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PART I

The Unity and Structure of Aristotle's
Generation of Animals

CHAPTER I

“One Long Argument”?
The Unity of Aristotle's Generation of Animals

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Introduction

We believe that the five books of Aristotle's *GA* are a single project, in answer to a single question, and thus have a single plan that runs from beginning to end. As a consequence, it seems to us that *GA* is a complex structure in which later parts depend on what has come before, so that it would not be effective to rearrange the pieces. Our sense is that the unity of *GA* derives from the way in which each of its parts is needed to make the case for the thesis that the entire argument is meant to support. This thesis, which represents also the conclusion of the argument, can be stated as follows: *In sexual generation, the animal offspring comes to be as it does from parents one in form with the offspring because of the transmission of form from the parents (primarily from the male) via an irreducible active potential to act upon material provided by the female (which material is such as to have a passive potential to be so acted upon) in ways that vary according to the type of animal in question (some of them live-bearing, some egg-laying, some grub-producing) – or by a process and factors analogous to that, deriving not from parents one in form with the offspring, as in spontaneous generation. And this*

Aristotle's *GA* remained at the very heart of Allan Gotthelf's philosophical engagement with Aristotle throughout his whole career – from his first article, *Aristotle's Conception of Teleology* (1976/77), where Allan offers an interpretation of Aristotle's teleology in terms of what he calls Aristotle's conception of an irreducible potential for form, to his last, *Teleology and Embryogenesis in Aristotle's GA II 6* (2012). In Allan's mind, the article that appears here for the first time was the necessary completion, and indeed vindication, of his reading of Aristotle's *GA*. I, Andrea Falcon, worked with Allan on this article from the Fall of 2010 to his death on August 30, 2013. When it became clear to Allan that he did not have much time left to live, this article became his top priority. I was able to correspond with him until August 4, 2013. What appears here is an abridged version of a much longer article. I am confident that this shorter version captures all the essential points made in the longer article, and that it represents accurately how Allan read and understood Aristotle's *GA*. I am happy to acknowledge that not only the original impetus for this article but also most of the ideas collected in it are Allan's. I consider myself fortunate to have been his friend and a collaborator on this project. I hope to be able to publish the longer version of this article together with our (Allan's and mine) joint translation of Aristotle's *GA* in the near future.

process, in the case of sexual generation, takes place entirely because it is needed for the generation of the offspring. In the pages to follow, we will collect textual evidence to help the reader evaluate our interpretation. We will begin with the overall aim of *GA* and continue with the argument of *GA* to see how the former is realized in the latter.

The Aims of *GA*

For the statement of the overall aim of *GA*, and its setting in the larger enterprise of the study of animals, the place to start is outside *GA*, in a passage in *PA* 1.1. Having argued that coming into being (*γένεσις*) is for the sake of being (*οὐσία*), and not the reverse, Aristotle adds:

- (i) Hence we should, if possible, say that because this is what it is to be a man, therefore he has these things; for he cannot be without these parts. Failing that, we should get as near as possible to it: we should either say altogether that it cannot be otherwise, or that it is at least good thus. And these things follow. (ii) And because he is such a thing, his coming to be necessarily happens so and is such. And that is why this part comes to be first, and then this. (*PA* 1.1, 640a33–b4; trans. Balme)

In this passage, Aristotle outlines an aim for both *PA* and *GA*. While *PA* is concerned with the explanation of why animals have the parts they do, *GA* focuses on the process by which those parts come to be present. The second part of our passage elaborates on how this process has to be explained. The explanation must start from the nature of what is to be produced: it is because the product has the nature it does that certain things follow (of conditional necessity) regarding how it must come into existence. And that is why, Aristotle adds, the parts come into existence in *the order* in which they do.

