia*, as I understand it, is to prime his audience for a surprising shift in the way we should conceive of agency—of what it is to be an agent of some change—by painstakingly running through the difficulties that will arise if such a shift is not made.¹⁸

At 733b32, Aristotle raises a question about what the agent of embryonic development can be. Here he is concerned to identify the agent that produces an embryo's body parts out of the first mixture of male and female spermatic residues, a mixture that he sometimes refers to as the *kuêma* and sometimes the *sperma*. This agent must be either something external or internal to this mixture, but there does not appear to be any viable candidate. First, Aristotle rules out the first possibility:

“For either something external or something present in the semen and the *sperma* makes [the parts], and the latter is either a certain part of soul or soul, or might be something having soul. Well, surely that something external makes each of the viscera or other parts would seem absurd. For it is neither possible for something not touching to move [anything], nor possible for something to be acted upon by something not moving [it].” (*GA* II.1, 733b32-734a4)

According to Aristotle's general account of change, there must be an agent with an active potential to impose form and a patient with a passive potential to receive form. But that is not sufficient: conditions must obtain such that the change occurs, namely, that the agent and patient be in contact. It is this general principle—that change requires contact between the agent and patient—to which Aristotle refers here.¹⁹ In his theory of animal generation,

¹⁸ For a similar use of *aporia*, i.e., one that motivates a conceptual shift, see *de Caelo* II.12, 292a19-22: “We may object that we have been thinking of the stars as mere bodies, and as units with a serial order indeed but entirely inanimate; but should rather conceive them as enjoying life and action. On this view the facts cease to appear surprising.” (Stocks trans., my emphasis)

¹⁹ Aristotle discusses contact in *Generation and Corruption* I.6-7 and *Physics* III.2.

the male parent has the active potential to impose form, but he never makes direct contact with the matter that has the passive potential to receive that form. So, it seems that there must be some part already present in the *kuêma* that is the agent, since only something in the *kuêma* could make contact with the matter. However, this option is also ruled out.

Aristotle's lengthy rejection of this second option involves establishing that (1) if the agent were some part present in the *kuêma*, it would have to be a part of the embryo that is being formed.²⁰ But (2) since there is no part of the body that does not have soul, some ensouled part would have to be present from the outset (734a14-16). Yet this, too, is impossible: (3) no part of the embryo can be present in the seed, because seed is simply what the parts come to be out of, and so must be produced *prior* to the parts that come to be out of it (734b1-2).²¹ So, nothing can be made simultaneously with seed such that it is both present in the seed from the outset and also comes to be out of seed.

Aristotle resolves this by showing how we might reconceive of the agent in a way that makes it possible for it to be something both internal and external, after all.

²⁰ He does so by setting up a dilemma: If the agent were something existing in the *kuêma*, it would have to be either a part of it, or something separate from it (734a5-6). The second horn, i.e. that the agent be something separate, is unreasonable (*alogon*) (734a5-7). For, if that were the case, once the animal has been generated, then that separate part either remains or perishes (734a7-8). It is evident that nothing remains in the new animal or plant that is not also a part of it (734a8-9). So, it would have to be something that perishes, which is also absurd (*atopon*) (734a10). Why? If it perished, it would have to do so either after having made all of the parts or after making some of them (734a9-10). If it perishes after making some of them, then how are the other parts formed (734a10-11)? Aristotle's reasoning seems to be that if we said that this separate part makes some of the internal organs, e.g. the heart and liver, and then perishes, it is unclear how the rest of the parts and organs are formed. If we say that it is the heart and liver that forms the rest of the parts, there is nothing to prevent these from also perishing after they make the next organ. By parity of reasoning (according to the "same *logos*"), the parts that make the other parts would also perish, but they survive (734a11-13). Thus, the agent would have to be a part in the *kuêma*, and not something separate (734a13-14).

²¹ I have omitted one epicycle in this long argument: The parts are produced in succession, since the idea that they come to be simultaneously is ruled out "by perception" (734a20-1). Parts formed earlier cannot be agents of later parts, because that conflicts with another general principle, namely, that the agent must have the form in actuality that which is being generated (734a29-31). The idea that the heart, for example, has the form of the liver is absurd (734a31-3).

