

Scott O'Connor

# The Subjects of Natural Generations in Aristotle's *Physics* I.7

**Abstract:** In *Physics* I.7, Aristotle claims that plants and animals are generated from sperma. Since most understood sperma to be an ovum, this claim threatens to undermine the standard view that, for Aristotle, the matter natural beings are generated from persists through their generation. By focusing on Aristotle's discussion of sperma in the first book of the *Generation of Animals*, I show that, for Aristotle, sperma in the female is surplus blood collected in the uterus and not an ovum. I subsequently argue that, for Aristotle, this blood does persist through the production of the fetus.

**Keywords:** Aristotle, change, matter

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## 1 Introduction

In *Phys.* I.7, Aristotle claims that “everything which comes into being is composite (συνθετόν)” (190b10–11). The *terminus a quo* of any change, he tells us, is the subject and privation (190b11–12), which are one in number, two in form (190a14–16). The *terminus ad quem*, on the other hand, is a complex of the subject and form which that subject acquired. Any substance that comes into being is a product of some change, and, so, Aristotle concludes that substances are composed of some subject, which he later dubs *matter* (ὕλη; 192a31–32), and the form that was imposed upon that subject to make that substance.<sup>1</sup> This is a

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<sup>1</sup> In what follows, I use ‘matter’ for the *per se* subjects of unqualified changes (GC 320a2–5). It is what substances come into being from non-coincidentally (190b18–20). These subjects are distinct from privations or any matter/privation complex, which Aristotle might also be taken as calling subjects when he calls the subject and privation one in number, two in form. He tells us at 190b13–17 that the subjects of change are things like a man, a stone, some bronze, some gold. These subjects are distinct, he says, from privations like unmusical, disordered, unmoulded, and so on.

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natural reading of Aristotle's argument for hylomorphism, the claim that matter and form are the principles and causes of natural beings (190b17–20). So understand, the argument rests on the key claim that the subject of a change persists as it acquires some form.<sup>2</sup>

There is, though, a long-standing problem with this reading of *Phys.* I.7. Just 6 lines before claiming that the product of each change is a complex of the persisting subject and form it acquired, Aristotle turns to identify the subjects of various changes and claims that plants and animals, paradigmatic Aristotelian substances, are generated from 'σπέρμα' (190b5). For the moment, I will leave this phrase untranslated and use the transliteration *sperma*. The most straightforward reading of this claim is that *sperma* is the subject animals are generated from.<sup>3</sup> Since the product is partially composed of the subject it was generated from, Aristotle seems to be committed to the claim that animals are partially composed of *sperma*. This claim has struck many as bizarre. Dolphins are made from mammalian eggs, ova, but ova don't survive and compose the dolphins that are generated from them. Thus, there is an apparent deep tension at the heart of *Phys.* I.7. Aristotle both relies on the claim that the subject of each change persists and at the same time offers a counter-example to this claim that undercuts the very use towards which he puts it, namely, arguing that substances are composed of matter and form.

Interpreters have tried a number ways of easing the tension. On one extreme are those who argue that Aristotle never commits himself to the general claim that the subject of each change persists through that change for which it is subject.<sup>4</sup> Rather, on this reading, Aristotle denies that matter, the subject of natural generations, persists when new substances are generated from it. On the other extreme are those who argue that he is so committed, but deny that he really does think that *sperma* is the matter from which animals are generated. Instead, these interpreters argue that the relevant matter is something that composes the *sperma*, either a mixture of the four elements or prime-matter. Each interpretive strategy has far reaching consequences. The former entails something significant about Aristotle's general understanding of change and his argument for hylomorphism. Aristotle does not, on this reading, believe that it is a necessary condition for S to be subject of change C that S persists through C. He does not, then, rely on this claim in his argument for hylomorphism. The

<sup>2</sup> For this standard reading, see Ross (1936, p. 22), Wieland (1975), Bostock (2006, p. 14), Graham (1987, p. 133). For worries with the standard reading see Kelsey (2010).

<sup>3</sup> In what follows, I speak only of animals and ignore plants since Aristotle's botanical works have been lost.

<sup>4</sup> References below.

second may entail something significant about Aristotle's understanding of matter, e.g., that he believes in prime-matter.

I think that neither of these interpretations of *Phys.* I.7 is correct. This is not to say that Aristotle nowhere denies that the matter of animals is destroyed in the generative process. Nor is it to say that Aristotle does not believe in prime-matter. It is to say that the sperma example in *Phys.* I.7 does not have the consequences that many have drawn from it. On the new reading I offer here, Aristotle really does accept the apparently bizarre claim that the sperma from which a dolphin is generated survives the process and is present in that dolphin once generated, i.e., I argue that, for Aristotle, the matter natural organisms are produced from is sperma. But I think that this claim is not as bizarre as first seems. To be sure, it is false – Aristotle's biology has been superseded. But by focusing on Aristotle's discussion of sperma in the first book of the *Generation of Animals*, I show that sperma in the female animal is surplus blood collected in the uterus and not an ovum. I subsequently argue that, for Aristotle, this blood does persist through the production of the fetus.

