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Aristotle on the Beginning of Animal Life and Soul Activities

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Abstract: For Aristotle, animals, by contrast to plants, possess a perceptual soul. However, there is disagreement concerning the point at which the perceptual soul is acquired, for him. On one influential interpretation, Aristotle thinks that the perceptual soul is acquired not during the initial formation of the embryo, but at some later stage of its development. On such interpretations of Aristotle's view, the newly formed embryo is not yet an actual animal, but a plant-like living being or even inanimate matter. We argue, by contrast, that Aristotle views the embryo, from the very beginning, as an actual animal exercising basic nutritive and perceptual functions. We show that this interpretation is consistent with Aristotle's views on embryogenesis in the *GA*, *HA*, *PA*, and the *Metaphysics*.

Keywords: Aristotle, embryology, nutritive soul, perceptual soul, plants, animals

1 Introduction

Commentators on Aristotle's embryology disagree over the status of newly formed embryos. According to a prevalent opinion, the immediate products of conception have in actuality either no soul or only a nutritive soul.[1] Such interpreters are faced

1 Code (1987) argues that for Aristotle the κύημα is not yet in possession of a soul, which is available only to "an organic body, rather than a fetation". Carraro (2017) argues that Aristotle thinks of embryo formation as an "alteration", rather than a substantial generation, and that he attributes only potential souls to embryos. For similar positions, cf. Preus (1970), Balme (1990), Cohen (1996), and Leunissen (2018). De Ribera-Martin (2019) argues that for Aristotle the "first *kuêma*" is "the result of a substantial transformation (*metabolê*) into one solid substance" but argues that it engages merely in nutrition and does not yet have a heart. Similarly, Peck (1942), Preus (1970), Balme (1990), and Henry (2006) think that embryos first solely engage in nutritive activities and acquire the perceptual soul only at some later stage of gestation. Against such interpretations, Connell (2020) points out that nutritive and perceptual souls cannot be acquired at different developmental stages. For a criticism

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with the following difficulties. First, they saddle Aristotle with the view that early embryos have an indeterminate ontological status, hovering between actual animals and unorganized matter.[2] It is not clear, however, whether or how Aristotle's theory can accommodate such a class of beings. Moreover, as some of the scholars mentioned above recognize, Aristotle in fact attributes active nutrition and perception to early embryos.[3] But he generally explains such activities as the exercise of the animal's soul, and one would be hard pressed to explain how embryos might perform them unless they already possess such a soul in actuality.

The interpretation we will be offering bypasses these issues by arguing that Aristotle regards the immediate result of conception as an animal having a perceptual soul and engaging in its typical processes and activities.[4] Apart from showing that Aristotle's view of embryos is fully consistent with his overall theory, recognizing that he thinks embryos are animals engaging actively in nutrition and perception already at conception could help to clarify his understanding of the essential features of animal life. Since in his view embryonic nutrition and perception radically differ from, and are more rudimentary than, those of a mature animal, learning about them could shed light on the basic functions and nature of these soul capacities as they figure in Aristotle's theory.

In the second section of the paper, we argue that embryo formation, for Aristotle, amounts to the creation of an animal properly speaking. In his view, embryos must possess, from the very beginning, a functioning heart (or an equivalent bodily part) that controls nutrition and perception. We argue that for Aristotle the embryo, from its very formation, possesses an animal soul in actuality,

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of Peck's view cf. also Gelber (2010, 199–202). We agree with Connell that nutritive and perceptual capacities are present from the outset, but rely on different arguments. Connell argues that the initiation of embryogenesis must be understood as the first actualization of a perceptual soul and highlights the intertwined development of nutritive and perceptual capacities in this process. By contrast, our argument focuses on Aristotle's description of newly formed embryos as actual animals with perceptual souls and corresponding bodies. Moreover, we go beyond Connell's paper by providing evidence that newly formed embryos actively exercise their perceptual and nutritive soul capacities. This emphasis also distinguishes our view from Quarantotto's (2022), according to which the newly formed embryo, although it is alive from the beginning, has its perceptual function in a state of potentiality, which implies, in her view, that newly formed embryos are plant-like and potential animals only.

2 Cf. especially Freeland (1987) and Peterson (2022).

3 Cf. Carraro (2017, 275; 299).

4 Though unpopular today, the attribution to Aristotle of the view that animal embryos are fully ensouled immediately upon conception was maintained by prominent interpreters in late antiquity and the middle-ages. See Maximus the Confessor, *Ambigua ad Johannem* 42, 22-3 and Ps.-Philoponus/Michael of Ephesus, *in lib. de Gen. An. comm*, p. 83, ll. 14-32 (Hayduck). We discuss the historical debate on this issue in A. Schriefl and M. Segev (forthcoming).

initially having the heart as its sole organ. This is also suggested by Aristotle's repeated description of the results of conception as "animals". Aristotle sometimes refers to embryos as "incomplete animals", which has been taken to imply that they are potential animals only. We argue that "incomplete animals", for Aristotle, are actual animals, i.e., percipient beings, albeit in need of further development.

In the third and fourth sections of the paper, we argue that embryos, for Aristotle, not only possess animal souls, but also exercise the corresponding capacities by engaging in nutritive and perceptual activities. Aristotle ascribes to embryos nourishing, growth, and, more basically, self-preservation. According to the principles of his psychological theory, these features must be due to the exercise of the nutritive soul capacities of their recipients. Indeed, similarly to newborn animals, embryos engage in life activities which, though not reaching the level of perfection characteristic of mature members of an animal species, nevertheless show that they possess *animal* souls in actuality, in Aristotle's view. His descriptions of the heart and its movements at the earliest developmental stage, and his discussion in *GA* V.1 of embryonic sleep, imply that early embryos are sentient beings and actively engage in sense perception.

In the fifth section, we address the reasons why this natural reading of Aristotle's embryology has been obscured. Commentators may have found it counterintuitive to think of primitive creatures such as newly formed embryos, which lack ordinary sense organs like eyes or ears, as animals with perceptual souls. But more importantly, Aristotle's comparison of embryos to plants (e.g., in *GA* V.1), and his presumed comparison of them to matter (in *Metaph.* Θ.7), have been taken to suggest that embryos are only potentially animals, and that they occupy an intermediate ontological status. We will argue that these discussions are in fact consistent with our interpretation, despite views to the contrary.

2 Aristotle on Newly Formed Embryos as Animals

In this section we argue that, despite views to the contrary, Aristotle thinks that the immediate product of conception is already an animal. First, for Aristotle, the heart (or its counterpart in bloodless animals), which in his theory emerges at the outset of gestation, is the central organ for both nutrition and perception, and equips the embryo with a body that corresponds to an animal soul. Second, Aristotle's terminology (specifically, his use of the word ζῷον) indicates that the embryo at that early stage is already an animal, as opposed to merely a living thing. Third, Aristotle's descriptions of viable embryos as "complete embryos" and as "incomplete animals" imply, in context, that they are indeed percipient living things, albeit in need of further development.

2.1 Embryo Formation, the Creation of the Heart, and Substantial Generation

As many commentators have pointed out, the heart (or its counterpart) plays a central role in Aristotle's theory of embryogenesis. He emphasizes that the heart is formed at the beginning of gestation (cf., e.g., II.4, 740a1-23; II.5, 741b15-24), and he often refers to the heart as the ἀρχή (e.g., II.4, 738b16-7; 740a17-8; II.5, 741b15-6).[5] To establish the primacy of the heart, Aristotle occasionally appeals to empirical observation (*Juv*. 468b28-30; *HA* VI.3, 561a6-12). He also argues that an embryo must engage in nutrition, which in turn requires that the heart be present from the beginning, manage nutritional processes, and provide nourishment, i.e., blood (*GA* II.4, 740a17-23). Aristotle presents this argument in direct response to Democritus, who suggests that the external parts of animals develop before the internal ones (II.4, 740a13-15). This view, Aristotle argues, does not only contradict empirical evidence according to which the heart is present from the beginning of gestation (II.4, 740a4-5), but also misses the point of what it means to be an animal. As he says, Democritus seems to be talking about "animals from wood or stone" that have no such principle, whereas "all animals have it, and have it within them" (740a15-17).[6]

In addition to being required for nutrition, Aristotle is clear on the point that the heart (or its analogue in bloodless species), which is the first to develop in an embryo, is also the primary organ or source (τὴν ἀρχὴν) of the perceptual soul (*GA* II.6, 743b25-6; *Juv.* 468b28-ff; 474a25-ff). And touch (along with its derivative, taste), the most basic sense shared by all animals, has the heart as its proper organ (*Sens*. 438b30-439a3; *Juv*. 469a10-ff; *PA* II.10, 656a27-31). The heart is also the source of all further perception (*PA* III.4, 666a11-18). Thus, the heart not only equips the embryo with its own principle of nutrition, but also functions as a perceptual organ that corresponds to its animal soul.

While commentators widely agree that the heart has to be formed early on, some think that it is not present from the very beginning.[7] In particular, it has been

5 Aristotle uses "ἀρχή" not just in the sense of "starting point", but also as "governing principle". This is evident from passages where he explicitly points out that the ἀρχή comes into being "at first" (II.5, 741b15), or argues against positions according to which the embryo's ἀρχή appears "later" (II.4, 740a9-13); these passages would be redundant if the accepted meaning of ἀρχή were exclusively temporal.

6 All translations are our own, unless otherwise noted.

7 Cf. Connell (2020, 17 with n. 47 and 21f.), Quarantotto (2022, 241 and *passim*), and Rapp (2022, 301–310), on the primacy of the heart. Gelber (2010, 208) also emphasizes that "the heart must be formed first" and that "the rudimentary heart is formed by the initial action of the semen upon the *katamênia*"; however, in Gelber (2020, 247), she distinguishes between the "initial setting" of the embryo where the material is simply congealed, and a subsequent phase where the heart is being

suggested that the initial formation of the new embryo does not yet bring about a heart or any other organ, but only "a functional, structured body".[8] This interpretation is well in line with views according to which the initial result of conception is not yet an animal properly speaking but a plant-like living being, which may have an animal soul potentially but not yet actually.[9] We will return to such interpretations below. For now, it is important to acknowledge that in *GA* II.4, where Aristotle gives the most detailed descriptions of embryo formation in blooded animals, he presents it as involving primarily the formation of a heart. In this chapter, Aristotle mentions two concrete parts belonging to the animal resulting from conception: there are membranes (ὑμένες, χόρια: 739b31) that separate the solidified part from the liquid, and, more importantly, the ἀρχή or heart emerges as the embryo's first functional organ (739b34-5; 740a1-4). He explains that the primacy of the heart is not just evident from empirical observation, but required by reason, because the heart is the principle that enables the newly created animal to manage the subsequent growth and development of the body independently of its parents:

> For this reason, the heart is set apart (ἀποκρίνεται) first in actuality (ἐνεργείᾳ). And this is not just apparent to the senses (for it happens like this), but also to reason. For once that which was formed is set apart from both parents, it must manage itself, just like a son moves away from his father into a separate house. So that it must have a principle, out of which also later the regulation of the body comes about for the animals. … Because of this, the heart is first manifestly distinct for all blooded animals; for it is the principle both of the uniform and of the non-uniform parts. For it is already worthy of being called the principle of the animal and of the organized whole (σύστημα) as soon as it needs nourishment. For of course the animal grows.[10] Nourishment of an animal is the ultimate blood and its equivalent. The vessel of these is the veins. Therefore, the heart is also the principle of them. (*GA* II.4, 740a3-23)

formed and the embryo acquires its own soul. Carraro (2017, 295 with n. 53) also emphasizes the central importance of the heart in Aristotle's theory, but does not think that the heart is present from the outset. See also n. 1 and n. 42; cf. De Ribera-Martin (2019, 117–18). By contrast, we argue that the initial setting of the embryo is the creation of the heart.