“We must try to resolve these. For perhaps something we said is not unqualified,²² namely how in the world it is not possible to come to be by something external. For in one way it is possible, but in another it is not.”
(*GA* II.1, 734b4-7)

There is no agreement among interpreters about how to understand the discussion that immediately follows.²³ As I understand it, the resolution involves showing that we were wrong to be looking for some *thing*—“some this” (*tode ti*, 734b18)—that could be making the embryo’s parts. It is rather the *movement* being conveyed in the semen that is making the parts.²⁴

“Surely, to say “*sperma*” or “what *sperma* comes from” makes no difference, insofar as it has in it the movement which that one [sc. the father] was moving. And it is possible for *this* to move *this*, and *this* to move *this*, and to be like the spontaneous marvels. For in a way the parts, although resting, retain a power. Whenever something external moves the first of the parts, straightaway the following one comes to be in actuality. Just as, then, in the spontaneous [cases], [a] in one way [the mover] moves, not touching anything now, but having touched. And similarly, also what *sperma* comes from or the one who made the *sperma* did touch something, but is no longer touching. [b] And in another way the internal movement [moves], just as the

²² This is the fallacy of *secundum quid*: “confusing what is general (*haplôs*) and what is not general but some particular”, e.g., that ‘non-being’ exists, since what-is-not *is* what-is-not (*Rhetoric* II.24, 1402a3-17). See also *SE* 166b37ff.

²³ See Henry 2005 for a discussion the interpretations offered by Alexander and Simplicius, as well as one of his own. This is one of two passages in *GA* which draws on an analogy with the spontaneous marvels (*automata tôn thaumatôn*), and it is unclear what kind of spontaneous marvels Aristotle has in mind. It is clear enough that the father is being compared to the “first external mover” that gets the marvel moving, but beyond that the details are all disputed. I will ignore this controversy here, since the point this example is meant to illustrate has to do with the purpose for which Aristotle raises this *aporia*. I think that everyone agrees that the point is to provide a model for conceiving of the agent as something both external and internal.

²⁴ Johannes Morsink (*Aristotle on the Generation of Animals: A philosophical study*, University Press of America, 1982, 98) also takes the point of the *automata* analogy to be to “teach us not to view the efficient cause as a thing or a *tode ti* but as a movement (*kinêsis* – b17) or power (*dunamis* – b12).”

house-building [makes] the house. Well then, that there is something which makes, not being some particular present in [the *sperma*], nor from the beginning completed, is clear.” (*GA* II.1, 734b7-19)

We need not worry that the father is no longer in contact with the semen and directly moving it, for it is really the movement that the father had set up (by concoction of the spermatic residues) that is doing the work. And that movement in the semen can continue after the father releases the semen, much like the “spontaneous marvels” can continue to move after an external mover moves a part of it. So, since the movement in the semen is making the parts, there is a sense in which (*tropon de tina*, 734b16) the agent is something internal; since the father set up at that movement, there is a sense in which (*tropon men tina*, 734b13) the agent is something external.

(iii) Finally, sometimes Aristotle claims there is an *aporia* where it is not clear that what he goes on to say is moving the inquiry along in any way at all. In fact, in at least some cases, it appears that he is simply pointing out that there is some phenomenon for which we lack any explanation. These uses seem to be merely a way of introducing the next topic to be discussed. An example of this sort of use is the *aporia* about the uterine mole (*mulê*):

“There is a puzzle, on account of what [uterine moles] have not come about among other animals, unless something has entirely escaped notice.” (776a8-9)

The uterine mole is an abnormality that occurs early on during pregnancy (a “molar” pregnancy) whereby a mass is formed inside the uterus. Aristotle claims that the cause of this phenomenon is a weakness of the heat relative to the matter that the heat needs to concoct.²⁵ But apparently, Aristotle reports, this phenomenon has only been observed to occur in human women, and not in other kinds of animals. So, there is a question, introduced by the

²⁵ Modern biologists attribute this phenomenon to an over-production of the tissues that are supposed to become the placenta. Interestingly, since the placenta is what feeds the fetus, Aristotle was not far off (even if only by accident) in thinking that the cause of uterine moles has to do with excess nourishment.

aporia terminology, about why this should be the case. Perhaps there is something unique about human females that would explain this:

“One must suppose (*dei nomizein*) that the cause is that the women alone of other animals is *busterikon* and excessive in evacuations (*katharseis*) and not able to concoct them. So whenever a *kuêma* is put together from moisture that is difficult to concoct, then the so-called *mulê* comes about, reasonably either especially or uniquely in women.” (776a9-14)

Although it is not entirely certain what it means for women to be *busterikon*,²⁶ it is this feature, specific to human women, that accounts for the *mola uteri* only occurring in humans.²⁷