Bringing to light these salient details about sperma will not solve every problem with the persistence of Aristotelian matter.<sup>5</sup> For instance, I do not offer here a theory of *how* sperma – the uterine blood – persists through the generative process nor do I offer a general theory of how sperma composes an animal. These are different projects and require, amongst other things, a detailed discussion of form. My goal is to show that not only is sperma the matter animals are generated from, but that this matter persists and partially composes the new animal.

## 2 The Sperma Puzzle

The difficulty with the sperma example arises, in part, because of Aristotle's general project in *Phys.* I.7, which he begins as follows:

Let us, then, speak about *all coming to be*, in the following way; for the natural procedure is to speak first about *what is common to every case*, and then to study what is special to each case (189b30–32; my emphasis; *trans.* from Irwin & Fine slightly modified).

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<sup>5</sup> For other problems with the persistence of Aristotelian matter see Ackrill (1972) and Gill (1989).

By this, Aristotle means that he will make some general claims about the principles involved in every change, most importantly, about their relations to the products of each change.<sup>6</sup> These principles, according to Aristotle, are subject (ὑποκείμενον), form (εἶδος), and privation (στέρησις). This is a claim about the structure of every change.<sup>7</sup> Aristotle, in agreement with his predecessors, argues that all changes occur between some pair of opposites, like the hot and the cold, or an intermediate between the two (*Phys.* I.5). The opposite that is gained is the form and the opposite that is lost is the privation.<sup>8</sup> Changes do not involve only privations and forms. There must also be, according to Aristotle in *Phys.* I.6, some entity that undergoes the change, the subject, which is distinct from those opposites a change occurs between. For different changes, there are different subjects, forms, and privations. When a dolphin changes from being cold to being hot, the dolphin is the subject, the hot is the form, and the cold is the privation. When some chocolate syrup changes from being soft to being hard, the chocolate is the subject, the hard is the form, and the soft is the privation.

Having established these three principles in earlier chapters, Aristotle now presents a schema that, when properly filled out by the three principles, describes all changes. He introduces this schema by first claiming that when speaking about change, we can speak either about what is simple (τὰ ἀπλᾶ) or what is compound (τὰ συγκείμενα) (189b32–34). He explains this point as follows:

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<sup>6</sup> Note that Aristotle is not offering an analysis of what changes are. According to *Phys.* III.I changes are diachronic entities that are related to the various entities that change. The principles involved in a change are different entities from the change itself. For discussion, see Coope (2009), Graham (1988), Kosman (1969).

<sup>7</sup> See Bolton (1991), Bostock (2006).

<sup>8</sup> Let me note two subtleties that we can set aside for our purposes. First, for every pair of opposites, one opposite is the form, call it *F*, and the other is the privation, call it *F*<sup>-</sup>. Aristotle says that there is an account of the form, but not the privation, i.e., of *F* but not of *F*<sup>-</sup> (191a12–14). This means that (i) there is something such to be *F*, and (ii) to be *F*<sup>-</sup> is to lack whatever it is to be *F* in a particular way. For instance, in the opposition hot/cold, hot is the form and cold is the privation. Thus, there is an account of being hot – perhaps to be hot is to be such as to transmit heat. But there is no similar account of being cold. Rather, for a being to be cold is to lack heat in particular way, i.e., to be in a state where it is not transmitting heat but is capable of being turned into a state where it does transmit heat. (See Beere (2009, pp. 82–89) for discussion). Second, a change occurs when *F* comes to be present in some being that possesses *F*<sup>-</sup> (191a5–7). A perishing occurs when *F* ceases to be present in some being, coming to be replaced by *F*<sup>-</sup>. For instance, a change occurs when heat comes to be present in some cold patient whereas a perishing occurs when the heat in some patient is destroyed and replaced by the cold.

What I mean is this: It is possible that a man comes to be musical, that the not-musical thing comes to be musical, and that the not-musical man comes to be a musical man. By 'simple thing coming to be', I mean the man and the not-musical thing; and by 'simple that comes into being' I mean the musical thing. By 'compound' I mean both the thing that comes into being and what comes to be that thing, whenever we say that the not-musical man comes to be a musical man (189b34–190a5).