8 Cf. Carraro (2017, 281 and 283). Carraro does not explain in which way the embryo's body is "functional" at the stage where it does not yet have, according to his position, a heart or any other functional organ.

9 Cf., e.g., Freeland (1987, 403–4); Balme (1990, 30); Cohen (1996, 170); Carraro (2017, 281); Leunissen (2018, 65f.).

10 Reading ζῷον at 740a21 with Vaticanus 261, rather than ὄν. Even if one retains ὄν, however, the reference would seem to be to τοῦ ζῴου καὶ τοῦ συστήματος at 740a20. Aristotle's point in 740a19-21 is that the heart is the principle of the animal "whenever it [i.e., the living thing] needs nutrition" (ὅταν δέηται τροφῆς), and that this is so because (γὰρ) that animal requiring nutrition (τὸ ὄν/τὸ ζῷον) "grows".

The passage emphasizes that once conception is complete, not the parents (i.e., external causes) but the embryo's inner principle controls all further processes, in particular its growth. Aristotle's emphasis on growth further indicates that, after the creation of the heart, we are no longer dealing with the *generation* of the embryo, but with its further development. Embryo formation is thus the significant substantial change after which the newly generated being has retained its ontological status as an animal, i.e., a being that manages its further development by itself.

Of course, the embryo does not come into being instantaneously, at the very moment the male (or its semen) comes in contact with the material provided by the female. Aristotle explicitly says that it takes some time to create an embryo, and that the duration of that process depends on the specific animal in question. Kinds of insects in which the male directly works on the female secretion without emitting semen create the new embryo during copulation. For this reason, they copulate "for a long time" (*GA* I.23, 731a15), namely for "a certain part of a day" (I.23, 731a19), until the embryo is formed. Immediately after copulation, insects release small larvae (I.21, 729b30-32). As Aristotle makes clear elsewhere, larvae are insects in their first embryonic state (III.9, 758b6-28).[11] For animals that emit semen, copulation is much shorter. It lasts until the male animal has emitted semen. Subsequently, the semen works on the menstrual fluid and thereby creates the new embryo within days (I.23, 731a20). After accomplishing this task, "the body of the semen is dispersed and evaporated" (τὸ σῶμα τῆς γονῆς διαλύεται καὶ πνευματοῦται, II.3, 737a11-12). Aristotle's remarks on the duration of embryo formation clearly shows that there is a definite time mark when the generation of the embryo is finalized.

2.2 The Significance of Aristotle's Terminology

In his discussion of embryo formation in viviparous blooded animals in *GA* II.4, Aristotle first describes the semen's action on the menstrual fluid, and then calls the

11 Aristotle points out that some larvae closely resemble eggs, and that all of them go through an egg-like stage when they become motionless pupae. They differ from proper eggs insofar as they do not carry yolk inside them. Thus, only part of the egg becomes the new animal, whereas a larva is that "from which … as a whole" the new animal evolves (II.1, 732a29-32; cf. III.9, 758b11-14 where this is introduced as the main criterion for distinguishing between larvae and eggs). Aristotle also notes that eggs and larvae sometimes overlap; in particular, imperfect eggs resemble larvae insofar as they keep growing after they were externally laid (*GA* II.1, 733a29-32). On the other hand, he goes on to say that pupae can be described as eggs that were formed outside the parents (733b10-16).

immediate result of this process an "animal" (ζῷον: II.4, 739b30).[12] That Aristotle deliberately describes newly formed embryos as animals is confirmed by *HA* VII.7, where he discusses embryonic development in human pregnancies. There, he describes newly formed embryos as being enveloped by membranes in the womb, and says, in this context, that "at first the animal is generated" (πρῶτον … γίνεται τὸ ζῷον) inside the deepest membrane. The context of the two passages is similar; in both, Aristotle explains that newly formed embryos need to be separated from the fluids in the uterus. Arguably, this is true not only for newly formed embryos, but also for embryos at later developmental stages. The word "animal", thus, might be taken to refer to newly formed as well as later ones. But even if the passage can be taken to be in principle about both, it is important to note that Aristotle does not terminologically distinguish between them, which is what we would expect him to do if his view were that newly formed embryos are not yet animals.[13]

In a longer passage in *GA* II.1, where Aristotle compares the reproductive processes of different kinds of animals, he says the following:

> There are, then, some animals which are not formed from seed, as I have also said earlier. But all blooded ones are formed from seed, as many as are formed as the result of copulation, with the male emitting semen into the female; when it has entered, the animals (ζῷα) are set and take on their peculiar shape, those that are viviparous within the animals themselves, the others in eggs [and seeds and other such secretions] (*GA* II.1, 733b16-23, trans. following Peck).

Aristotle says here that, in the case of blooded animals, the new animals are set when the semen enters the female. Since the passage mentions animal generation in connection with the assumption of their specific shape, Aristotle's reference to "animals" might be taken to describe, not the immediate products of conception, but rather embryos once they have attained their species-typical appearance at a later developmental stage. But the context of the passage, which discusses copulation and the entering of the semen, might suggest that Aristotle's description does not focus on those later stages, but instead on the very first setting of the embryo. Thus, in this passage, "animals" can be taken to refer to embryos at the beginning of gestation.

Aristotle extends the view that newly formed embryos are animals to oviparous animals and insects. In III.2, 753b10-11 (cf. 16, 22) he refers to a newly formed embryo inside an egg as an "animal", in a context that is focusing on the beginning of the formation process (cf. 730b15-16). And, as we will show in Section 2.3, Aristotle describes larvae, i.e., the immediate products of conception in insects, as creatures with

12 In the same passage Aristotle calls the result of conception also "an embryo" (κύημα: II.4, 739b34). This can be taken as an indication that "embryo", in his terminology, standardly refers to an animal. In exceptional cases κύημα can also refer to the seed of plants (see Section 3.2) and to unviable embryos such as wind-eggs (see Section 2.3).

13 We are grateful to an anonymous referee for a helpful comment on these texts.

the equivalents of hearts and the corresponding animal functions such as locomotion, which should make them qualify as animals as well.

In Aristotle's natural theory, the term ζῷον does not refer to the broad class of living beings that also includes plants, but is explicitly restricted to beings with sense perception.[14] In *DA* II.2, 413b1-4, Aristotle says that whereas living (τὸ … ζῆν) belongs generally to things that are alive (τοῖς ζῶσι), "something is an animal (ζῷον) primarily in virtue of perception". In *DA* II.3, 414b1-5, he emphasizes that plants only engage in nutrition, whereas animals (ζῷα) have at least one sense, i.e., touch (cf. II.2. 413b4-9).[15] In his biological works, he standardly restricts the term ζῷον to living things that have sense perception, and hence are animals in the proper sense of the word. In his definition of animals in *Sens*. I, 436b10-12, he states that animals qua animals have sense perception and differ from other beings with regard to this feature. At *Juv*. 467b22-5, he argues that plants, though alive, are not ζῷα. In the *Generation of Animals*, he remains consistent with this terminology. In *GA* II.1, 732a11-13, he says that whereas all living things (including plants) live by virtue of "participation in the female and the male", only animals have sense perception. In II.3, 736a30-31, he says that animals have a perceptual soul, by contrast with wind eggs (cf. 736b1; III.7, 757b15-19). When comparing animals to plants, he emphasizes that even the lowest degree of perception qualifies something as an animal (I.23, 731a33-b5). That Aristotle sometimes uses the word "ζῷον" to characterize newly formed embryos thus provides evidence that he thinks of them as percipient beings.

2.3 Complete and Incomplete Animals; Complete and Incomplete Embryos

Aristotle sometimes describes embryos as incomplete animals (*GA* II.4, 737b8-25; *GA* II.1, 733a32-b16). For example, in the context of discussing reproduction in insects, he points out that a larva is a "complete embryo", but "not yet a complete animal" (κύημα τέλειον

14 In the *Metaphysics*, Aristotle defines the unmoved mover, which is a pure intellect, as ζῷον (Λ.7, 1072a29; cf. *Top*. III.1, 116b13-17 and Segev (2017, 91–93)). Divine beings, however, are not the primary subject matter either of his biological treatises or of *De anima*. Whenever Aristotle refers to mortal ζῷα, he has percipient beings in mind. He thus generally seems to restrict the term ζῷον to conscious living beings, i.e., those having perception, intellect, or both.

15 Bertoni (2014, 11–12), who refers to *EN* 1097b33 and *DA* 415a14-416b31 on the point that plants for Aristotle are living things sharing only in the nutritive soul, argues based on *DA* 414b1-5 that "Aristotle disagrees with Plato [in *Tim*. 77b] and believes that plants cannot properly be called ζῷα". As pointed out to us by an anonymous referee, one might think that ζῷον refers to both plants and animals at least at *De anima* I, 402a7, where Aristotle states that studying the soul, which is a principle (ἀρχή) of ζῷα, is required for a comprehensive understanding of nature. However, the reference there may well be to animals alone, since Aristotle thinks of animals as paradigmatic occurrences of natural things, which indeed include, not only living things, but also inanimate beings (e.g., stones; the four elements) (cf. *Phys*. II.1).

ζῷον δὲ μήπω τέλειον: II.4, 737b9). This has been taken to imply that embryos are only potential animals.[16] However, as we shall see, Aristotle's description of embryos as incomplete animals in fact supports the view that they count as actual animals, for him.