From this survey of a variety of passages, it appears as though there are a number of purposes for which Aristotle raises what he calls an *aporia*. Some are raised in order to refute alternative theories (refutative *aporiai*) by showing that they involve some absurdity or conflict with the observed facts or zoological principles, while others advance Aristotle’s own project (zetetic *aporiai*). Moreover, the zetetic *aporiai* move the inquiry forward in several ways: they either offer occasion to posit some unobservable entity, or to add new empirical data, or to revise the details of Aristotle’s own theory, or to change the conceptual framework being employed. Finally, claiming that something has or involves an *aporia* sometimes seems merely to be Aristotle’s way of introducing the next topic for discussion,

²⁶ It does not seem as though *busterikon* means merely “suffering in the womb,” “hysterical,” or “of or belonging to the womb,” which are the meanings listed in LSJ (online version, August 2015). It likely has rather to do with overt menstruation, which is most apparent in humans. Other references to *busterikon* in *GA* include *busterikous* membranes (717a5); *busterikon* part (*morion*) (720b21); *busterikon* place (738b7). At *HA* 570a5, (cf. 566a11), the *busterikous* passages are contrasted with seminal passages (*thorikous*).

²⁷ A case might be made for thinking that Aristotle’s purpose in raising this *aporia* about the uterine mole is to advance his inquiry, since it allows him to point to a ‘fact’ about human women not previously mentioned. Thus one might prefer to consider his purpose here to be zetetic. I am proposing, however, that this use of *aporia* be placed in a distinct category. Unlike the introduction of *pneuma* or revisions to Aristotle theory of the sort we have seen, the claim that human women alone are *busterikon* does not play any further role in Aristotle theory, as far as I can tell.

where he seems to mean that someone might not know how to answer a question and thus be as yet “without passage”.

Structure

In our previous discussion, we have seen that there are a variety of purposes for which Aristotle raises *aporiai*. Now, we will see that an *aporia* can take a number of different forms.

(i) Some of the *aporiai* are presented in the form of a dilemma. In such cases, we are given what appear to be exhaustive options. In some of these, the options are equally unappealing or impossible (the “negative” *aporiai*). The discussion of the agent of embryonic development is an example of a negative *aporia*. Recall that it initially seemed as though the agent must either be something internal to the *kuêma* or something external to it, and it did not seem that either could be the case. Aristotle resolved this by showing how, in a way, the agent can be both: Since it is movement—not “some this”—that is the agent, and that movement is derived from the male parent and conveyed to the *kuêma*, it is both something external (the father’s movement) and something internal (the movement in the first mixture of spermatid residues). *Aporiai* of this type have the form “Is A or B the case?”

(ii) In other cases, we are given what looks to be an exhaustive and exclusive dilemma, but no considerations for or against one of the horns are given. For example, in an *aporia* about what occurs at “the beginning of generation” in *GA* V.1, Aristotle begins by providing two options.

“There is a puzzle concerning the beginning of generation: does wakefulness obtain prior, or sleep?” (*GA* V.1, 778b23-25)

Without even considering the possibility that wakefulness is the prior state, Aristotle proceeds to adduce reasons in favor of it being sleep that is prior. It would be reasonable to think sleep is the earlier stage, he says, since animals become more wakeful as age advances, suggesting that they are proceeding towards wakefulness from its opposite. Moreover, since animal generation is a transition from not-being to being, it is plausible to think that an

animal would first be asleep, since that appears to be intermediate and “like a boundary (*methorion*) between living and not living” (778b29-30). However, Aristotle is reluctant to call whatever the developing animal does at the beginning “sleep”. Wakefulness is or at least involves the exercise of sense perception, and its opposite—sleep—is the absence sense perception. But it is not simply any absence of perception that constitutes sleep, but only the absence of perception in creatures for which perception can be present. Plants do not *sleep*, and they cannot wake up from being asleep, and that is because plants do not perceive.²⁸ The state plants are in is something else. So, too, at the earliest stage of development when the animal lacks the ability to perceive, we must say that the state they are in is not exactly sleep, but something *like* sleep.

“If it is necessary for an animal to have perception, and whenever perception has first come to be it is at that time first an animal, then it must be supposed that the condition from the beginning is not sleep but like sleep, just as the sort that plants also have.” (*GA* V.1, 778b32-35)

Here, the *aporia* is initially about whether A or B is the case, but Aristotle immediately moves to consider only B. This looks less like a genuine dilemma than a question about whether and how B might be the correct answer to the question that was originally posed.