Aristotle here uses 'simple' and 'compound' as variables. The principles are the values for the simples, and the combinations of certain principles are values for the compounds. Thus, by speaking about simples and compounds, Aristotle provides a general schema for talking about all change, i.e., his general claims are to be applied to a specific change by taking the relevant principles involved in that change as the values for the simples and by taking their combinations as the values for the compounds.

Aristotle draws two conclusions from this general schema, the first conclusion being the following:

When something comes to be in the sense in which we say a simple thing comes to be, in some cases the simple persists when it comes to be and in other cases the simple does not persist. For the man persists when coming to be musical and is [still] a man (190a9–11).

This conclusion comprises two claims. The first claim says that in each change one of the simples persists while another simple does not. The example makes clear that it is the subject that persists while the privation does not. And while a music lesson is an alteration, this example is meant to illustrate what is common to all change, e.g., to both the warming up of dolphins and also to their generations. Thus according to Aristotle, the subject of every change persists through that change for which it is subject. The second claim says that the subject remains the same kind of thing, e.g., it remains a man. This claim is important. A subject will remain unchanged in many different ways throughout some specific change. For instance, the change could also be described with the sentence, 'the pale thing becomes musical and is still pale after the change'. Aristotle does not describe the change in this way. In the quotation above, he emphasizes that the subject remains a man throughout the musical lesson, e.g., Socrates remains a man as he learns music and is still a man once he has completed his music education. This generates a certain expectation: if Aristotle refers to the persisting subject with a kind term 'F', then he believes that the subject remains an F.<sup>9</sup>

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<sup>9</sup> In this case, the relevant kind is man, a kind of substance, and so Aristotle might be taken to claim that the subject remains the same kind of substance. But I want to remain neutral as

Aristotle's second conclusion comes later in the chapter, but I discuss it here:

Suppose, then, that there are indeed causes and principles of natural beings, from which they primarily are and have come to be – not come to be coincidentally, but come to be what each thing is called in accordance with its essence. It evidently follows that everything comes to be from the subject and the shape. For in a way the musical man is composed from man and musical, since you will analyze him into their accounts. It is clear, then, that whatever comes to be does so from these things (190b17–23).<sup>10</sup>

In this quotation, Aristotle concludes that the product of each change is made up in some way of two simples, the subject and the form that it comes to possess, e.g., warm chocolate syrup is in some way made up of chocolate and heat, a statue is made up in some way of some bronze and some shape (see also 192a13–14). Aristotle is careful not to offer any specific theory of how they are so made up. He says that a musical man is *in a way* composed of musical and man, but he leaves open what that way is. He does, however, claim that the product is in some way analyzable into the accounts of the subject and form that was imposed upon it to create that product. While he offers little details, for our purposes, it is important to stress that he is committed to the claim that the nature of a musical man is determined by the nature of musicality and the nature of man. Similarly, the nature of a bronze statue is determined both by the nature of bronze and by the nature of the form of that statue. Thus, for every change, the nature of the product is determined by the nature of the subject and the nature of the form that was imposed upon it.

This second conclusion relates to the first in two key ways. First, since the subject must partially compose the newly generated animal, it must survive the process of being turned into that animal. By itself, this does not require that the

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to whether Aristotle thinks the subject remains the same kind of substance throughout the change. For my purposes, all I emphasize is that (i) Aristotle thinks that the subject remains some same kind of thing, and (ii) Aristotle's descriptions of the various examples indicate the relevant kinds for those examples.

**10** The Greek is 'φανερὸν οὖν ὡς, εἴτερ εἰσὶν αἰτίαι καὶ ἀρχαὶ τῶν φύσει ὄντων, ἐξ ὧν πρῶτων εἰσὶ καὶ γεγόνاسι μὴ κατὰ συμβεβηκὸς ἀλλ' ἕκαστον ὃ λέγεται κατὰ τὴν οὐσίαν, ὅτι γίγνεται πᾶν ἐκ τε τοῦ ὑποκειμένου καὶ τῆς μορφῆς· σύγκειται γὰρ ὁ μουσικὸς ἀνθρώπος ἐξ ἀνθρώπου καὶ μουσικοῦ τρόπου τινά· διαλύσεις γὰρ [τοὺς λόγους] εἰς τοὺς λόγους τοὺς ἐκείνων. δῆλον οὖν ὡς γίγνεται' ἂν τὰ γινόμενα ἐκ τούτων.' 'διαλύσεις γὰρ [τοὺς λόγους] εἰς τοὺς λόγους τοὺς ἐκείνων' is difficult. Ross (1936, p. 493) brackets the first 'τοὺς λόγους' because it is plural while the supposed referent, 'the musical man', is singular. However, we should note that bracketing the phrase leaves open whether Aristotle means that the account of a musical man is divided into the account of man and musical, or whether it is, somehow, the musical man that is so divided.

same subject survive the various changes that the animal will subsequently undergo, but it does require that it survive the generation of the animal. Second, it requires that the subject remains the same kind of thing, i.e., it remains that kind of thing that the product will, in part, be analyzable into. For instance, the music student remains a man as he learns music, the very thing that a musical man is in part analyzable into. Let me sum up these points by saying that Aristotle accepts what I call *Persistence* (PER):

**PER:** For any change, there is a subject of that change, that subject persists, that subject remains the same kind of thing, and that subject along with some form makes up the product of that change.