Aristotle introduces the distinction between complete and incomplete animals in a passage where he describes a hierarchical order among animals. On Aristotle's theory, the place of an animal species on the *scala naturae* corresponds to the level of perfection or completion of its offspring once it is released.[17] Blooded viviparous animals, which have the highest rank, release complete offspring that is already "similar to itself" (II.1, 732a25-6) and "complete … in terms of quality" although not in terms of quantity (II.1, 733a33-b3). By contrast, animals of lower ranks, which are oviparous or larva-producing, release their offspring while it is still "unarticulated" (ἀδιάρθρωτον) and has not yet reached its final shape (μορφή: *GA* II.1, 732a25-28).[18] Their offspring is incomplete in the sense that, at the time it is released, it is still in its embryonic stage and has not yet reached its species-typical appearance.[19]

When Aristotle describes larvae and other embryos as incomplete animals, he indicates that they are animals, but emphasizes that they need further development before they can count as a proper member of their species. When analysing the reproduction of insects, Aristotle points out that they go through three stages — larva, pupa, insect (cf., e.g., III.9, 758b27; 759a3-7) — and emphasizes that the respective animal reaches its completion in the third and final stage, which implies that it is already an animal, if an incomplete one, in the first two stages (*GA* II.1, 733b13-16; *GA* III.9, 758b24-28).[20] More importantly, larvae and other embryos are not "incomplete" animals in virtue of lacking a perceptual soul; to the contrary, Aristotle's descriptions underline the fact that they must have bodies that correspond to a perceptual soul.[21] For example, he says that embryos are perfect

16 Cf. Cohen (1996, 170); see below n. 21.

17 Cf. Leunissen (2018, 59–61) discussing *GA* II.

18 Already in *GA* I, Aristotle notes that what insects produce is "imperfect" (ἀτελές: I.21, 729b32). According to Cohen (1996, 169), "complete" or "perfect" means that something "has all the parts proper to it", which explains why larvae, taken as embryos, can be called "perfect" but, taken as animals, are "imperfect".

19 Aristotle sometimes also describes newborns of higher species (e.g., foxes, bears, lions, humans) as "incomplete" (*GA* IV. 4, 774b5-16; V.1, 779a24-25; see below Section 3.1).

20 Aristotle writes: "First, insects produce larvae; and the larva develops until it becomes egg-like (for what we call chrysalis has the potentiality of an egg); then, out of this there comes to be an animal having reached the *telos* of its generation." (*GA* II.1, 733b13-16, trans. following Peck). And, similarly, in a further passage: "After having had the nature of the larva, all of them are immovable, and their shell dries around them, and after that the shell bursts and there emerges, as from an egg, an animal that was brought to completion in its third generation" (*GA* III.9, 758b24-28, trans. following Peck).

21 Cohen (1996, 170) claims that by calling embryos "incomplete animals" Aristotle denies that they are actual animals and have a perceptual soul. Cohen specifically relies on Aristotle's remark that all animals create an embryo that is "at first undifferentiated (ἀδιόριστον)" and for this reason

whenever they are male and female (*GA* II.4, 737b10-11). Since an animal's sex is determined by its heart (or its equivalent), complete embryos will necessarily have that organ (*GA* IV.1, 766a34-b5).[22] Moreover, Aristotle says that larvae are "moving things" (III.9, 759a4: κινουμένων), in the context of describing them as "taking nourishment" (λαμβάνουσαι … τροφὴν) before they turn into pupae, and comparing them to eggs, which also take nourishment and grow (αὐξάνεται), up to a certain point (758b29-36).[23] The initial movements of larvae, then, are associated with their life activities, presumably instances of locomotion with a view to gathering and absorbing food. But they can only exhibit such movement provided that they possess the necessary functional organs, among others the equivalent of a heart, which Aristotle identifies as the origin of all movement (cf. *PA* II.1, 647a24-6; III.3, 665a10-15; III.4, 666b14-15). In Aristotle's psychological theory, life functions such as growth and locomotion, whenever they occur together, are actualizations of an animal soul. The fact that Aristotle ascribes both of these activities to newly formed embryos must mean, then, that they have such a soul, for him.

Aristotle's distinction between complete and incomplete embryos further confirms that "incomplete", in his terminology, does not imply "potential". "Incomplete embryos," for him, are not, as the term might be taken to imply, beings on their way to becoming live embryos. Rather, he uses the term to designate unviable embryos, such as wind-eggs, which at *GA* III.7, 757b18-19 he calls "incomplete" precisely because, unlike larvae, they are not alive and cannot grow or develop.[24] Thus, for Aristotle, incomplete embryos do not possess any potential for further development.

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comparable to a larva (*GA* III.9, 758a32-36). But Aristotle's statement does not imply that larvae and other newly created embryos have no functional parts or only a nutritive soul. As we have already seen, he thinks of larvae as having functional organs, such as the equivalent of a heart, and as being capable of locomotion. The fact that they are, like other embryos, "undifferentiated (ἀδιόριστον)" or "unarticulated (ἀδιάρθρωτον)" implies, as also noted above, that they have not reached their species-typical appearance and have not yet developed all their species-typical organs.

22 The level of heat in the heart (or its equivalent) determines whether the animal in question produces semen or menstrual fluid, cf. O'Connor (2015, 66–68); Connell (2016, 277).

23 Aristotle also applies the distinction between an initial state involving motion and a later stage of being at rest to "all the other [species] not generated from breeding, in wools or some other such things, and those in water" (*GA* III.9, 758b21-5).

24 De Ribera-Martin (2019, 105–6) notes that, though Aristotle does call wind-eggs κυήματα, he means more specifically that they are "'pseudo-seeds'", since they develop to an extent and are "'set up together'", but only contain the female principle of generation and cannot in any way develop into an animal (cf. *GA* III.7, 757b18-19; *GA* III.1, 750b10-13). Specifically, at *GA* III.7, 757b18-19, Aristotle makes the point that the wind-egg "is perfect as an embryo of a plant" (ὡς μὲν φυτοῦ κύημα τέλειόν ἐστιν) but "imperfect as [an embryo] of an animal" (ὡς δὲ ζῴου ἀτελές). Connell (2020, 12 n. 36) plausibly interprets this statement counterfactually, as claiming that a wind-egg *would have* been a proper embryo *had there been* an oviparous plant species growing out of wind-eggs laid by animals; as things stand, however, wind-eggs do not qualify as perfect embryos strictly speaking, for Aristotle.

3 The Nutritive Soul and Its Activities in Embryos from Their Very Formation

As we have seen in Section 2, Aristotle's references to newly formed embryos as "animals", combined with the details of his views on their formation, indicate that he thinks of them as having both nutrition and perception. In Sections 3 and 4 we will explore to what extent the newly formed embryo actualizes the capacities of its animal soul. In this section, we will first argue that Aristotle thinks of early embryos as having actual souls, and that these are specifically animal souls, rather than, e.g., the souls of plants. We will then focus on the nutritive souls of early embryos, and argue that they both possess actual nutritive souls and actively engage in nutrition, in Aristotle's view.

3.1 Actual and Potential Soul in *GA* II.3

In *GA* II.3, 737a16-18, Aristotle says:

> Περὶ μὲν οὖν ψυχῆς πῶς ἔχει τὰ κυήματα καὶ ἡ γονὴ καὶ πῶς[/πως] οὐκ ἔχει διώρισται· δυνάμει μὲν γὰρ ἔχει, ἐνεργείᾳ δ' οὐκ ἔχει

This text is often taken to mean that both embryos and seed have soul only potentially, and not actually. For example, Platt translates the sentence as follows:

> It has been settled, then, in what sense the embryo and the semen have soul, and in what sense they have not; they have it potentially but not actually.[25]

In a comment, Platt adds that "this sentence is misplaced, but one cannot say where it should go".[26] This comment is warranted, given Platt's translation. As Carraro notes, whereas in *GA* II.1, 735a4-9 Aristotle expressly asks whether or not seed (there, τὸ σπέρμα) has soul, and answers conclusively that it both has and is soul in potentiality (καὶ ἔχει καὶ ἔστι δυνάμει), extending that claim to the case of embryos "is more surprising".[27] However, the text in 737a16-18 does not seem to be misplaced on the following alternative translation, which therefore is preferable:

Presumably, for him, wind-eggs are "perfect" in the sense that they grow no further (cf. *GA* III.1, 749a24-7), and imperfect "with respect to generation" (πρὸς τὴν γένεσιν), i.e., insofar as they cannot develop into an animal (750b21-8).

25 Platt (1912) ad loc. See also Peck (1942) ad loc.; Carraro (2017, 288).

26 Platt (1912) ibid.

27 Carraro (2017, 288).

> Therefore, concerning soul, it has been determined how the embryos have it and the semen also in a way does not have it; for it [sc. the semen] has it potentially, but it does not have it in actuality.

On this reading, the sentence summarizes two views that have already been established previously in *GA*, namely, both (1) that semen has soul in potentiality, as already concluded in II.1, 735a4-9, and (2) that the embryo has soul in actuality, as has been argued in II.3 736b8-13 (see Section 3.2 below).

One might object that Aristotle cannot view embryos as having a soul in actuality, at least as early as they are formed, because he is explicitly committed to the idea that "nature simultaneously (ἅμα) assigns to each [living thing] the capacity (τὴν … δύναμιν) and the organ (τὸ ὄργανον), for it is better thus" (*GA* IV.1, 766a5-6).[28] And so, the objection would run, Aristotle must think that an embryo does not possess in actuality either the nutritive or the perceptual capacities of the soul until it possesses all the organs by means of which those soul capacities are to be exercised. However, it is difficult to see how Aristotle could consistently think of embryos as being only potentially ensouled while also ascribing to them the actual performance of life activities like nourishing, growth, or perceiving. For Aristotle, it is by the soul functioning as cause that anything partakes of these activities (cf., e.g., *DA* II.4, 415b21-416a8; 416b9-11). His theory simply does not accommodate the occurrence of such an activity except as the exercise or actualization of a corresponding soul capacity.[29] The conclusion to draw is that, as soon as embryos are formed, they possess a soul in actuality, and their performance of life activities is due to that fact.

It has been suggested that for Aristotle embryos "do not possess the nutritive soul in actuality because they live like plants and, thus, do not exercise the nutritive capacity in the way that is appropriate for animals".[30] However, for the reasons given above, the very exercise of nutrition by embryos implies that they do possess the nutritive soul in actuality, whether or not they live like plants, in Aristotle's view (and we shall see that they do not below; cf. Section 4.1). It may still be argued

28 As examples, Aristotle notes that the eyes and sight are not perfected (τελειοῦται) without each other, and that the intestines and bladder are generated simultaneously with the capacity related to residues (766a6-10).

29 Aristotle's theory does of course accommodate the existence of life activities that are not the exercise of any soul capacities in the case of such beings as the prime mover. But that feature of the intellectual activity of the prime mover is connected both to its continuity (ad aeternum) and to its status as the most honorable being (*Metaph.* Λ.9, 1074b28-32), and hence cannot be helpfully compared to the nascent life activities in embryos. See n. 14.