(iii) Furthermore, some *aporiai* do not have the appearance of a dilemma at all. Many times Aristotle says that there is an *aporia* about some phenomenon, where what he apparently means is that there is a question about it, such as how, what or why something happens.

(iiia) Some of these questions are of the form “Why does F occur among A’s but not among B’s?” Typically, these are questions about why something generally true of some larger kind is not true of some subset of that kind. He uses the *aporia* language, for instance,

²⁸ cf. *de Somno* I, 454b25-29: “We say that sleep is in a certain way a motionlessness (*akinêsia*) of perception, and like a restraint (*desmos*), and that the release and relief is wakefulness. But no plant is able to partake in either of these affections; for without perception, neither sleep nor wakefulness obtain.”

when he introduces the discussion of a difference between bird and fish generation: bird eggs are separated from the uterus prior to being ‘complete’, whereas fish eggs remain attached to the uterus. Aristotle says that “someone might *aporéseien* about why the generation of birds and fish differ in this respect” (754b20-1). Both are egg-layers, but the particular ways in which they produce eggs is not the same.²⁹ So, Aristotle sometimes introduces with the *aporia* language a question about why something true of A is not true of B, where A and B are members of some wider kind, such as egg-layers or live-bearers.³⁰

(iiib) Aristotle also uses the *aporia* language where what follows is simply a question about *what* happens. For example, he begins *GA* II.3 by asking what happens to the bodily part of semen when it enters the uterus, given that that bodily part does not become part of the developing embryo (736a24ff). And sometimes these are questions about *why* something happens. He says that the reason why the eyes appear largest at the beginning of generation but are the last of the parts to be completed “has” *aporia* (743b32ff). What Aristotle says involves *aporia* here is simply a question about the cause of some phenomenon that we do not yet know.

There does not appear to be any significant overlap among the *aporiai* if we attend to the form in which they are presented, i.e., whether as dilemmas or merely questions. So, just as we were not able to draw any general conclusion about the purposes of Aristotle’s biological *aporiai*, there is also no such conclusion to draw about their structure.³¹

²⁹ Besides the fact that birds and fish are both egg-layers, it is not clear why someone would expect bird and fish generation to be the same. Aristotle has discussed many other differences between birds and fish earlier in *GA*. And Aristotle does not spend any time explaining why this difference, in particular, should be puzzling. Rather, he immediately proceeds to simply give the explanation.

³⁰ Another *aporia* having this structure concerns a peculiarity of selachia (757a14ff). Female selachia are not seen discharging their *kuémata*, and the males are not observed emitting their milt. Both of these phenomenon, however, are seen in other live-bearers. Here the question being raised is why selachia do not exhibit all of the characteristics of other live-bearers.

³¹ Is there some other feature of their structure that might lead us to some general conclusion? One might wonder, for example, whether there is some important difference that is being tracked by occurrences of *aporia* versus *aporeseien an tis*. Unfortunately, however, this seems not to be the case. For, Aristotle uses both the noun and verbal forms when discussing the same phenomenon on several occasions. Both *aporia* and *aporeseien an tis* are used in the discussions of, for example, the behavior of semen (735a29ff), why the female

Sources

Having been unable to discover any common purpose for which Aristotle raises *aporiai* in biology, and having seen that they lack any common form, one might wonder if instead there is some other distinctive feature they share. Perhaps, one might think, the biological *aporiai* are united in being generated by having a common type of source, such as a lack of observational evidence. However, there does not seem to be anything general to conclude about the reasons—what I am calling the “sources”—why the *aporiai* arise.

(i) Some involve a tension between Aristotle’s biological theory, as it has been articulated so far, and some apparently recalcitrant data or observations. The tension that gives rise to the *aporia* about the heart’s nourishment (740b2-8) is of this sort. The theory established the heart as the source of nourishment for the developing embryo, but the heart, too, has to get its nourishment from somewhere. Here the conflict is resolved by simply modifying the theory: Perhaps there is nourishment in the heart from the outside, so it is not true that all nourishment comes from somewhere else.

(ii) Other *aporiai* arise because there is a conflict between the details of Aristotle’s biological theory and his own deeply held, general commitments. Attending to these is often illuminating, for they reveal a natural scientist working within the constraints of a grand metaphysical framework, self-consciously applying the concepts and principles he argues for elsewhere, though at a fairly abstract level. As I understand it, the *aporia* about the agent of embryonic development has this type of source. Aristotle has argued elsewhere that in general, change requires contact between agent and patient. Here the *aporia* arises because it seemed difficult to see how his embryological theory could accommodate this.