Aristotle said he would speak about all change. Thus, PER has unrestricted scope. In every change, the product comes about when the subject comes to possess some form while remaining the same kind of thing. The resulting product is a compound of this subject and form. And, so, for any change whatsoever, we should be able to identify a persisting subject and that kind of thing the subject remains, the kind the product will be partly analyzable into. The problem is that PER doesn't seem to have unrestricted scope; Aristotle himself seems to offer a counter-example to it.

Before Aristotle draws the second conclusion, he turns to distinguish qualified change from unqualified change and argues that his general schema applies to the harder cases of unqualified changes. A qualified change involves no new substance coming into or going out of existence, e.g., a dolphin grows larger.<sup>11</sup> The subjects of qualified changes are individual substances, things like men, dogs, trees, etc. By contrast, an unqualified change occurs when some substance does come into or go out of existence, e.g., a dolphin is born. The subject of an unqualified change is what Aristotle generally calls *matter* (ὕλη; 192a31–32).

While Aristotle intends his general schema to apply to both unqualified and qualified change, he seems to recognize that the applicability of the schema is in doubt. Unlike alteration, he tell us that it is only by examining specific cases of unqualified changes that it will become evident that there are subjects for them (190b1–3):

For in every case there is something that is a subject from which the thing that comes into being [comes into being], as plants and animals come into being from *sperma*. Some

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<sup>11</sup> Some believe that a different kind of entity, a kooky object, comes into or out of existence during these changes. Code (1976a, 1976b) and Matthews (1982, 1992) argue that Aristotle believes in kooky objects. Shields (1999) argues that Aristotle does not believe in what he calls *hyper-finely-individuated objects*. The issue is not important for my purposes, so I set it aside.

of the things that come into being without qualification do so by change of figure (for instance, a statue); some by addition (for instance, growing things); some by subtraction (for instance, Hermes from the stone); some by composition (for instance, a house); some by alteration (for instance, by being turned [into something else] in accordance with matter). It is evident that everything that comes to be in this way comes to be from a subject (190b3–10).

The following are examples of the various unqualified changes listed in this passage:

**By change of figure:** A bronze statue is formed by changing the shape of some bronze.

**By subtraction:** A stone statue is formed by chipping away pieces of stone from a block of stone.

**By composition:** A house is built by combining appropriate bricks, wood, and other building materials.

**By addition:** Growing things, animals, are generated when sperma is added to in some appropriate way.

This lists four processes of unqualified change, e.g., subtraction is a process in which bits of something are taken away to leave a new entity like a statue.<sup>12</sup> PER should apply to these four types of unqualified changes. It does apply to at least three of these four cases. For instance, when a statue is sculpted from some bronze, the bronze is the subject, the bronze persists, the bronze remains bronze, and the bronze along with the form of the statue makes up that new statue. Similarly, when a statue is made by chipping away at some stone, the stone is the subject, the stone persists, the stone remains a stone, and the stone along with the form of the statue makes up that new statue.

However, it is difficult to apply PER to the fourth case, the generation of animals. Aristotle says that animals come into being from sperma. This suggests that he believes the following: when animals are generated from sperma, sperma is the subject, sperma persists, sperma remains sperma, and sperma along with the form of the animal makes up that newly generated animal.

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<sup>12</sup> There is a fifth example in our passage: some entities come into being by alteration, where this is supposed to include those that result from entities being turned into something else in accordance with matter. It is difficult to understand what Aristotle means by this, though, see Ross (1936, p. 493) for discussion. Since the correct interpretation of this example is tangential to my project in this paper, I set it aside.



This is puzzling. Let us, for the moment, assume that Aristotle thinks of mammalian eggs, ova, as sperma. Consider Socrates when he was a fetus. This fetus came into being from his mother's egg being fertilized. If the general schema applies, then Aristotle is committed to the following claim: the egg persists, the egg remains an egg, and the egg along with the form of Socrates makes up the fetus. This claim is false, and obviously so. The egg Socrates came from was no part of him, even when he was only a fetus. This is a clear difficulty. Within a few lines, Aristotle seems to commit himself to PER and also to give a counter-example to PER. I will present this difficulty as what I call *the Sperma Puzzle*, which comprises three claims:

- A1:** For any change, there is a subject of that change, that subject persists, that subject remains the same kind of thing, and that subject along with some form makes up the product of that change. (PER)
- A2:** For the generation of any animal, the subject of that generation is sperma.
- A3:** For the generation of any animal, the subject of that generation is sperma, that subject persists, that subject remains sperma, and that subject along with the form of the animal makes up that newly generated animal.