30 Carraro (2017, 290). Carraro's comment occurs within the context of discussing *GA* 736b8-13 in light of 737a17-19, both of which Carraro takes to be making the point that embryos only have souls in potentiality.

that the soul of embryos is fundamentally different from that of animals and is perhaps akin to that of plants. But that assumption, which brings forth problems of its own,[31] is unneeded. For there are reasons to think that Aristotle, contra Carraro, cannot maintain that being unable to exercise life functions "in the way that is appropriate for animals" should deny embryos the possession of animal souls in actuality.

Aristotle notes that in the case of many animal species (e.g., fox, bear, lion) members are at birth "unarticulated" (ἀδιάρθρωτα), in many species the newborn are blind, and some birds are born without nostrils and ears (*GA* IV.6, 774b5-775a3). If having a lion soul in actuality requires performing life functions "in a way that is appropriate for a lion", then a newborn, developing, and blind lion would not count as having a lion soul in actuality.[32] Unless one is willing to accept that implication in the case of a newborn member of a species, one should not accept the equivalent implication in the case of embryos.[33] It is reasonable to suppose, then, that Aristotle thinks embryos all along possess *animal* souls in actuality.[34] Otherwise, one would be confronted with the problem, approximating a sorites paradox, of determining the point at which an embryo possesses enough functional organs and corresponding capacities to count as an animal, a task no less daunting, it seems, than attempting to determine a particular point in an organism's development at which it should count as a member of an animal species (a question that is beyond the scope of this paper, if it can be answered conclusively at all).

A further reason to think that Aristotle in *GA* II.3 means to attribute animal souls to early embryos appears in the subsequent chapter. In II.4, Aristotle compares early

31 One such problem would be the challenge of explaining the occurrence in embryos of (not only nutritive but also) perceptual activities, whose existence (at some embryonic stage at least) Carraro (2017, 275; 299), for example, acknowledges. Frey (2015, 158) argues, based on *GA* IV.1, 766a5-6 (as well as II.3, 736b21-6), that "[t]he soul that is an animal embryo's principle of life is, from the beginning a perceptual soul", but thinks that "animal embryos in their early developmental stages … are such that they can come to possess perceptual capacities *energeiai* (*GA* II.4, 736b13-15)", presumably supposing that they first possess those capacities only potentially.

32 Peterson (2022, 220–224) argues, partly based on *GA* II.3, 736b2-5, that animal generation is an extensive process which begins with the first creation of nutritive capacities and ends with the completion of the last organ relevant for the "essence of the species". Peterson does not address the question of whether the process of animal generation, thus conceived, encompasses the time after birth or hatching, but seems to be open to answering it in the affirmative. According to our reading of *GA* II.3, 736b2-5, Aristotle distinguishes animal generation from the further development into a mature representative of a given species (human, horse), and regards embryos as actual animals (i.e., percipient living beings) before they have attained their species-typical functions. See Section 5.2.

33 Note that Carraro (2017, 289–90) himself likens the difference between the nutritive souls of plants and animals to the difference between the souls of dogs and horses.

34 So far, we have focused on nutrition as it pertains to such souls; in Section 4 we will elaborate on perception.

embryos (i.e., embryonic hearts, prior to the development of any other bodily part) and the emergence of blood-vessels in them to sown seeds and the growth in them of roots and shoots (739b33-740a4). In this context, he states that the heart is the principle "of the animal, or the composite, whenever it requires nourishment" (τοῦ ζῴου καὶ τοῦ συστήματος ὅταν δέηται τροφῆς), and speaks of blood or its analogue as the ultimate nourishment "of an animal" (ζῴου) (740a20-21). He then goes on to say the following (740a24-7):

> τούτων δ' ἀγγεῖον αἱ φλέβες· διὸ ἡ καρδία καὶ τούτων ἀρχή. δῆλον δὲ τοῦτο ἐκ τῶν ἱστοριῶν καὶ τῶν ἀνατομῶν. Ἐπεὶ δὲ δυνάμει μὲν, ἤδη ζῷον ἀτελὲς δέ, ἄλλοθεν ἀναγκαῖον λαμβάνειν τὴν τροφήν· διὸ χρῆται τῇ ὑστέρᾳ καὶ τῇ ἐχούσῃ ὥσπερ γῇ φυτόν, τοῦ λαμβάνειν τροφὴν ἕως ἂν τελεωθῇ πρὸς τὸ εἶναι ἤδη ζῷον δυνάμει πορευτικόν.
>
> And of these [viz. of blood and its analogue] the blood-vessels are a container. For this reason, the heart is their principle. And this is clear from the studies and the dissections. And since [the blood-vessels] exist in potentiality, and an animal is at this time imperfect, it is necessary for it to take in nourishment from elsewhere. For this reason, it makes use of the uterus, and the [mother] having it, just as a plant [uses the] earth, for the sake of taking in nourishment until it would be perfected toward being an already potentially mobile animal.

Translators often take δυνάμει … ζῷον ἀτελὲς to be predicated of "foetus" or "embryo", even though the last occurrence of κύημα appears only quite earlier, at 740a1-4.[35] There, Aristotle makes the point that *all* organs exist in some sense potentially in an early embryo, with the heart being the first to be "set apart" in actuality — a fact that he goes on to elaborate on down to the passage quoted above.

Reading αἱ φλέβες along with δυνάμει at 740a24, apart from making better grammatical sense and avoiding the problem of squaring this line with Aristotle's unqualified references to an embryo as an animal,[36] also fits in better with the overall argument in this chapter. The blood-vessels that Aristotle at 740a24 says exist potentially are those that he goes on to specify in the following lines, namely, "the two primary blood-vessels" emerging from the heart and the "blood-vessels going away from these toward the uterus — what is called the navel" (740a27-30).[37] Upon birth,

35 See Platt (1912), ad loc., Peck (1942), ad loc., Peterson (2022, 223), Rapp (2022, 307).

36 As well as with the fact that he straightforwardly calls embryos animals elsewhere; see Section 2.2.

37 It is true that Aristotle thinks of the development of embryonic bodies as crucially involving the presence of blood-vessels that "extend from the heart," and of bodily organs as "coming into being from these" (γινόμενα ἐκ τούτων) (*GA* II.6, 743a1-3). The blood-vessels thus used for the formation and sustenance of bodily organs during an embryo's development may well be thought of as operating similarly to the way blood-vessels function in animals after birth (cf. *PA* II.3). Since the reference to blood-vessels at 740a22 is made in the context of discussing the temporal priority of the emergence of the heart (cf. 740a3-21), and is followed by a discussion of specifically the first embryonic blood-vessels connected to the uterus for nutritional purposes (740a27-30), it is reasonable to think that the functioning of blood-vessels for the formation of further organs is left out of the discussion. We are grateful to an anonymous referee for a helpful comment on this issue.

once nutrition is no longer supplied to the embryo via the umbilical cord, the blood-vessels constituting the cord are compressed (συμπίπτουσιν) (IV.8, 777a25). And, at *GA* II.7, 745b22-746a2, Aristotle expressly associates the transition into independent nutrition, marked by the umbilical blood-vessels ceasing their operation as conveyers of nutrients from the uterus to the embryo, with the perfection of the animal, as we have suggested he implicitly does at II.4, 740a24-7.[38]

The claim that the blood-vessels connecting an embryo to the uterus, despite functioning along with the heart in the nutritive processes of early embryos (cf. 739a35-8), are animal blood-vessels of a newborn animal only in potentiality, is directly relevant to defending Aristotle's view that no organ apart from the heart exists in actuality at that stage. Aristotle's comparison of the way in which such embryonic potential blood-vessels convey nutrients derived from the mother to the way in which plant roots convey nutrients derived from the earth, at 740a25-6 (cf. 739a36-8; 740a33-5), also indicates that he thinks of early embryos as animals in 740a24-7. The embryo, once connected to the uterus, depends on it for nutrition, and Aristotle points out that the umbilical blood-vessels, once formed and used for that purpose, have the potentiality to transform and be used for the self-sustaining nutrition of the animal upon birth.[39] But the embryo itself is, at the outset, already an actual animal, albeit an "imperfect" one.[40]

3.2 The Nutritive Soul and Its Activity in Embryos

A further remark in *GA* II.3 suggests that Aristotle takes embryos to possess the nutritive soul in actuality. In 736b8-13, he says that:

> Τὴν μὲν οὖν θρεπτικὴν ψυχὴν τὰ σπέρματα καὶ τὰ κυήματα τὰ χωριστὰ[41] δῆλον ὅτι δυνάμει μὲν ἔχοντα θετέον, ἐνεργείᾳ δ' οὐκ ἔχοντα πρὶν ἢ καθάπερ τὰ χωριζόμενα τῶν κυημάτων ἕλκει τὴν τροφὴν καὶ ποιεῖ τὸ τῆς τοιαύτης ψυχῆς ἔργον· πρῶτον μὲν γὰρ ἅπαντ' ἔοικε ζῆν τὰ τοιαῦτα φυτοῦ βίον.

38 I.e., with the transition from an embryo (counting as an imperfect animal) to a newborn animal; see Section 2.3.

39 In Section 3.2, we shall examine comparable instances in Aristotle's biology of referring to one and the same thing as existing both actually (signifying its current properties and functioning) and potentially (indicating the shift in the organization and functioning of that being at a later stage)

40 Cf. *PA* II.3, 650a14-31. There, Aristotle revisits the analogy between plant and animal nourishment, this time likening the role of earth in nourishing plants to the role of the self-nourishing animal's stomach. As we shall see in Section 5.1, he also compares embryos to plants elsewhere, without thereby implying that embryos are non-animals.

41 Reading τὰ κυήματα τὰ χωριστὰ is clearly preferable over the OCT's τὰ κυήματα τὰ μήπω χωριστὰ, which has no manuscript support.

> It is clear, then, that the seeds and the separate embryos should be supposed to have the nutritive soul potentially, but not to have [it] in actuality before they draw up nourishment and perform the function of the soul of such a kind, exactly as the separated of the embryos do. For at first all such things seem to live a life of a plant.

Aristotle says here that, whereas seeds and separate embryos both have the nutritive soul potentially, the separate embryos, in addition, have the nutritive soul in actuality. The identity of the "separate embryos" in question is controversial. But, since the reading above suggests that Aristotle in this passage is interested in contrasting seeds with embryos in general (rather than contrasting seeds and "unseparated" embryos with "separated" embryos), the reference seems to be to embryos, which are generally speaking separate, by contrast to seeds, which are not.[42] In the next chapter, Aristotle, discussing the formation of the embryo, says that "the heart is set apart (ἀποκρίνεται) first in actuality (ἐνεργείᾳ)" (II.4, 740a3-4; cf. 740a17-18: διωρισμένη), with each of the other parts subsequently being separated (χωρίζηται: 740a9-13). By contrast to seeds, which are parts of the original organisms generating the new animal (i.e., the parents), the embryo is an entity "set apart in actuality" from the earliest stage of its very formation, and it is called "separate" on that account.[43] Indeed, the emergence and development of the embryo's parts immediately following the formation of its heart, as well as the growth of such organs (cf. *GA* II.4, 740a3-23; Section 2.1 above), already constitute an exercise of its actual nutritive soul (cf. Section 2.1 above).