What we read in *PA* 1.1 has to be integrated with what we are told in the opening paragraph of *GA*. There we are told that we have already studied the final, formal, and material causes of each of the parts of animals except for the generative ones. What remains to be done is a *PA*-like study of the generative parts and an overall study of the moving cause:

- There remain of parts the ones that contribute to generation, about which nothing was delineated earlier, and in regard to the moving cause, what the source is. To inquire about this cause and about the generation of each animal is in a way the same thing. (*GA* 1.1, 715a11–14)

According to this passage, a primary focus of *GA* is “the source of the moving cause.” To put it differently, *GA* is an attempt to answer the

following question: *What agent(s), and what actions of theirs, bring animals and their parts into existence?* If we bring to bear on this passage from *GA* what we read in *PA* 1.1, we may add: *And in what order?* *PA* 1 mentions an account in terms of conditional necessity. This brings our attention to *the final cause* of animal generation: the production, or existence, of an animal of a certain nature. A full account of the generation will not only include but also connect the final and the efficient causes of generation. It will establish the order in which the generation takes place and explain why the order is that way. The need for the teleological dimension explains why Aristotle says that an account of the moving cause is an account of generation *in a way*. With this qualification, Aristotle does not rule out that other causes, in addition to the efficient cause, are involved in the explanation of generation. In fact, it is only with the teleological dimension in place that we have a full account of the coming into being of an animal.

GA 1: Aristotle's Initial Move

With the overall aim of *GA* in place, we can turn to its argument. The latter begins with the following three-part observation: in many cases, animals come into existence from (1) the *coupling* of (2) *male* and (3) *female* (*GA* 1.1, 715a18–20). This is our initial observation – what we observe, when we first look. It is one observation because the three items that constitute it are interdefined. What we observe is a coupling, that is, the insertion by one organism of a part into the other organism. This observation originates the initial definitions of the male as that which is capable of generating into another, and of the female as that which is capable of generating into itself (*GA* 1.1, 716a13–15). So neither “male” nor “female” nor “coupling,” as we observe in most cases, makes sense without the other two. Our observation is concerned with the moving cause of generation, which is to say the whence of the motion that is the coming into being of an animal offspring. In other words, the move that opens the argument of *GA* is perfectly aligned with the stated aim of the work: a study of the generation of animals largely (but not entirely) understood in terms of the moving cause.

A great deal follows from this initial move. As an immediate consequence of the choice to begin with the coming into existence of an offspring that is the product of the coupling of a male and a female, we must start our explanation of generation from the sources or principles (ἀρχαί) of that coming into being: the actual parents and their reproductive powers. Put differently, the process that we aim to explain begins with

the parents, so our explanation must start from them. In particular, *it must include a discussion of their reproductive parts*. The latter are considered organs or instruments for their reproductive powers (*GA* 1.1, 716a23–25). Therefore, if we want to study the reproductive powers of the male and the female, we have no choice but to study how they are realized in the relevant bodily parts. This explanatory strategy is the reason why Aristotle turns to a study of the reproductive parts as soon as the initial definitions of the male and the female are in place. This study occupies the first part of *GA* 1 (*GA* 1.2–16).

This explanatory strategy is also the reason why the discussion of reproductive parts is postponed in *PA*.¹ Aristotle could (and would) have spoken of the reproductive parts in the context of his treatment of the parts of animals, if he did not need to speak about the coming into being of animals. But since he has to speak of the coming into being of animals, he makes a determination that it is only in the context of the latter account – which is a fuller account of the reproductive capacities and functions of the male and the female as sources or principles (ἀρχαί) of generation – that he can optimally explain why there is not only a general difference between the generative parts of male and female animals, but also further differences between the generative parts of both male and female members of different species. If we return to the opening lines of *GA*, where the overall aim of the investigation is outlined, we find that Aristotle announces an argument that brings together two things: a study of generative parts and a study of the coming into being of animals, to be approached in this very order:

Our argument (λόγος) has brought them together, putting these parts [sc. the parts that contribute to generation] last among the things to do with parts, and the beginning of our account of generation next after that. (*GA* 1.1, 716a2–4)