The puzzle arises because what Aristotle explicitly says seems to commit him to A1. He says A2. And A1 and A2 together seem to entail A3. However, A3 seems false. Hence, Aristotle seems committed to a bizarre falsehood. While Aristotle may be committed to many falsehoods, interpreters have spilled much ink avoiding ways to attribute this falsehood to him. They do so not because they wish to defend Aristotle's views on reproduction, but because they wish to properly understand his views on matter and hylomorphism, e.g., they wish to understand whether Aristotle argues for hylomorphism by considering the general structure of change.

I first survey and reject two different responses to the Sperma Puzzle. The first rejects A1 (and A3). It claims that Aristotle never defends PER at all. On this view, Aristotle believes that the subjects of qualified changes persist, but the subjects of unqualified changes do not. The second accepts A1 and A2, but denies that they together entail A3. On this view, Aristotle accepts that the subjects of natural generations do persist, and he accepts that those subjects are *initially* sperma, but, on this reading, he denies that those subjects remain sperma throughout the change.

Neither of these responses pay much attention to Aristotle's sophisticated view about the nature of sperma in the first book of *Generation of Animals*. By bringing these details into focus, I argue that he does accept the apparently bizarre claim that sperma persists, remains sperma, and is present in the new animal, i.e., he accepts each of A1–A3. However, I argue that the claim makes

sense given Aristotle's views of reproduction. To be sure, the claim is false – Aristotle's biology has been superseded. Nevertheless, I show that by bringing some salient details of Aristotle's biological works into focus, we can ease what has been considered a deep tension in Aristotle's discussion of persistence, matter, and hylomorphism in *Phys. I.7*.

### 3 Solution One: Restricting the Analysis

#### Introduction

Recall that the Sperma Puzzle arises, in part, because Aristotle begins *Phys. I.7* by claiming that he will speak generally about change. He seems to commit himself to PER when doing so, and so he seems to committed to applying PER to the sperma case. However, William Charlton rejects this reading of *Phys. I.7*. Instead, he argues that Aristotle only ever accepts a restricted version of PER:<sup>13</sup>

**PER\*:** For any *qualified change*, there is a subject of that change, that subject persists, that subject remains the same kind of thing, and that subject along with some form makes up the product of that change.

According to Charlton, "Aristotle does not say that anything remains, but only that something underlies, in cases of coming into existence."<sup>14</sup> By this, Charlton means that even though animals are *made from* sperma they are not *made of* sperma, where being made from is a mere diachronic relation that holds between the animal and the pre-existing sperma and being made of is a synchronic relation that holds between the animal and some matter that currently composes it. To see the difference between the relations of being made from and being made of, notice that, while glass is made from sand, ash is made from wood, and diamonds are made from coal, glass is not made of sand, ash is not made of wood, and diamonds are not made of coal. Just consider whether the window is sandy. Charlton then generalizes from the sperma example to the claim that while each natural being is made from some pre-existing matter, it is not made of this pre-existing matter, e.g., earth and water are the matter that clay is made from, but not the matter that clay is made of.<sup>15</sup> Charlton's view,

<sup>13</sup> Charlton (1992, pp. 70–79). See also Jones (1974).

<sup>14</sup> Charlton (1992, p. 77).

<sup>15</sup> Bennett (Unpublished) discusses the distinction between what she calls synchronic and diachronic compositions relations. For more controversial examples, see Earley (2005) who claims

then is, that, (i) animals are made from but not of sperma, and (ii) there is nothing else which the animal is both made from and made of. Charlton sums up his argument for (i) & (ii) as follows:

Flesh and bone do not become or turn into a dog; they are not, under any description, a *terminus a quo* of the change to a dog, but rather the *terminus ad quem*. It is the seed which is the *terminus a quo*, the factor which Aristotle's method of handling the matter brings to light, and, incidentally, the factor the disappearance of which makes the change to an animal a coming into existence. (For whilst some features of the seed, e.g. temperature, survive fertilization, they become parasitic on the embryonic body.)<sup>16</sup>

Aristotle owes us a means of distinguishing qualified change from unqualified change. Why think, for instance, that a new entity comes into being when some bronze is worked upon rather than think that the bronze has merely been altered? What is needed is some principled way of distinguishing those changes that result in new substances from those that do not. According to Charlton, Aristotle distinguishes the two by claiming that the subjects of qualified changes persist while the subjects of unqualified changes do not, i.e., for any change C, if the subject of C persists, then C is a qualified change, while if the subject of C does not persist, then C is an unqualified change. Thus, according to Charlton, we expect Aristotle to identify a subject of natural generations that is destroyed in the process, an expectation that is met, according to Charlton, by Aristotle's claim that animals are generated from sperma.