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42 Platt (1912, ad loc.), emending the text, presents a reading taking χωριστά to signify the separation between the embryos and the seeds. Platt's view is discussed by Carraro (2017, n. 46), who himself takes the "separate embryos" referred to in this passage to be "newborn animals that have just been separated from the mother" (without, as he admits, having any equivalent case to support his reading); see Carraro (2017, 293). De Ribera-Martin (2019, 118) argues that the "separated embryo" in this passage "is not the first *kuêma*, but rather a posterior stage in the development of the *kuêma*". By "first *kuêma*" De Ribera-Martin means a stage at which the κύημα is still "*un*differentiated (*adioriston*) … ([*GA* III.9] 758a35-36)", and preceding the development of the heart, which is "the first part to show up (*apokrinetai*) and to be differentiated (*diôrismenê*)" (ibid., 116–117; cf. *GA* II.4, 739b33-740a21). But for Aristotle the embryo possesses a heart even when it is still "grublike" and "undifferentiated". Thus, for example, at *GA* III.11, 762b21-8, he goes on to say that certain species, like the eel, "are produced as grubs" (σκωληκοτοκεῖται), and that these animals, specifically at the stage at which they have "the nature of a grub" (σκώληκος ἔχει φύσιν), already "have a blooded heart as the originator of their parts" (καρδίαν ἔχουσι τὴν ἀρχὴν τὴν τῶν μορίων αἱματικήν).

43 As an anonymous referee has helpfully pointed out to us, one might think of the separate embryos mentioned in *GA* II.3, 736b8-13 as referring exclusively to embryos at the earliest stage of their formation, at which the heart is not yet connected to the mother by the blood-vessels (cf. *GA* II.4 and Section 3.1 above). However, since Aristotle in this passage argues that, among embryos, only those that are separated perform nutritive functions actively, this reading would commit him to the view that embryos at first have a nutritive soul in actuality, but proceed to lose it at some later developmental stage.

Furthermore, Aristotle has a special reason to refer to the embryos that he is contrasting in this passage with seeds as "separate embryos". At *GA* I.20, 728b32-4, he says that, in those beings that have life but in which the female and the male are not separate, "the seed is so to speak an embryo" (τὸ σπέρμα οἷον κύημά ἐστιν). And at I.23, 731a1-4, he again says that plants, in which the female and male are not separated, emit, not semen, but rather "an embryo, the ones called seeds" (κύημα τὰ καλούμενα σπέρματα). At II.3, 736b8-13, therefore, Aristotle must clearly distinguish the seeds/embryos of plants and unisex animals from "the separated of the embryos" — the embryos of those animals in which male and female are distinct and in which seeds and embryos are clearly marked off from one another. Embryos in this latter class, he thinks, are "separated" and have the nutritive soul in actuality.

It may be objected that the reading above attributes to Aristotle a claim that is either absurd or redundant. For, if X is actually F, then it is unreasonable to say that X is simultaneously F potentially (because X's potentiality for being F is already being actualized), unless what one means by saying so is simply that in order for X to be F actually X needs to be such as to be capable of being F in actuality (in which case no new information is added by saying that X is also F potentially). But Aristotle's usage of similar language elsewhere suggests otherwise.[44] In *PA* II.3, 649b16-17, he says that, when taken out of a mixture of earth and water, water is both potentially and actually (καὶ ἐνεργείᾳ καὶ δυνάμει) moist. Water is actually moist on its own, but it also contains the potentiality of making moist a mixture combining it and another (dry) component. Put more generally, Aristotle's view is that in at least some instances a thing X has a property F actually while also having F potentially insofar as X, differently configured (e.g., mixed with other components, having developed, or having undergone some other process of change), would possess that same property F actually. When Aristotle says, in *GA* II.3, 736b8-13, that embryos both actually and potentially have the nutritive soul, then, his point seems to be that an organism, at its earliest embryonic stage, is in possession of the nutritive soul in actuality, but is also capable of undergoing a change process (here, specifically, development into a member of an animal species, such as "horse") at the end of which it — the developed organism — would have that soul in actuality as well.[45] If this is correct, then there is no reason to think that Aristotle thinks embryos might "exercise life

44 Quarantotto (2022, 246; cf. 242 n. 29) argues that the nutritive faculty of newly formed embryos is fully active, while being, at the same time, in some state of potentiality. This explains, in her view, why the embryo is alive both in actuality and in potentiality.

45 Of course, unlike water in a mixture, an embryo does not remain as a component in a developed organism. And, whereas the properties of water remain intact at both stages, an embryo acquires new properties as it develops. But these disanalogies ought not to detract from the proposed comparison between Aristotle's uses of "potentiality" and "actuality" in these two cases. In both cases, something (water; an embryo) having a certain feature in actuality (moisture; a nutritive soul) is said

functions like nutrition and even perception" while also thinking that they have "a merely potential soul".[46]

The interpretation above requires that Aristotle think that there is a fundamental function actually fulfilled by the nutritive soul in embryos, and which persists in the newborn animal (in addition to new types of function or activity only added at that later stage). In *GA* II.3, 736b8-13, Aristotle does say that embryos (in general, given our reading above) "draw up nourishment and perform the function of such a [sc. the nutritive] soul". One might take the καὶ in this sentence epexegetically, in which case the activity of drawing up nourishment itself would constitute the primary function for which the nutritive soul is responsible, perhaps in addition to growth, which is closely related to it. But it might be objected that this activity takes radically different forms in embryos and in newborn animals, such that it could hardly be said to persist between the embryonic and postnatal stages.[47] Indeed, Aristotle argues that the nourishment of embryos resembles that of plants (*GA* II.4, 740a24-31). Similarly, he likens the growth of embryos, "which comes to be through the umbilical cord", to the growth of plants coming to be "through the roots" (*GA* II.4, 740b8-10). Lastly, as mentioned above, already at formation, and prior to taking in nourishment from the uterus through the umbilical cord in the way that Aristotle describes as "plant-like", embryos already actively engage in rather different nutritive processes — they develop and grow parts, particularly the blood-vessels by which they are to be subsequently connected to the uterus and draw nutrients from it.

Thus, one might do well to appeal to an even more basic function for which the nutritive soul is responsible. In *DA* II.4, 416b17-19, Aristotle refers to the nutritive part of the soul as its "primary principle" (ἡ … τῆς ψυχῆς ἀρχή) because it is a capacity "to preserve that which has it qua the kind of thing that it is". Such a function, at least, seems basic enough to apply, in full, to the embryo (at all stages) and the newborn animal alike.[48]

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to have that feature in potentiality as well, insofar as the final product involving that thing, once it appears on the scene, would be said to have the feature in question in actuality.

46 Carraro (2017, 299).

47 See Carraro (2017, 289–90).

48 Thinking of preservation as the basic function of the nutritive soul, to which growth would be subordinate, is also consistent with Aristotle's point, in *GC* I.5, 321a9-29, that increase in quantity or size does not count as growth as such, unless the growing thing is preserved (σωζομένου) and endures (ὑπομένοντος). See Coates and Lennox (2020, 41–3; 24), who argue, largely based on their reading of *DA* II.4, 416b9-20, that for Aristotle (i) the two primary functions of the nutritive capacity of the soul – nourishment and reproduction – share "one object and goal", viz., the preservation of the ensouled body qua ensouled, (ii) "[p]reservation (σώζειν) encapsulates both [of those] functions", and (iii) growth is a function "derivative" of nutrition (and presumably thus also falls under the broad description of the nutritive soul as oriented toward self-preservation, by implication).

4 The Perceptual Soul and Its Activities in Embryos

In this section we will argue that embryos, from their very formation, not only possess a perceptual soul but also actively exercise their perceptual capacity. In Section 4.1, we present an account of the sleep-like state that characterizes early embryos in Aristotle's view, and argue that this state implies that they have perceptual capacities, and allows that they might engage in perceptual activities. Then, in Section 4.2, we argue that he indeed thinks that embryos actively perceive as soon as they are formed.

Although Aristotle is not explicit about the kind of perception that early embryos engage in, there are reasons to think that this would consist of a rudimentary form of touch. Plausibly, for Aristotle, this early form of touch is markedly different from the tactile perception of later developmental stages, and all instances of perception are unified by a fundamental and overarching function, applicable to all animals at all stages of their development. That fundamental perceptual function, we suggest, consists in awareness, for him. Thus, Aristotle's discussion of the nutritive soul in embryos in *GA* II.3, 736b8-13, as we have interpreted it above, can be extended to the case of perception. As was the case with the nutritive soul, early embryos possess the perceptual soul both in actuality (qua underdeveloped animals currently ensouled and engaging in perception) and in potentiality (qua future possessors of a perceptual soul characteristic of a given animal species).

4.1 Early Embryonic Sleep and Perception

That embryos for Aristotle are capable of sense perception and indeed actively engage in it ought to be uncontroversial.[49] In *GA* V.1, he says plainly that animals first acquire perception (αἴσθησιν) within their mother (778b22), and that embryos are observed to be periodically awake (779a7-9) — a state that for him necessarily and essentially involves actively perceiving (*Somn.* 454a1-7). There are, however, questions about the time at which that soul capacity and its activity become available to embryos. Aristotle presents this as the "puzzle" of whether it is sleep or waking that comes first at "the beginning of the generation" (τῆς ἐξ ἀρχῆς γενέσεως) of an animal (778b23-5). Sleep comes out on top, since wakefulness is more frequent in later stages of development and because sleep is an intermediate state between being and non-being (778b25-31). The problem Aristotle faces here is that

49 According to Sprague (1977, 232), "there is no doubt that sensation begins before birth for Aristotle; the source of sensation is in the heart, and the heart is the first part of the animal to be formed (see, e.g., *Generation of Animals* II, 6, 743b26)."

on the one hand embryos seem to be continuously asleep from the point they first acquired perception (778b21-23), while on the other hand perception usually takes place during waking periods (778b31-2). After laying out the problem, he says the following (778b31-779a4):

> τῷ γὰρ ἐγρηγορέναι τὸ ζῆν μάλισθ' ὑπάρχει διὰ τὴν αἴσθησιν. εἰ δ' ἐστὶν ἀναγκαῖον ἔχειν αἴσθησιν τὸ ζῷον, καὶ τότε πρῶτόν ἐστι ζῷον ὅταν αἴσθησις γένηται πρῶτον, τὴν μὲν ἐξ ἀρχῆς διάθεσιν οὐχ ὕπνον ἀλλ' ὅμοιον ὕπνῳ δεῖ νομίζειν, οἵανπερ ἔχει καὶ τὸ τῶν φυτῶν γένος· καὶ γὰρ συμβέβηκε κατὰ τοῦτον τὸν χρόνον τὰ ζῷα φυτοῦ βίον ζῆν—τοῖς δὲ φυτοῖς ὑπάρχειν ὕπνον ἀδύνατον· οὐθεὶς γὰρ ὕπνος ἀνέγερτος, τὸ δὲ τῶν φυτῶν πάθος τὸ ἀνάλογον τῷ ὕπνῳ ἀνέγερτον.
>
> For living belongs mostly to waking on account of perception. And if the animal must have perception, and it is an animal then when perception first comes to be, one should think that the condition at the beginning is not sleep but similar to sleep, of a kind such as the one that the genus of plants has too. For the animals at that time happen to live a life of a plant. And it is impossible for sleep to belong to plants, for no sleep is unbroken by waking, and the affection of plants that is analogous to sleep *is* unbroken by waking.