Another consequence of the initial move, and the ensuing focus on sexual generation, is the need to understand the respective contributions to the generative process of the male and the female, including the extent to which each contributes seed (σπέρμα). It is telling that, already in the opening chapter of *GA*, the study of σπέρμα is predicted to be of the utmost importance in understanding the distinctive roles of the male and the female in the coming into being of an offspring:

In accordance with what we said, one might posit the male and the female as sources of generation [. . .] one would most of all come to believe

¹ Cf. *PA* 4.4, 678a21–26.

this if one studied how the seed (σπέρμα) is produced and from where.
 (GA I.1, 716a4–8)

Also in light of this anticipation, it is no surprise to find out that Aristotle turns to the study of σπέρμα as soon as he has completed his study of the reproductive parts. Here is what Aristotle says as he introduces the topic of σπέρμα in GA I.17:

It is thought that all [animals] come from seed, and that the seed comes from those that generate. Therefore, it is part of the same argument (λόγος) [to establish] whether both male and female emit seed and whether it comes from all the body or not from all; for it is reasonable, if it does not come from all the body, that it may not come from both the generators either. Since some say that it comes from all the body, we must first examine how the matter stands. (GA I.17, 721b6–12)

The question of whether the σπέρμα comes from both the male and the female is linked to the question of whether it comes from all of the body. If not the latter, then the former need not be true either. This link is reaffirmed at the end of the discussion of pangeneses as a way to introduce the discussion of the respective contributions of the male and the female, beginning with the role played by the female:

If the female does not emit seed, by the same argument neither does it come away from all [body], and if it does not come away from all [body], there is nothing absurd in the seed not coming from the female, but the female being a cause of generation in some other manner, which is what is to be investigated next, since it is apparent that the seed is not separated off from all the parts. (GA I.17, 724a7–13)

The question of whether the female emits σπέρμα is the entry point into the larger question of how the male and the female contribute to the generative process. The latter is the question that concerns Aristotle in the second part of GA I (GA I.17–23). This stretch of text provides *the basic framework* of an answer to this question, *a schema* for understanding the role of the male and the female *qua* contributors to the generation of the offspring. We will have to see how this schema is filled out in the rest of GA. For the time being, let us concentrate on the progression of the argument in GA I.17–23. Aristotle is quite forthcoming about his argumentative strategy: the starting point of his investigation is to establish what σπέρμα is (GA I.18, 724a14–15). It is neither a part of the body, nor some unnatural growth, nor nutriment taken in from outside, nor a colliquation, and so it must be a residue. It must be a residue of the useful nutriment at its final stage – blood concocted and somehow particularized (GA I.18, 726a26–28 combined

with *GA* 1.19, 726b5–6). As soon as he has established what σπέρμα is, Aristotle turns to the female contribution to generation in order to establish what it is. He is able to establish that the blood-like secretion produced in the female (the menses or καταμήνια) is a useful residue, having its nature because of the colder (and thus weaker in ability to concoct) character of the female (*GA* 1.19, 726b30–727a2). This contribution is not σπέρμα: two spermatid secretions cannot be produced at once; if the female produced σπέρμα, it would not have καταμήνια; but it has καταμήνια, so it cannot produce σπέρμα (*GA* 1.19, 727a25–30). He is also able to establish the nature of the female contribution to the generative process: *the female contributes the matter* (*GA* 1.19, 727b32). At this point, Aristotle turns to the male contribution to establish, again, what it is. He approaches this question by presenting two options:

At the same time from these things it is apparent in regard to those things which are to be investigated next, how in the world the male contributes to generation, and how the male's semen is a cause of that which comes to be, whether [a] as present within and being immediately a part of the body of that which is coming to be, mixing with the matter from the female, or [b] the body of the semen does not participate but the potential (δύναμις) and movement (κίνησις) in it does, for this potential is that which acts while that which is constituted and takes the shape is the remainder of the residue in the female. (*GA* 1.21, 729b1–8)