Is there any evidence that Aristotle does distinguish these kinds of changes in this way or must distinguish these kinds of changes in this way in *Phys. I.7*? The following is how he explicitly distinguishes the two:

A thing is said to come into being in many ways, and, in some cases, some things are said not to come into being, but, in these cases, a thing comes to be something; only substances are said to come into being without qualification (190a31–33).

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that atoms are destroyed when they are made into molecules and Burke (1994a, 1994b) who claims that a piece of bronze is destroyed when it is made into a statue.

<sup>16</sup> Charlton (1992, pp. 76–77). Charlton offers a second argument for his reading, which I don't discuss in detail. He claims that "for ice to exist is for water to be solidified in a certain way" (Charlton (1992, p. 76)). More generally, he thinks that for something to exist is for some matter to be differentiated in some specific way. On this view, for a dog to exist is for some matter to be differentiated in some specific way. And Charlton points out that "it seems more correct to say that for a dog to exist is for flesh to have a certain sort of life, than to say that for a dog to exist is for a seed to be fertilized." (Charlton (1992, p. 76)). I agree that it seems more correct if sperma is something like an ovum. But Charlton simply assumes that sperma cannot be, for Aristotle, one of those things that the dog is made of. In Section 5, I discuss Aristotle's detailed account of sperma and argue that, contra Charlton, Aristotle does not think of sperma as an ovum.

In this quotation, Aristotle distinguishes two different general categories of changes. His distinction turns on the various entities that can be said to come into being. Certain entities are said to come into being only with qualification. These are entities from non-substantial categories, e.g., musical, heat, and color. These non-substantial entities are said to come into being insofar as some substance comes to be them. For instance, the hot comes into being only insofar as Socrates or some other substance comes to be hot. Aristotle explains as follows:

In the other cases it is evident that there must be something underlying whatever is coming to be; for a quantity, quality, relative, and place, come to be of a subject, because the substance is the only thing that is never said of any other subject, whereas everything is said of a substance (190a33–190b1).

In this passage, Aristotle assumes two things. First, he assumes a distinction between substantial and non-substantial entities. Substances are not qualities of anything else while all non-substantial items are qualities of a substance. Second, he assumes that when a non-substantial item comes into being, it does so because some substance changes in one of its qualities.<sup>17</sup> These two assumptions are related. It is precisely because non-substantial entities are qualities of substances that non-substantial entities come into being in virtue of substances changing in one of their qualities.

By contrast, unqualified changes do not involve any substance coming to qualify the subject of the unqualified change. For instance, when Socrates comes into existence, no substance comes to be qualified by Socrates.

Recall that Charlton claims that Aristotle distinguishes qualified from unqualified change by claiming that the subjects of the former persists, but the subjects of the latter do not. But this is not what Aristotle explicitly says. He makes no mention of persistence in distinguishing the two. Rather, he explicitly distinguishes the two changes in two related ways. First, he distinguishes them in terms of the kind of entities that come into being, i.e., qualities or substances. Second, he distinguishes them in terms of how those entities relate to the subject of change. In qualified changes, the qualities that come into being do so by

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<sup>17</sup> Unfortunately, it's unclear what Aristotle's mean by 'qualities come into being'. The phrase can be understood in at least two different ways. First, it could mean that when a dolphin warms up, a new entity comes into existence. This could be either some hot object or the property instance of heat that is related to but numerically distinct from that dolphin. Second, it could mean that when a dolphin warms up, we can speak as if a new entity comes into existence, but no new entity did, in fact, come into existence. See Footnote 11 for references.

qualifying the subject of change. In unqualified changes, substances come into being but not by qualifying the subject of change.

Charlton needs then to argue that what Aristotle explicitly says entails that the subjects of qualified changes persist while the subjects of unqualified changes do not.<sup>18</sup> His basic argument seems to be the following: if the subject of the unqualified change were to persist, then the product would have to be predicated of this subject. Hence, the change would not be an unqualified change after all. For instance, he thinks that if the subject Socrates comes from were to persist, then Socrates would have to be predicated of this subject, and, hence, his coming into being would not be an unqualified change.