Aristotle has been taken here to mean that "the initial state of embryos does not even deserve to be called sleep", so that the instances of perception he considers later in the chapter follow a period of time during which "the embryo is not able to perform any perceptive activity".[50] This reading suggests that the initial state of embryos does not only preclude active sense perception but denies them the status of percipient beings altogether. But the passage suggests otherwise.

The condition that Aristotle ascribes to embryos "at the beginning" is a special kind of sleep, surely, because there is no waking state to contrast with it during that time. It is in this regard that the sleep in question is plant-like, because plants are never awake. Aristotle says at the beginning of this passage (and consistently with his overall view) that an animal counts as such only when it is percipient. And, in the very sentence that compares newly created embryos to plants on the basis of their continuous sleep, he calls such embryos "animals" (τὰ ζῷα) and clearly contrasts that term there with "plant" (φυτοῦ) (779a1), as he generally does (see Section 2.2). Therefore, the comparison to plants cannot have the purpose of denying embryos the status of animals, and thus the capacity for sense perception. To the contrary, Aristotle's view must be that newly created embryos are animals having perceptual souls from the moment of their creation, *despite* the fact that they are not awake for

50 Carraro (2017, 295). Similarly, Platt (1912, ad. loc.) concludes from this passage that the formation of the heart, which for him marks the beginning of perceptual activity, has to take place, not at the beginning of gestation, but at a later stage of development; prior to the formation of the heart, embryos in his opinion live the life of plants and are not percipient beings. Cf. also Sprague (1977, 232–233), who thinks that embryos pass through a "pre-animal" stage where they are "plant-like" and therefore "not sleeping".

some time. Indeed, Aristotle thinks of sleep as being essentially a feature of animals. He defines sleep as a "lack of motion" of and "a kind of fetter" on sense perception (*Somn*. 454b25-6), and he points out that it affects the heart (*Somn.* 458a25-32). Sleep, properly speaking, cannot be attributed to living beings devoid of sense-perception.

Of course, embryos could be percipient living beings in virtue of having perceptual souls, and not exhibit active sense perception. But in *GA* V.1, Aristotle goes further. Immediately after the passage quoted above (778b31-779a4), he presents empirical evidence for the view that sleep is compatible with active sense perception. First, he reminds us that newborn animals, and in particular human infants, cry and laugh during their sleep, which is evidence for actual sense perception taking place: "for perceptions occur also in sleeping animals, and not just what we call dreams, but also others besides dream" (779a12-14). And second, he points out that people who sleepwalk have perceptions of their surroundings just as if they were awake. Both phenomena show, in his opinion, that newborn animals and human infants who spend the greater part of their time asleep can nevertheless engage in perception. As he explains, they "seem to be perceiving and living in sleep, just as being ignorant of waking" (779a19-21). This statement can easily be applied to newly formed embryos as well.[51]

In conclusion, Aristotle's view that newly formed embryos are asleep rests on his assumption that they are percipient beings. Moreover, his observation that sleep is compatible with actual sense perception allows for the possibility that they actively perceive while asleep.

4.2 The Embryonic Heart and Its Perceptual Activities

In a passage where he specifies the heart as the source of touch and all further perception (*PA* III.4, 666a11-18), Aristotle supports his position using the following claim (666a20-21):

> ἐν γὰρ τοῖς ἐμβρύοις εὐθέως ἡ καρδία φαίνεται κινουμένη τῶν μορίων καθάπερ εἰ ζῷον
>
> For in embryos straightaway the heart is manifestly moving, of all the parts, exactly as if it were an animal.[52]

51 Aristotle also grants elsewhere that actual sense perception takes place during sleep. In *De divinatione per somnum*, he notes how perception during sleep becomes apparent in corresponding dreams that exaggerate the sensations. For example, someone who hears a soft ringing imagines a loud thunderstorm, someone swallowing while asleep imagines drinking honey, or someone perceiving slight heat imagines walking through flames (463a12-16).

52 Translation following Lennox (2001, ad loc.).

The facts that the movement of the heart indicated here is supposed to explain the status of the heart as the source of sense perception, and that the relevant feature of it in this respect is that it is animal-like, signal that for Aristotle the embryo, from its earliest stages (i.e., when the only bodily part it has is the heart), engages in perception.

Aristotle also notes in the *History of Animals* that the heart is moving in its own right from the very beginning. In the passage in question, he describes his experiment of opening chicken eggs after three days and three nights. At that time, the heart of the embryo is the size of a "speck of blood" (στιγμὴ αἱματίνη) and jumps and moves around "as if it were ensouled" (ὥσπερ ἔμψυχον: *HA* VI.3, 561a11-13). The use of ὥσπερ in this text is certainly not meant to question the fact that there is an actual soul involved. Rather, it is meant to compare the embryonic heart with a small (post-embryonic) animal.[53] Aristotle's main point here seems to be that at this early stage one can observe, not only that the heart has already been formed (a fact he stresses also elsewhere), but also its characteristic activity. And since the life activities of such an early embryonic heart include autonomous and lively movements, it resembles a small living (post-embryonic) creature.

Similarly, when Aristotle says, in *PA* III.4, 666a20-21, that the heart behaves from the very beginning "as if it were an animal", or when he goes on to say at 666b16-17 that the heart "is naturally akin to some animal" (οἷον ζῷόν τι πέφυκεν),[54] he presumably means to liken the heart to an insect, a bird, or a small mammal, and thus to a fully developed member of a particular species whose characteristic behavior we observe more readily and regularly. The analogy with mature members of a given animal species indicates that the active perception of early embryos consists in the exercise of their perceptual soul, which they possess in actuality, as is standardly the case with animals exercising life activities, for him.[55]

Aristotle does not specify the nature of the perceptual activities available to early embryos. Since he thinks of embryos as animals, and since he thinks that

53 Aristotle stresses the fact that all animal body parts require a perceptual soul to be present; cf., e.g., *GA* II.5, 741a9-13 and 741a26-28. Therefore, his remark that a chicken-embryo's heart behaves "as if it were ensouled (ἔμψυχον)" cannot be meant to deny that embryonic hearts are ensouled. Aristotle most likely uses "ἔμψυχον" more narrowly for "animal" here. This usage can also be found in a passage where Aristotle says that plants, compared to lifeless bodies, seem "as if [sc. their genus is] nearly ensouled" (σχεδὸν ὥσπερ ἔμψυχον: *HA* VIII.1, 588b9-10). Just as the remark about chicken-embryos' hearts, this statement does not intend to question the fact that plants are ensouled, but rather compares them more specifically to animals. For this narrow usage of ἔμψυχον cf. also the LSJ entry, which lists Thucydides' use of τὰ ἔμψυχα for animals (7.29), and Aristotle's quotation of Empedocles on the universal demand "not to kill the living" (μὴ κτείνειν τὸ ἔμψυχον: *Rh.* I.13, 1373b14).

54 Lennox (2001, 258) points out the parallel between 666a20-21 and 666b16-17.

55 Contra Carraro (2017, 275; 299). See Section 3.2.

all animals have at least the sense of touch, he should attribute at least tactile perception to them. Indeed, his theory leaves room for attributing to early embryos actual instances of tactile experience. For Aristotle, as we have seen, embryos from their very formation possess a heart, which functions as the primary organ of the sense of touch. In addition to the role of the heart in touch, he thinks, flesh functions as the medium in the activity of that sense (cf. *DA* II.11). And he says that the embryo from its inception is "fleshy" (κρεῶδες) (*HA* VII.3, 583b10), and features membranes (ὑμένες) (*GA* II.4, 739b31), presumably surrounding the heart.[56] Early embryos therefore seem to satisfy Aristotle's criteria for, and for him may well actively exhibit, at least a rudimentary type of tactile perception.

But early embryonic instances of touch may differ radically from later ones, given the physiological differences between early embryos and (say) mature animals, similarly to the difference between embryonic and postnatal nourishment.[57] And so, even if early embryos do exhibit a form of tactile perception, one may do well to appeal to a more basic perceptual function that they share with animals at later stages of their development.[58] A plausible candidate for such a function, given Aristotle's psychology, would be subjective awareness, which is arguably the product of the perceptual capacity whenever it occurs, including in instances of human intellectual activity.[59]

In Section 3.2, we have argued that Aristotle in *GA* II.3, 736b8-13 attributes to embryos both a potential and an actual nutritive soul, since an early embryo both actively exercises its nutritive capacity and would, given its successful development, eventually exercise the nutritive capacity of the animal species to which it would belong. These successive nutritive capacities, for Aristotle, differ radically, but they nevertheless also share a basic function in common. We are now in a position to attribute to Aristotle a similar view with regard to the perceptual capacity. On that

56 In *DA* II.1, in the context of establishing the role of flesh as the medium of touch, Aristotle compares flesh to a membrane (ὑμένα) hypothetically enveloping one's flesh (422b34-423a6; 423b8-11).

57 See Section 3.1; cf. Carraro (2017, 290).

58 As we have seen above, in the case of the nutritive soul such a basic function, namely preservation, is indeed retained throughout an organism's development (see Section 3.1).

