



Ancient Philosophy and Scientific Method: Aristotle and Galen on the Role of the Heart in the Construction of the Embryo

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Abstract: This paper concerns Aristotle and Galen's scientific method and the place of philosophy in their natural scientific endeavors as manifested in their discussions on the role of the heart in the formation of the embryo. I will begin first by discussing Aristotle's conception of natural sciences and his discussion on the role of the heart in the body and embryo. Following this is Galen's critique of the role of the heart in the formation of the embryo. Galen had considerably more knowledge about anatomy and the construction of the embryo, yet his scientific method is not radically different from Aristotle's as he also utilizes both logical arguments and observational data. Nevertheless, he attempts to banish philosophers from discussing anatomical issues, thus opening the path to specialization.

Keywords: Ancient philosophy, Aristotle, Galen, heart, embryo, scientific method, natural science.

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Introduction

In his trilogy, *History of Animals*, *On the Parts of Animals*, and *Generation of Animals*, Aristotle presents not only factual information about animals but also discusses theoretical and methodical issues regarding the study of animals and natural sciences. According to Aristotle, “an educated man should be able to form a fair off-hand judgment as to the goodness or badness of the method used by a professor in his exposition.”¹ Thus, he articulates his method of studying animals in order to enable his audience to judge whether his explanations are reliable. Aristotle points out that instead of studying each species separately; he analyzes certain characteristics that are shared by different species. He notes, putting differences aside, there are many commonalities between genera such as sleep, respiration, growth, death, etc. Considering practical outcomes, Aristotle argues for categorization across species for practical purposes such as avoiding repetition and saving time and energy.

Aristotle on Natural Sciences and the Heart

In order to fully appreciate the epistemic value of Aristotle’s works on animals, I would like to note his ontology and epistemology roughly based on his discussion in *On the Parts of Animals*. Aristotle classifies beings into two: eternal beings and natural beings. Theoretical sciences and natural sciences correspond to these two kinds of beings respectively. While theoretical sciences deal with “that which is”, which manifests “absolute necessity”, natural sciences deal with that “which is to be”, which manifests “hypothetical necessity”.² Aristotle noticed that it was impossible to trace back the origins of a certain phenomenon in nature considering the possibility of multiple influences and the impossibility of reconstructing those influences.

Scientific endeavor for Aristotle consists of explaining the

¹ Aristotle, *De Partibus Animalium*, trans. William Ogle, *The Works of Aristotle*, vol. V, ed. David Ross (Oxford: Clarendon Press, 1912), Book 1, Part 1, 639a5-8.

² Aristotle, *De Partibus Animalium*, Book 1, Part 2, 640a1-5.

causes of things. Aristotle determines four causes in natural phenomena namely final, formal, efficient, and material causes. Among these causes, Aristotle thinks that final and formal causes provide the best explanation of natural phenomena.³ Thus, in his works, Aristotle starts his natural scientific explanations of final and formal causes of things and then describes the process (material and efficient causes) through which teleology is achieved.

Aristotle's discussion on the construction of the embryo and the heart manifests his above-mentioned theory. He looked at the final product and worked through this end product in order to explain why it came into being and what is its purpose. Similarly, he looked at the animals and observed that the heart is the main source of vitality and sensation in them. Considering its role as a manager in the complete body of animals, Aristotle thought that the heart should play a similar role in the construction of the embryo. Aristotle's conception of the heart was primarily influenced by his theoretical vision, notwithstanding his claim that dissections and observations of the embryo support his views on the heart. The following passage succinctly represents Aristotle's views and the way he reasons:

For the heart is the first of all the parts to be formed; and no sooner is it formed than it contains blood. Moreover, the motions of pain and pleasure, and generally of all sensation, plainly have their source in the heart, and find in it their termination. This, indeed, reason would lead us to expect. For the source must, whenever possible, be one; and, of all places, the best suited for a source is the center. For the center is one and is equally or almost equally within reach of every part. Again, as neither the blood itself, nor yet any bloodless part, is endowed with sensation, it is plain that that part which first has blood, and which holds it as it were in a receptacle, must be the primary source. And that this part is the heart is not only a rational inference but is also evident to the senses. For no sooner is the embryo formed, than its heart is seen in motion as though it were a living