It turns out that the latter is the position endorsed by Aristotle: the male does not contribute any matter but rather an active potential (δύναμις), which is based in certain movements (κινήσεις) conveyed by the semen (σπέρμα). A general reflection on what comes into existence from the action of an agent on a patient suggests that this is all that is needed. Furthermore, what we observe in the case of certain insects, where the male does not insert a part of itself into the female but, on the contrary, the female inserts a part of herself into the male, and the heat and the δύναμις of the male (such as it is) does the causal work, confirms this suggestion (*GA* 1.21, 729b22–33).

At this point, Aristotle has delineated an answer to the question of how the male and the female contribute to the generation of an animal. He is in a position to explain why the female parent does not produce offspring by herself: generation needs a source of motion, which is to say something that initiates the process (*GA* 1.21, 730a29–30). He is also in a position to explain why the formation and development of the embryo takes place in the female: the matter out of which the embryo comes into existence is provided by the female parent – both that out of which the embryo

is formed and the additional matter supplied as the embryo grows (*GA* 1.22, 730b1–4). Aristotle uses the craft analogy to argue that the male contribute *the form* by means of his role as source of motion. In particular, in those animals that emit semen (σπέρμα), nature uses the latter as a tool with motion in actuality just as an artist uses specific tools to produce a certain outcome (*GA* 1.22, 730b19–23).

With an answer to the question of how the male and the female contribute to the generative process, the argument has come to a natural pause. Before continuing our review of the argument of *GA*, we would like to take stock of what we have learned so far:

- (1) The key to the unity of *GA* 1 is Aristotle's initial move (our initial observation). This move helps dispel the special problems posed by *GA* 1 for those who seek unity in *GA* – unity not only between books but also across a book.
- (2) Aristotle uses the term “λόγος” to describe what he is offering in *GA*. With reference to the study of the moving causes and the *PA*-like study of the generative parts, he says that “*our λόγος has brought them together*” (*GA* 1.1, 715a15). In postponing the study of spontaneous generation, Aristotle announces that the study of each kind of animals is to be conducted “*according to the ongoing λόγος*” (*GA* 1.1, 716a3). In introducing his discussion of σπέρμα, Aristotle tells us that “*it is part of the same λόγος whether both male and female emit seed and whether it comes from all body*” (*GA* 1.17, 721b7). In all three cases, we have translated λόγος with “argument” rather than “account” or “exposition.” As we proceed in our analysis of *GA*, it will become clear that the λόγος in question is a logical narrative in which subsequent components build on previous components, and that together they form a unity leading up to a single complicated thesis – the conclusion of the argument we have expressed in a single statement at the outset of our essay.
- (3) *GA* 1 is the first installment in a long argument. The book provides the beginning of an answer to our central question: *what agent(s), and what actions of theirs, bring animals and their parts into existence? And in what order?* *GA* 1 is manifestly not meant to stand on its own. A few times, the text points ahead: when it promises a discussion of milk (*GA* 1.16, 721a26–30); when it says that mutilations and resemblances are to be studied together (*GA* 1.17, 724a3–7); when it postpones dealing with the significance of multiple births (*GA* 1.20, 729a11–14.); and finally when it announces a study of the generation of the hard-shelled animals (*GA* 1.23, 731b13–14).