59 Kahn (1995, 364), for example, argues that Aristotle understands αἴσθησις both objectively, as the perception of "information about the environment", and subjectively, as "awareness, feeling, or reflexive consciousness" (cf. *Sens*. 448a26-30). On Kahn's view (1995, 363), αἴσθησις in its subjective sense accounts for one's self-awareness not only in instances of perceiving, but also in instances of thinking, so that "our ordinary intellectual activity is for Aristotle a joint action of sentience and intellect". In *Metaph*. Λ.9, 1074b35-6, Aristotle makes the point that self-cognition invariably accompanies cognition, including sense perceiving; cf. Kahn (1995, 374–5). In *DA* III.2, 425b12-25, he discusses the perception or awareness that one is engaging in sense-perception, specifically. We are grateful to an anonymous referee for a helpful note on this last text.

view, an embryo about to develop into a horse, say, has the perceptual soul both actually and potentially. Actually, because it has a functioning perceptual soul performing the fundamental function of awareness (in addition, most probably, to the exercise of a basic form of tactile perception), and potentially, because it is not yet the horse (e.g.) that would have a perceptual soul featuring that fundamental function alongside additional ones — both those characteristic of later animals in general (a more advanced form of touch) and those specific to the species to which it belongs (the rest of the senses, if the species in question happens to have them).

5 Possible Objections

Having argued above that Aristotle regards embryos, from their very formation, as animals, having both nutritive and perceptual soul capacities and actively exercising both, it remains to address several features of his theory that have been standardly taken to deny such a view. Specifically, Aristotle likens the state of early embryos to the life of plants. He is also taken in *Metaph.* Θ.7 to assimilate embryos to unformed matter. It is not difficult to see how such comparisons, taken at face value, would lead one to think that early embryos for Aristotle are not percipient or even alive. Nevertheless, in the following subsections we argue that, despite appearances, a proper understanding of these comparisons shows that they are all fully congruent with the interpretation we have proposed thus far.

5.1 Embryos and Plants

As we have seen in Section 4.1, Aristotle in *GA* V.1 compares the initial embryonic state resembling sleep to the life of plants. This comparison, which recurs in other places in Aristotle's corpus, may seem to imply that he denies embryos animal status. In fact, however, the import of the analogy is quite different. In *HA* VIII.1, 588b4-23, Aristotle says that the differences between inanimate natural things and living things, and the differences between different life forms, are sometimes subtle to the point of being indiscernible in practice. Thus, there are difficulties in determining whether some marine organisms, for example, are to be classified as either animals or plants. And, generally, different living things exhibit "life" and "movement" to varying degrees, and "according to minute difference" (588b21-3). Given these considerations, there seems to be ample room for comparing certain animals to plants, and this is particularly true for embryos, and generally for animals at the earliest stages of their development. Aristotle thinks that embryos initially only have rudimentary perceptual functions, much more basic than those of adult animals, especially

animals of higher species (see Section 4.2). He also thinks that at the beginning embryos are permanently in a state akin to sleep, and only perceive during that state (see Section 4.1). For this reason, he repeatedly compares embryos to plants. Embryos, like mollusks, would be comparable to plants because of their relative lack of movement and perception. But, as Aristotle points out in his comparison between plants and animals in *GA* I.23, 731a25-731b7, even the most basic forms of sense perception, touch and taste, which "seem to be like nothing" when compared to wisdom (φρόνησις), are in fact "wonderful when compared to a plant or a stone" (731b1-2).

The comparison between the uninterrupted sleep-state of newly created embryos and the life of plants in *GA* V.1, then, highlights the point that sense perception in newly formed embryos is extremely limited. Since it takes place during a sleep-state that appears to be initially uninterrupted by waking periods, the condition of early embryos in fact closely resembles the life of plants. But the fact that embryos share some commonalities with plants does not mean that they lack perceptual souls and therefore *are* plants. This is also evident on the basis of passages where Aristotle draws a comparison between sleeping humans and plants. In *EE* I.5, 1216a2-9, he says that living a life of uninterrupted sleep (ἀνέγερτον ὕπνον) is no different from "living [while] being a plant" (ζῆν ὄντα φυτόν).[60] He goes on to say that plants seem to partake of such a life, and so do children, who "from their first generation in the mother" (κατὰ τὴν πρώτην ἐν τῇ μητρὶ γένεσιν) are asleep the entire time. Here, the sleeping condition of children is explicitly likened to the condition of embryos, and both are compared to the condition of plants. The comparison, then, cannot be meant to deny perception to the comparanda. Similarly, in *NE* X.6, 1176a33-5, Aristotle says that if happiness were a condition of the soul, it would have belonged to a person who spent their entire life sleeping, "living the life of plants" (φυτῶν ζῶντι βίον). Again, though a life of a plant is explicitly attributed to that hypothetical person here, surely this is not meant to deny that person a perceptual soul.[61] Likewise, when Aristotle likens animal nourishment to that of plants, in *PA* II.3, 650a14-31,[62] the animals in question are mature members of their species. Thus, his comparisons of embryos to plants do not imply that he views embryos as non-animals.

60 Indeed, whereas at *GA* V.1, 778b31-779a4 Aristotle has merely claimed that early embryos "live the life of a plant" (cf. *GA* II.4, 740a24-31; 740b8-10), here at *EE* I.5, 1216a2-9 he implies, rather hyperbolically, that the people he is describing *are* plants. Since the latter comparison does not imply that the people in question literally are plants, however, the former comparison certainly need not imply that embryos are.

61 But see Sprague (1977, 232–3, 235), who seems to associate the continuous sleep discussed in 1176a34-5 with the state "analogous to sleep" discussed in *GA* V.1, which she thinks Aristotle applies to embryos in a "pre-animal state".

62 See Section 3.1, n. 40.

5.2 The Comparison to a Mass of Bronze in *Metaph*. Θ.7

In *Metaph*. Θ.7, Aristotle raises the question "when each thing exists potentially (δυνάμει) and when not" (1048b37). He illustrates the issue as follows:

> οἷον ἡ γῆ ἆρ' ἐστὶ δυνάμει ἄνθρωπος; ἢ οὔ, ἀλλὰ μᾶλλον ὅταν ἤδη γένηται σπέρμα, καὶ οὐδὲ τότε ἴσως;
>
> For example, is earth a human being potentially? Or not, but rather more so whenever seed already comes about [alt. whenever it already becomes seed], and perhaps not even then?

Whereas earth certainly is not yet potentially a human being, Aristotle says here, seed might be. Later in the chapter, discussing specifically things having an internal principle of generation, Aristotle returns to the example mentioned above, and says the following (1049a14-18):

> οἷον τὸ σπέρμα οὔπω (δεῖ [εἶναι][63] γὰρ ἐν ἄλλῳ καὶ μεταβάλλειν), ὅταν δ' ἤδη διὰ τῆς αὑτοῦ ἀρχῆς ᾖ τοιοῦτον, ἤδη τοῦτο δυνάμει· ἐκεῖνο δὲ ἑτέρας ἀρχῆς δεῖται, ὥσπερ ἡ γῆ οὔπω ἀνδριὰς δυνάμει (μεταβαλοῦσα γὰρ ἔσται χαλκός).

This text may be translated as follows (henceforth, reading 1):

> For example, the seed [is] not yet [a human being] (for it must [be] in another and change), and when it is already of such a kind through its own principle, it is this potentially. But that requires another beginning, just as earth is not yet potentially a statue (for, having changed, it will be bronze).

This reading of the text, similarly to numerous previous translations,[64] takes it to convey the idea that seed is not yet potentially a human being, but that it will be so, upon undergoing the appropriate process of material change eventuating in an embryo, just as earth is only potentially a statue once it has changed into bronze.[65]

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63 Jaeger, in the OCT, claims that some infinitive verb should be assumed here, mentioning W.D. Ross' proposed "πεσεῖν" and considering "γίγνεσθαι" instead. Beere (2009, 252 n. 31) argues against the need for the addition, taking καὶ to be "emphatic".

64 W.D. Ross (1985, 129): "E.g. the seed is not yet potentially a man; for it must further undergo a change in a foreign medium … "; Makin (2006, 9): "for example, the seed is not yet [potentially a man] (for it needs to fall in something else and change)"; Beere (2009, 251): "For instance, the seed is not yet [a human being in capacity], because it must still undergo a change within something else … "

65 De Ribera-Martin (2019, 119–21) argues that, at *Metaph*. Θ.7, 1048b37-1049a18, Aristotle distinguishes between seed "that is not yet a human being in potentiality" – the "spermatic residue" of the male and female parents – and the seed that "is already a human being in potentiality", viz. the "first *kuêma*" – a κύημα at an early stage during which it is not yet differentiated but already engages in nutrition. As we argue below, however, Aristotle can consider a κύημα a potential human being although it already possesses both nutrition and perception in actuality.

Because on this reading Aristotle likens the embryo about to develop into a human being to the mass of bronze about to be sculpted into a statue, it might seem to suggest that he similarly regards the embryo as matter of the relevant quantity and kind, to be shaped into a human being at some later stage.[66] But that need not be the case. In *GA* II.3, in the context of discussing the development of seeds (σπέρματα) and embryos (κυήματα), Aristotle says that

> an animal (ζῷον) and a human being do not come to be at the same time, nor do animal and horse, and similarly in the case of the other animals, for the end comes to be last, and the characteristic mark of each is [the] end of generation (736b2-5).

In the immediately preceding line (736b1), which is supposed to be explained by 736b2-5,[67] Aristotle specifies that "ζῷον" refers to a being endowed with, and defined by, the perceptual soul (τὴν αἰσθητικήν).[68] He seems to think, then, that the formation of a human being (or a horse) is preceded by a stage at which the embryo counts as a percipient pre-human (or pre-horse) animal. To return to *Metaph.* Θ.7, 1049a14-18, on reading 1 Aristotle might mean there that seed is not yet potentially a human being because it must first develop into an embryo, which in turn would be potentially a human being, but which itself would also already have its own form, i.e., the soul of a percipient pre-human living thing.

It is not clear, furthermore, that one must accept reading 1, or, generally, the understanding of 1049a14-18 as mapping the development of a seed, through an embryo, to a human being, onto the creation from earth first of bronze and finally of a statue. Alternatively, one could translate these lines as follows (henceforth, reading 2):

> For example, [earth is] not yet the seed (for it must [be] in another and change), and when it already is of such a kind through its own principle, it is already potentially this. But that requires another beginning, just as earth is not yet potentially a statue (for, having changed, it will be bronze).

On this reading, Aristotle in these lines returns to the question raised at the beginning of the chapter, of whether seed, unlike earth, can already be said to be a human potentially, and answers it in the affirmative. Earth, when it is "in another" —

66 Cf., e.g., Connell (2001, 319), who concludes from the passage that Aristotle's use of "matter" in his embryological theory is quite broad: "In Aristotle's embryology, since the use of 'form' is limited to the specification of completed reproductive animals, any incomplete substance, even if very complex, is matter. Clearly, then, biological materials are far from being entirely indistinct and indefinite."

67 Notice, however, that Lulofs, in the OCT, posits a lacuna between 736b1 and 736b2.

68 See Section 2.2.

presumably, as earthy matter inside the human body[69] — can change and morph into seed, at which point it would be of such a kind as to constitute a (further) human being potentially.