³ Aristotle, *De Generatione Animalium*, trans. Arthur Platt, *The Works of Aristotle*, vol. V, Book 1, Part 1, 715a3-17.

creature, and this before any of the other parts, it being, as thus shown, the starting-point of their nature in all animals that have blood. A further evidence of the truth of what has been stated is the fact that no sanguineous animal is without a heart.⁴

As can be seen, Aristotle believes that the heart is the first organ that is formed and the source of other members of the body. The heart occupies the center of the body and is the seat of sensation. It is clear that Aristotle applies his metaphysical or theoretical principles to natural phenomena when he says that “the source must, whenever possible, be one; and, of all places, the best suited for a source is the center.” In fact, this statement contradicts his above-mentioned theory that natural phenomena have multiple causes and it is difficult to determine those causes.

Aristotle has a sophisticated theory and method in natural sciences. Yet his discussion on the role of the heart shows that he does not abide by his own methodological principles as he applies theoretical principles to natural phenomena. In other words, it seems that Aristotle’s conception of the heart is tremendously informed by his general philosophy and cosmology rather than evidence of the senses. As we will see, Galen challenges both Aristotle’s observational data and logical principles in his critique.

Galen’s Critique

Galen’s treatise entitled “The Construction of the Embryo” reflects his views on the formation of an embryo and the role played by the heart. He starts with a critique of the philosopher’s ideas on the matter. Galen states “Philosophers, too, have addressed the subject of the construction of the embryo, but have provided no anatomical basis for their statements. And it is really little wonder that such people miss the truth—and also, incidentally, disagree amongst themselves”.⁵ As can be seen, Galen’s critique of philosophers’ ideas, such as Aristotle’s and Stoics’, on the formation of the

⁴ Aristotle, *De Partibus Animalium*, Book 3, Part 4, 666a10-24.

⁵ Galen, *The Construction of the Embryo*, trans. Peter N. Singer, *Galen: Selected Works* (Oxford: Oxford University Press, 1997), 177.

embryo generally, and the role of the heart in this formation specifically, is primarily directed to their sources of knowledge. Reminding us that even the experts on anatomy erred on this issue, Galen notes, that it is much easier for a philosopher to err since they lack anatomical knowledge.

Galen asserts that a true account of the construction of the embryo should be based on substantial evidence of the senses. He warns doctors not to make absolute claims about these issues based on one or two observations of a few embryos. Galen has in mind contingency in the nature, and variation among different members of the same class while making this admonition. Thus, he suggests that natural scientists refrain from generalizations and absolute statements that are based on limited knowledge. In fact, on this issue, there is no difference between Aristotle and Galen as the former also makes similar remarks when he states:

Lack of experience diminishes our power of taking a comprehensive view of the admitted facts. Hence those who dwell in intimate association with nature and its phenomena grow more and more able to formulate, as the foundations of their theories, principles such as to admit of a wide and coherent development: while those whom devotion to abstract discussions has rendered unobservant of the facts are too ready to dogmatize on the basis of a few observations.⁶

Thus, theoretically speaking, Aristotle and Galen share similar views of how nature should be studied. Yet they differed dramatically regarding the construction of the embryo and the place of the heart in this process, since Aristotle lacked the observational data that was accumulated by the time of Galen.

Like Aristotle, Galen initially believed that the heart must have been formed in the nascent stage of the embryo. He states that

⁶ Aristotle, *De Generatione et Corruptione*, trans. Herold H. Joachim, *The Works of Aristotle*, vol. II, ed. David Ross (Oxford: Clarendon Press, 1930), Book 1, Part 2, 316a5-11.

...reasoning in this was based on the extraordinary importance of function of this organ in the fully grown creature. When, however, I realized that all other doctors and philosophers agreed that, until clear construction, the embryo is still managed in the same way as plants, it appeared to me more likely that the heart had no function at all in the initial stages of formation, and that its entire construction was subsequent to that of the liver.⁷

Even though Galen uses some anatomical observations in order to support his new views, this confession suggests that he might have changed his former ideas owing to the influence of his more immediate or contemporary authorities.