(iii) Further, there are cases said to involve *aporia* in which there is a tension between some general principles and the empirical evidence. For example, Aristotle announces at *GA* I.8, 718a35-7 that “someone might be puzzled about the facts concerning the uteri in

needs the male in order to generate (741a6ff), and whether the cause of multiple births and redundant parts is the same (770b30ff).

women, how they are” since “many oppositions (*hupenantioseis*) belong to them”(718a36-7). In some kinds, the uterus is higher up, near the diaphragm, and in some it is lower, near the pudenda.

Five chapters earlier, (*GA* I.3, 716b12-13) Aristotle had already said that “the things concerning” (*ta peri*) the testes and uteri are not the same in all blooded animals, and then proceeds to discuss differences amongst the male sexual organs for the next five chapters. He explains why some kinds have and some lack testes, and why those which have them do so internally or externally. Thus someone might rightly be puzzled about why variations amongst the female sexual organs should be so puzzling.³²

It appears as though this *aporia* arises because the variation in the position and orientation of the uterus does not coincide with the distinction between being a live-bearer and egg-layer. Some kinds of live-bearing animals have the uterus high, and others have it low. The same is true of the egg-laying creatures. However, the variations found among male testes, too, cuts across the live-bearer/egg-layer distinction, and that is not something Aristotle identified as puzzling. Why might someone be puzzled about the variations in the position of uteri in different animal kinds, but not about the variations in the placement of testes?

Although Aristotle does not say so explicitly, I suspect that the reason this is puzzling is that it is in tension with some familiar principles of his natural science, such as the principle that nature does nothing in vain, and that *morphê* follows function (and not the reverse). In the case of the uterus, there seem to be variations in *morphê* that do not track variations in its function, which is to provide “protection, shelter, and concoction” (I.12, 719a33-4). Given this function, one might expect that only a difference in what is being produced (i.e., whether what is being protected, sheltered, and concocted is an egg or a ‘complete’ animal) should require a difference in the position of the uterus. But not all egg-layers have the uterus positioned in the same way. The function of the testes is to “make the movement of the spermatic residue more steady” (717a30-1). Given that function, there is no reason to expect the male organ’s presence or position to co-vary with the kind’s being an

³² This seems to be reflected in, for example, Platt’s translation: “It is not easy to state the facts about the uterus in female animals, for there are many points of difference.” Platt seems disinclined to treat this as a puzzle at all, but rather a “difficulty” in “stating facts” about the uterus.

egg-layer or live-bearer. This is why there is puzzlement about the uterus but not about the male sex organs.

Aristotle resolves this by distinguishing different ways of being egg-layers, and different ways of being live-bearers. Egg-layers are divided into the kinds that produce “complete” eggs (i.e., hard-shelled ones, such as those of birds), and those that produce “incomplete” eggs (i.e., soft ones, such as fish produce) that are “completed” externally. For the hard shell to be formed, the uterus needs to be near a source of heat, and this is what the higher placement provides. If less heat is required, as is the case for the formation of the soft-shelled, incomplete eggs, the uterus is positioned lower and closer to the exit (*peras*), since that is more expedient. So, there is a difference in function from which the differences in *morphé* follow, after all.

(iv) Finally, sometimes the source of *aporia* is not any difficulty or tension of the sort we have seen in the previous examples. Sometimes the reason that there is *aporia* is that some fact has been overlooked. For example, it has “escaped notice” that bird eggs have an umbilical cord-like part at the beginning, and that missing observation is what gives rise to the difficulty in explaining how the egg receives its nourishment. And sometimes it is not that we lack observations, but it is simply the fact that no explanation has yet been offered that creates the impasse.

So, difficulties can be due to conflicts between some particular explanation, whether Aristotle’s or someone else’s, and the empirical evidence. An *aporia* can also involve tensions between some particular explanation and some more general principles. Some of the principles are specific zoological ones, such as the principles that nature does not give weapons to females, or that males do not tend to their offspring. Other principles are ones that hold of change, generally, such as that change requires contact. Further, sometimes the source of *aporia* is that the observed data do not cohere with the general principles. Lastly, for some of the *aporia*, it is not obvious that there is any genuine conflict or tension at all. These appear to be cases where the *aporia* is simply due to an absence of evidence or lack of any explanation, at least so far. Consequently, *aporia* in Aristotle’s biology cannot be said to be generated by some specific type of problem. There is no obvious way, at any rate, to unify the *aporiai* in *GA* by their source.