It may be argued against reading 2 that, if a seed already is potentially a human being, then the embryo, which results from that seed, ought to already count as a human being, and that this would be inconsistent with Aristotle's view in *GA* II.3, namely that there is an intermediate stage between the seed and the human being at which the embryo exists as "an animal". There are at least two possible responses to that worry. First, a seed and the embryo resulting from it could both qualify as a potential human being, albeit at different levels of approximation to that final product. To return to Aristotle's own analogy, on this proposal the seed and the embryo would count as a potential human being in the same way that a randomly shaped lump of bronze and a quantity of bronze already assuming the preliminary shape of the sculptor's work would both count as a potential statue. Second, human beings are not mentioned anywhere in *Metaph.* Θ.7, 1049b14-18. And so, even though it is likely that this passage hearkens back to the previous discussion of whether seeds count as potential human beings at 1048b37, the discussion at 1049b14-18 might focus on a specific part of the development of a seed into a human being. Thus, when Aristotle at 1049b14-18 speaks of the seed as potentially *this*, he may have in mind an "animal", an "embryo", or a "substance", rather than specifically a "human being".

Reading 2 offers several advantages over reading 1. First, the earlier occurrence of the example of embryogenesis in *Metaph.* Θ.7 (at 1048b37) discusses the status or role of both earth and seed in that process. And the discussion in 1049a14-18, on reading 2 and by contrast to reading 1, again mentions both earth and seed, and thus corresponds more closely to 1048b37. Second, on reading 2, Aristotle compares the relation between earth, seed, and human to the one between earth, bronze, and statue, respectively. It seems reasonable for that comparison to be made, inter alia, because earth is the first item on both lists (and serves as the starting point in both of the change processes corresponding to these). Finally, whereas reading 1 takes Aristotle to be drawing an analogy between bronze (of whichever shape) and an embryo having its own specific form (the form of a percipient pre-human animal, to follow the interpretation offered above), this discrepancy is avoided by reading 2, on which bronze is likened to seed.

We need not determine conclusively whether one of these possible readings is preferable over the other. For our present purposes, it is sufficient to note that, on either reading, Aristotle may well consider the embryo a percipient living thing. On reading 1 (and the interpretation of it proposed above), the embryo, which is taken

69 For Aristotle, blood, which contains earth and water, is the "matter of the entire body" (ὕλη … παντὸς τοῦ σώματος) (*PA* II.4, 651a13-14).

to be a potential human being, is conceived of as a pre-human percipient animal, following Aristotle's view in *GA* II.3. On reading 2, it is seed that is said to be a human being potentially, leaving room for the view that the development into an embryo would include a further step toward the actualization of that potentiality, or at any rate the possession by that embryo of at least a perceptual soul.

6 Conclusion

We have argued that Aristotle views embryos, from their very conception, as animals actively engaging in both nutrition and perception. Apart from clarifying a key issue pertaining to his embryology, and establishing the compatibility between his views on embryogenesis and on animal souls, this interpretation has significant implications for our understanding of Aristotle's psychology, his metaphysics, and his ethical and political views on abortion.

First, as we have seen, Aristotle is standardly taken to conceive of embryos as something other, and indeed lower, than actual animals. On such interpretations, he attributes to early embryos either only a nutritive soul or no soul in actuality. But, as proponents of these readings sometimes recognize, Aristotle ascribes to early embryos active nutritive processes and perceptual activities. If embryos did not have nutritive and perceptual souls in actuality, then, their case would have deviated from Aristotle's general psychological theory, according to which nutritive processes and perceptual activities require the operation of an actual soul of the relevant kind. In that case, one would have expected an elaborate account explaining how Aristotle might have allowed and accounted for embryonic soul activities as a nonstandard case. We are not aware of any such explanation, let alone a successful one. The view of embryonic soul activities that we have offered alleviates the need for such an explanation. On our interpretation of Aristotle, the nutritive and perceptual activities of embryos are the exercise of the nutritive and perceptual souls that they possess in actuality, just as is the case in animals postnatally (though the kinds of nutritive and perceptual activity performed by each differ significantly). If we are correct, then Aristotle's embryology does not deviate from his standard understanding of the conditions under which soul activities take place and the causes bringing them about, which in turn suggests that his view on this subject is firm, unified, and generally applicable.

Second, our argument informs our understanding of Aristotle's view of nutrition and perception. As we have seen, Aristotle attributes to early embryos basic nutritive and perceptual functions, which carry over to later stages of the organism's development, at which point they are gradually supplemented by further psychological functions along with the origination and development of the corresponding organs.

The presence already at conception of such basic functions — preservation, in the case of the nutritive soul, and either basic awareness or rudimentary tactile perception (or both), in the case of the perceptual soul — suggests that Aristotle views these functions as fundamental to the relevant types of soul, and hence as crucial for determining and understanding fully how it is that nutritive and perceptual souls figure in animals of different species, and in a single animal at different stages of its development.

Third, our interpretation has implications for Aristotle's view of substantial change. Since, for him, animals are paradigmatic cases of substances, their generation is of special interest. On the interpretation that we have rejected, gestation includes stages during which the embryo is not yet an actual animal. The status of early embryos has been compared to the condition of a construction site, which is more than unorganized matter, but not yet, e.g., a building capable of fulfilling the function of a house, namely, to provide shelter.[70] By contrast, on our reading, the immediate products of conception are already animals, comparable to a recently built house that is already capable of providing shelter in a rudimentary way, while it still needs to be further equipped and decorated. This interpretation suggests that Aristotle neatly distinguishes between the initial generation of a substance and its further development. Our interpretation does not deny that it takes some time to create a new substance (as noted in Section 2.1, Aristotle specifies that it takes a few hours or days to create an embryo); nor does it deny that an entity needs further development after its initial creation. But it emphasizes that the generation of a substance involves the creation of its most fundamental functions and features, which it will possess for the rest of its existence. It also takes seriously the far-reaching effect a form has on matter: it does not, at first, just superficially modify it, but it fully transforms it to create a new substantial being.

Our interpretation, according to which Aristotle views the immediate products of conception as animals, might at first sight be taken to downplay the role of the mother in the embryo's development, or even to reduce her role to that of a vessel, in which the embryo develops autonomously. But Aristotle's position on conception, as we understand it, is compatible with the significant role that he ascribes to mothers in the corporeal and formal development of the embryo. On our reading of Aristotle, early embryos are animals whose development is managed and controlled by their souls, but they also depend for that development on a supply of appropriate nutrition from their immediate surroundings, and much more so than mature animals. Aristotle emphasizes that it is the mother's role to provide the necessary means for the embryo's growth (*GA* I.22, 730b2-5). In viviparous animals, the mother provides nutrition inside her body. In oviparous animals, she provides

70 Freeland (1987).

the nourishment within the egg; since, as Aristotle notes, the developing embryo must be connected to the mother, she fulfills her role in the embryo's development remotely, as it were, by providing the yolk (III.2, 753b30-754a9).

The mother's contribution is not limited to providing nutrition for the physical development of the offspring. There are places where Aristotle seems to attribute to the mother some influence on the embryo's formal development. For example, in *GA* II.4, 738b27-739a3, he points out that, after an extended process of crossbreeding, an offspring can be shown to approximate its mother "in shape".[71] Aristotle's theory of maternal resemblance in *GA* IV.3 (cf., e.g., 767a35-b5, 768a14-21) has also been taken to imply that she contributes formal characteristics to her offspring.[72]

But the mother's contribution to formal characteristics is compatible with the embryo in question being an animal, i.e., a living being with a perceptual soul, from the beginning. On Aristotle's view, as it emerges from our analysis above, the embryo, though counting as an animal already at conception, takes time to develop into a member of a particular animal species (see Section 5.2; cf. *GA* II.3, 736b1-5). That process leaves room for the embryo to undergo numerous changes in its formal features and capacities, enacted both by its own soul and by its surroundings, and above all by its mother, on whom it of course also depends for an environment conducive to its growth and for its source of nutrition. Indeed, Aristotle believes that even newborn and young animals depend on their mothers for such purposes. Thus, the female fox not only nourishes her newborn and hides them for their protection but, by licking them, also "warms and shapes" (ἐκθερμαίνει καὶ συμπέττει) them, seeing as a newborn fox is particularly "inarticulate" (ἀδιάρθρωτον) (*HA* VI.34, 580a6-10). In humans, analogously, Aristotle says that it is necessary for the soul of the student "to be molded in advance" (προδιειργάσθαι) by the habits, just as it is for earth about to nourish the seed (*NE* X.9, 1179b24-6), and warns against children under the age of seven spending time with household slaves, lest their souls be negatively (and presumably irreversibly) affected, specifically by acquiring "illiberality of mind" (ἀνελευθερίαν) (*Pol.* VII.17, 1336a39-b3).

Finally, our interpretation also has implications for the understanding of Aristotle's ethical and political views on abortion. In *Politics* VII.16, 1335b19-a6, Aristotle recommends abortions as a legitimate strategy for population control, but introduces a time limit for them based on the occurrence of "life and perception" (1335b23-26). According to a prevalent reading, Aristotle in this passage argues that abortion is permissible only before the embryo acquires perception. A full examination of the passage goes beyond the scope of this paper. But it is worth noting that Aristotle seeks

71 We are grateful to an anonymous referee for drawing our attention to this passage and its relevance to our topic.

72 Cf. Henry (2006).

to establish a law with practical applicability, which makes it unlikely that he regards embryological developments as relevant factors, given that they are difficult to discern and verify.[73]

Perception by itself is not sufficient for granting a being moral status, for Aristotle. He has no qualms about speaking of the ending of animal or even human life as morally permissible in certain contexts. He accepts the hunting and killing of wild animals (*Pol.* I.8) as well as the exposure of disabled children (*Pol.* VII.16, 1335b19-23). Generally, it is worth remembering that Aristotle, although regarding embryos as animals, is aware of their underdeveloped state. All embryos, even those of relatively high, viviparous animals, are in his view so underdeveloped that they can be compared to the larvae of insects (cf. *GA* III.9, 758a32-36). This suggests that Aristotle's theory of conception differs significantly from theories according to which newly formed human embryos have a high moral status deserving of protection.[74]

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73 We discuss the topic in Schriefl and Segev (forthcoming). There, we reject the standard reading of *Pol.* VII.16 and *HA* VII.3, which takes Aristotle to be opposed to abortion from the point at which perception emerges in the embryo; see, e.g., Kraut (1997, 155–6). We argue that, instead, Aristotle is concerned in both texts with the detection of a certain stage of pregnancy by the pregnant woman, through her perception of embryonic movement, and that in *Pol.* VII.16 he recommends banning abortion from that point on, probably for reasons having to do with the safety of that woman.

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