Throughout his piece on the embryo, Galen reminds us that he prefers observations of anatomy to theoretical considerations, which shows that he is extremely disturbed and enraged by other philosophers who discuss the issue while ignoring anatomical findings. Based on the evidence of the senses, Galen argues that the embryo, in its initial stage, consists of a membrane, arteries, and veins.⁸ Galen suggests that the sperm provides these vessels, which are formed at the mouth of the womb, with sustenance. Moreover, he states the “entire subsequent construction of the embryo takes place by the power within the sperm”.⁹ Galen points out that an aborted embryo, after thirty days, shows three organs: the liver, the heart, and the brain. He notes that of the three, the liver is the biggest which according to him evinces that it must have been formed first.

Despite his emphasis on observation and evidence of the senses, Galen utilizes the rhetoric of “logical” a couple of times while arguing for his newly adopted views. According to Galen, it was logical that first the liver be constructed, then the heart, and finally the brain.¹⁰ Nevertheless, Galen does not articulate a tension that arises between logical and observational data. It is this

⁷ Galen, *The Construction of the Embryo*, 182.

⁸ Galen, *The Construction of the Embryo*, 178.

⁹ Galen, *The Construction of the Embryo*, 180.

¹⁰ Galen, *The Construction of the Embryo*, 186.

tension which is the source of disagreement among his contemporaries and predecessors. In fact, as mentioned earlier it was because it sounded logical that Aristotle, younger Galen and Stoics held the idea that the heart should come into being first since it plays a crucial role in the body. In short, while Galen criticizes Aristotle and other philosophers for establishing their arguments on speculative and abstract ideas rather than concrete evidence, he still uses a similar language, that is appealing to the logical whenever he sees it appropriate.

Another critique that Galen raises towards those who believe that the heart is the sole agent behind the formation of other members of the body, is that it is not necessary for a single part of the body to accomplish all the work. Galen draws on Plato's division of labor in society, and argues, in a similar way, that a similar thing is the case for the body.¹¹ Thus, Galen believes each part of the body has a separate function, even though they might be in need of assistance from each other. In order to prove this, Galen uses two experiments regarding the function of the brain and the heart. Galen first observed a damaged spinal cord. He points out that nerves that remain above the point of harm work perfectly, while nerves that remain below the damaged point lose their functions immediately. Therefore, he concludes, the brain is the center of sensory perception considering that those nerves that keep their functions originate from the brain. Galen makes a similar observation regarding arteries and concludes that the heart is the source of motion for arteries.¹² Galen also notes that when there are injuries in perception, doctors apply remedies to the head which evinces that the head is the center of sensation. Through these experiments and observations, Galen shows that the heart is not the sole governor of the body, as Aristotle and Stoics believed, rather there is a division of labor between different organs of the body.

Despite all his arguments against the role of the heart in the

¹¹ Galen, *The Construction of the Embryo*, 187.

¹² Galen, *The Construction of the Embryo*, 190.

construction of the embryo and rejection of the Aristotelian and Stoic notions of the heart, Galen still finds it an enigma as to how is it that the embryo is formed. He ends his discussion by stating “The most probable solution, in an area of uncertainty, is that the same force which is responsible for the formation of arteries and veins also subdivides them and brings them on into every part of the embryo, and constructs the parts themselves around them in their proper places.”¹³ Rather than solving the problem, Galen discredits other views and leaves his reader with more questions than answers, which evinces his philosophical mind behind his anatomical observations. Nevertheless, he does banish philosophers from dealing with these issues and suggests that instead of making judgments about anatomical issues, they should study metaphysics and explain the nature of the Craftsman and their operations.

Conclusion

I have pointed out that despite having a similar approach to natural sciences, Aristotle and Galen held conflicting views on the role of the heart in the bodies of animals. That is because, by the time of Galen, there was an accumulated knowledge in the field of anatomy from which he benefited. Having a firm knowledge of anatomy, Galen criticized Aristotelian views of the heart. Nevertheless, Galen shares the general scientific method of Aristotle. Even though they both try to support their claims by observations and dissections, they seem to be heavily informed by theories and logical inferences. However, I believe by decisively and forcefully rejecting philosophers’ views on the construction of the embryo and the role played by the heart, and suggesting that they deal with metaphysical issues instead of anatomical ones, Galen opens the path to specialization in different disciplines.

¹³ Galen, *The Construction of the Embryo*, 192.

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