Conclusion

From a close look at the discussions in which Aristotle explicitly uses the *aporia* terminology, it appears as though *aporia* in *GA* is *pollakôs legomenon*. The purposes for which Aristotle raises them vary a great deal, as do the structures the discussions exhibit, as well as their sources. Moreover, it is possible to point to further ways in which they differ. For example, Aristotle uses a variety of methods to resolve them. Sometimes he brings in additional observations, such as the fact that eggs do have something umbilical cord-like, even though it is hard to see.³³ At other times, he modifies or qualifies his theory in some way, as he does when discussing the source of the heart's nourishment. More interesting cases involve his making some conceptual distinction, as he does when trying to identify the agent that makes the embryo's body parts.

The *aporiai* also differ quite a bit in terms of their seriousness. Some, to be sure, are deeply problematic, and Aristotle seems to think that their resolution is pressing. Others, however, do not seem to be particularly worrisome to him at all, at least in the present context. In fact, sometimes he seems merely to be pointing to a potential problem for his theory, but one that he is not going to attend to at this time. After raising the issue about heart's nourishment, for instance, Aristotle returns to discussing how the growing embryo receives its nourishment through the umbilicus, and makes no further mention of the heart's nourishment.³⁴

Now, what can we conclude about Aristotle's biological *aporiai*, given that they seem to be so multiform and multipurpose? One might reasonably harbor doubts that those puzzles that he calls *aporiai* mark off some well-delimited group. Perhaps the concept of an *aporia* may be more fluid for Aristotle than one might have supposed. It may be simply a matter of being without passage, in some vaguely defined sense.

³³ See also, e.g., his criticism of the idea that hyenas have two pudenda (757a2-13). "Cursory" or "casual" (*ek parodon*) observation has produced this false belief.

³⁴ The same is true of the *aporia* in *GA* V.1 about whether sleep or wakefulness is prior. After concluding that it is not sleep but something "like sleep" that is the prior state, he immediately goes on to the next topic.

Alternatively, one might maintain that he does in fact have some clearly defined notion of an *aporia*, such as the state of puzzlement arising from dialectical *problemata*,³⁵ while thinking nevertheless that such genuine *aporiai* are not tracked by the use of *aporia* language. For, the multiplicity of purposes, structures and sources of the *aporiai* we have looked at suggests that no common kind of puzzlement is being indicated by the occurrence of the *aporia* terminology. At best, the genuine *aporiai* would have to be merely a subset of the difficulties Aristotle calls by that name. So, if he thinks an *aporia* is a specific type of puzzlement, his use of *aporia* terminology will not be sufficient for telling us when we are facing one. We also have reason to doubt that the occurrence of *aporia* terminology is necessary for telling us when there is a genuine *aporia*: There are at least a few instances in *Generation of Animals* where one finds discussions that are very similar in structure and purpose to some of those we have examined. For instance, in his survey of the various arguments adduced by the preformationist theory of generation³⁶ in Book I, chapters 17-18, there is the same systematic treatment of preformationist arguments as one finds in passages explicitly flagged as involving *aporia*. This is also true of his discussion of alternative explanations of sexual differentiation in Book IV, chapter 1. The purpose for which he methodically runs through the arguments and rival views, just as in the *aporia* about bee generation, is to show the superiority of his own theory and the impossibility of any other. In neither case does Aristotle employ *aporia* language.

Finally, we might conclude that *aporia* is not an especially important part of Aristotle's method in his biology. When studying the heavens, perhaps *aporiai* are needed, since "we have but little to go upon, and are placed at so great a distance from the facts in question" (*de Caelo* II.12, 292a15-7, Stocks trans.). The study of eternally ungenerated and imperishable beings is more valuable and more divine than that of generated and perishable beings, but it is harder to study the former since "those things on the basis of which one would examine them and those things about them which we long to know, the perceptual phenomena are altogether few" (*PA* I.5, 644b25-6, Lennox trans.). Where observable data is available, on the other hand, perhaps the knots are readily apparent, and thus running through the puzzles is not required. In the case of the study of plants and animals,

³⁵ As discussed by Rapp in his contribution to this volume (Chapter 6).

³⁶ According to the preformationist theories, the seed from which the organism develops is composed of parts from each parent's body.

consequently, using *aporia* might thus be less pressing: in this domain, we have more means (*euporoumen mallon*) to attain knowledge, since we are fellow creatures (*sunthropon*) (PA I.5, 644b28-9).

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