GA 2: A Fresh Start? Not Quite

Let us recall the observation that marks the beginning of the argument in *GA* 1: in many cases, animals come into existence from (1) the *coupling* of (2) *male* and (3) *female*. It is on the basis of this initial observation that Aristotle posits the male and the female as the sources of the coming into being of animals. Given the centrality of the male and the female in Aristotle's theory of animal generation, the argument of *GA* cannot be completed without an attempt to answer the question of why there are males and females. Furthermore, *GA* 1 ends with the claim that the male and the female are together in plants but are separate in animals (*GA* 1.23). At that point, the perceptive reader may wonder why the sources of generation have to be separate in animals if they are not so in plants. With this in mind, let us turn to the beginning of *GA* 2:

It was stated earlier that the female and the male are sources of the coming to be, and what is their capacity and the definition of their being. Why the one comes to be and is female, the other male, insofar as it is of necessity and from the proximate mover and a certain sort of matter, our argument (λόγος) must try to tell as it proceeds; but insofar as it is due to the better and the cause that is for the sake of something, it has its source from above. (*GA* 2.1, 731b18–24)

While the first sentence makes contact with *GA* 1, the second promises an answer in two parts to the question of why there are males and females. The second part of the answer is an explanation of why it is better that the male and the female are separate principles. This explanation is given in *GA* 2.1. This is not yet an explanation of the coming into being of the male and the female. For that, we have to wait until *GA* 4.

As soon as Aristotle has an answer to the question of why it is better that the male and the female are separate sources, he makes an observation that shapes his discussion throughout *GA* 2–3. He observes that there is a great deal of variation in the degree of completeness of the immediate outcome of γένεσις: some animals produce similar, complete, live young, while others give birth to something that is not articulated: eggs in the case of blooded animals, grubs in the case of bloodless insects. Aristotle traces this variation in the degree of completeness at birth back to the nature of the generating parents: the hotter and the moister their nature is, the more complete their product is at birth (*GA* 2.1, 732b27–32). This observation is our second observation. While the three-part observation that opens the argument of *GA* controls the whole argument of *GA*, the second observation shapes the argument in *GA* 2 and *GA* 3. As we progress in our

explanation of the coming into being (γένεσις) of animals, we have to take into account what is *specific* about each of the different modes of reproduction, starting from the live-bearing animals, continuing with the egg-laying animals, and ending with those that produce grubs. The study of the live-bearing animals is offered in *GA* 2. The other two kinds of animals are discussed in *GA* 3.

Before turning to the study of the live-bearers, Aristotle deals with three concatenated puzzles whose significance is general. At least two things should be noted in connection with these puzzles. First, they concern *all* modes of generation, so they have to be discussed *before* engaging in a study of what is specific about the different types of animals. Second, these puzzles naturally arise from the results reached in *GA* 1, so their discussion represents a natural development, and indeed an inevitable continuation, of the theory advanced in *GA* 1. We have suggested that the second part of *GA* 1 (*GA* 1.17–23) provides a *schema* to understand the role of the male and the female contribution to the γένεσις of animals. In *GA* 2.1–3, Aristotle fills that initial schema in various, important ways. The first puzzle, which is emphatically described as a very great one, is introduced by this question: How does the plant or any of the animals come from the seed?² The puzzle is generated by the following considerations. On the one hand, the agent must be in contact with the product, so the male parent cannot be responsible for the internal conception, and indeed the development, of the embryo. On the other, the agent must be in actuality what comes into existence, so the agent cannot be in the semen. To solve the puzzle, Aristotle introduces the idea that contact can be transmitted in such a way that the actual parent can be responsible, as source of motion, for the final product of γένεσις even if it does not touch it. The example used to illustrate this idea is that of the “marvelous αὐτόματα” in which a single, minute movement at the beginning can initiate a complex, structured result. In the case of the “marvelous αὐτόματα,” the result is perhaps a dance; in biological generation, it is the coming into existence of an animal and its parts. With the help of the illustration, we can see how a single causal power or potential transmitted from the actual parent via the σπέρμα remains active throughout the entire process, shaping and controlling it from beginning to end.

As soon as Aristotle has worked his way through the first puzzle, he is ready to turn to the question of what kind of material nature the σπέρμα must have in order to be able to carry the generative δύναμις:

² *GA* 2.1, 734b22–24.