In response, I think Aristotle was aware of this problem and blocks the inference that Charlton draws. For recall that Aristotle claims that the product of each change is somehow composed of the subject and form that it acquired, which he glosses as the claim that the product is to be analyzed in terms of the accounts of both the subject and form. Aristotle is extremely careful to avoid saying that the product is predicated of the subject. To be sure, he says that the form is predicated of the subject, but this is, on the face of it, different from the claim that the product is so predicated, e.g., Aristotle commits himself to the claim that the form of the statue is predicated of the bronze, but does not commit himself to the claim that the statue itself is so predicated. To be sure, the statue is composed of the bronze and form. But it does not thereby follow that the statue is predicated of the bronze. And Charlton's worry finds purchase only if Aristotle claims, or must claim, that the statue is so predicated. Since Aristotle goes out of his way to avoid claiming this, we have no reason to attribute this claim to him.

## 4 Solution 2: Sperma does not Remain Sperma

### Introduction

Recall that Aristotle seems to believe that when a dolphin is generated from some sperma, the sperma remains sperma and is present in that dolphin. This is puzzling. Why would Aristotle think that a dolphin is made of sperma? Our sec-

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<sup>18</sup> Charlton (1992, p. 77) cites *Generatione et Corruptione* I.4 as evidence that this is Aristotle's view. Some, like Broadie (2004) agree that Aristotle in *GC* I.4 distinguishes unqualified change from qualified change by claiming that the subjects of the latter persist while the subjects of the former do not. But this is a controversial and a minority interpretation of that chapter, an interpretation that Charlton does not try to defend. See Charles (2004), Williams (1982, pp. 211–219).

ond candidate solution to the Sperma Puzzle claims that the subject persists but denies that the subject remains sperma, and so denies that sperma makes up that dolphin. Consider again A1–A3:

- A1:** For any change, there is a subject of that change, that subject persists, that subject remains the same kind of thing, and that subject along with some form makes up the product of that change. (PER)
- A2:** For the generation of any animal, the subject of that generation is sperma.
- A3:** For the generation of any animal, the subject of that generation is sperma, that subject persists, that subject remains sperma, and that subject along with the form of the animal makes up that newly generated animal.

Terence Irwin argues that A1 & A2 do not entail A3. On Irwin's reading, the subject is sperma at the beginning of the change, but the subject does not remain sperma throughout the change, i.e., he argues that the fact the subject is sperma at t1 and the fact that the same subject exists at a later time t2 do not together entail that the subject is sperma at t2. Irwin's argument rests on his interpretation of Aristotle's general claims about change, which he explains as follows':

Aristotle argues, however, that there is always both a persisting subject and a non-persisting contrary. A full description says that the man who was unmusical becomes musical because he had the quality unmusicality and has lost it, acquiring its contrary, musicality. Other descriptions are true, but less informative, because they do not refer to the items involved in the change under the appropriate full descriptions. We can say 'The unmusical man becomes musical', and 'The unmusicality (*to amouson*) became musicality', because we refer coincidentally to the appropriate items.<sup>19</sup>

Call Irwin's interpretation of Aristotle's general claims about change the *Intensional Reading*. Call defenders of the Intensional Reading *Intensionalists*.<sup>20</sup> Intensionalists see Aristotle claiming that we can truly describe the same change in different ways. However, they think that one of these descriptions is privileged. They think a description is privileged when that description says which subject persists and somehow explains how that subject persists. To illustrate this point, let us consider a music lesson once again. We can describe a musical lesson in each of the following ways:

- A:** The man comes to be musical.
- B:** The not-musical thing comes to be musical.
- C:** The not-musical man comes to be a musical man (189b34–190a1).

<sup>19</sup> Irwin (1988, p. 88).

<sup>20</sup> Most accept the Intensional Reading: Bostock (2006), Waterlow (1982), Charlton (1992), Dancy (1978), Ebrey (2007), Jones (1974), Irwin (1988), Gill (1989), Kelsey (2008), Ross (1936).

Intensionalists believe that A–C are different ways of describing the very same event, the same change. In different ways, each description describes the subject before and after the change, i.e., ‘man’, ‘musical’, ‘unmusical’, ‘unmusical man’, and ‘musical man’ are all different ways of describing the very same subject of change.<sup>21</sup>

Although [A]–[C] describe the same change, according to Intensionalists, each description says different things about that same change. For instance, the description ‘the unmusical becomes musical’ says that the privation unmusical is possessed by something that becomes musical. But this description does not also say which subject becomes musical or what that subject remains, e.g., that it is a man that becomes musical and remains a man. In order for a description to be full, Intensionalists claim that it must contain a term which says what the persisting subject is and what it remains.<sup>22</sup> In order for a description to be full, it must contain what I call a *Descriptively Privileged Term*, which, for ease, I also call a *D-term*. The following are independently necessary and jointly sufficient conditions for a term T to be a D-term:

**N1:** T refers to the subject.

**N2:** T remains true of the subject as that subject changes.

**N3:** In some way, T explains how the subject persists through the change.

Conditions N1 and N2 are straightforward. N3 is less obvious. Intensionalists require N3 because N1 and N2 are weak. They are both satisfied by ‘snub-nosed’, ‘being the son of Sophroniscus’, ‘being once musical’, and so on. After all, Socrates also remains snub-nosed as he becomes musical. But, according to Intensionalists, while ‘snub-nosed’ satisfies N1 and N2 it is not a D-term. Since they think that a D-term must do more than remain true of the subject, they interpret Aristotle as believing that this term must somehow explain how the subject persists through the change (N3).<sup>23</sup> While ‘snub-nosed’ satisfies N1 and N2, it does not satisfy N3. Thus, it is not a D-term.

<sup>21</sup> Quoting [A]–[B], Waterlow (1982, p. 12) claims that “what occurs on either side of the verb is a simple term”. Quoting [C], she says that in this “third type [of become sentence] what occurs on each side is a complex term.” She claims that we can use both these simple and complex terms to describe the very same entity.

<sup>22</sup> Waterlow (1982, p. 14) says both these things: “(i) the term ‘man’ remains through the change while the term ‘unmusical’ does not. [A]lthough ‘uncultured’ does not ‘remain’ (i.e. it cannot coherently be added to the right-hand formula in any of the sentences), another description, ‘man’, of the same component does ‘remain.’ (ii) since the description remains then so does the subject under that description: Thus the same thing (component) remains under one description though not under the other.”

<sup>23</sup> O’Connor (2012) argues that a D-term would explain how the subject persists by describing whatever grounds the ability of the subject to be acted upon as it is being changed. In contrast,

## Intensionalists and the Sperma Puzzle

According to Intensionalists, Aristotle tells us that we can describe the subject of change and the change it undergoes in many different ways. This allows them to claim that 'sperma' is just one of the many ways of describing the subject of a natural generation. Hence, 'animals come into being from sperma' is also just one of the many ways of describing a natural generation. However, according to Intensionalists like Irwin, just because 'sperma' describes the subject at the start of the change, it need not describe the subject throughout the change, i.e., the subject need not remain sperma.

Intensionalists could defend this reading in different ways. The best defense is Irwin's and it is the one that I focus on here. According to Irwin, 'sperma' refers to the sperma as a stage of one persisting subject. In particular, 'sperma' refers to what is sperma at the beginning of the change. And, according to Irwin, what is sperma at the beginning of the change is some matter that constitutes the sperma (he takes the 'is' as the is of constitution). Since 'sperma' refers to what is sperma, and since what is sperma is the matter that the sperma is made of, this allows Irwin to claim that 'sperma' refers to the matter of sperma, i.e., it applies to the "continuous thing that is the matter of the organism."<sup>24</sup> This matter first composes sperma, then a zygote, then an embryo, etc. Thus, Irwin claims that the matter persists, but does not remain sperma.

Irwin's reading does seem plausible. If the subject of a natural generation cannot remain sperma, the subject might still be sperma at the start of the generation. And the fact that the subject does not remain sperma throughout the generation is no evidence that it does not persist through it.

However, Irwin's reading leaves Aristotle with a seriously deficient argument for hylomorphism, in particular, for the claim that the natural beings are what they are in virtue of the natures of the subject and form from which they were produced. To see this, recall PER:

**PER:** For any change, there is a subject of that change, that subject persists, that subject remains the same kind of thing, and that subject along with some form makes up the product of that change.

A D-term picks out the kind of thing the persisting subject remains. It also picks out the relevant feature of the subject that will feature in the nature of the product, i.e., the nature of the subject determines, in part, the nature of the product

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Waterlow (1982, p. 22) claims that the relevant term that remains true of the subject "must import characteristic C whose instances are substantial individuals qua instances of C."

<sup>24</sup> Irwin (1988, n. 26, p. 515).



it composes. So, Aristotle requires that the subject remains the same kind of thing. He defends his general claims about change by showing that they also apply to unqualified changes. He does this by giving several examples (see Section 2). If Aristotle is to convince us that his general claims do apply to these examples, he must provide this material for a full description of each change, i. e., he must provide a D-term for each.

N1–N3 are individually necessary and jointly sufficient conditions for a term to be a D-term. And Aristotle does state candidate D-terms for some other unqualified changes, e.g., he says we can sculpt a statue from bronze. ‘Bronze’ does seem to satisfy each of N1–N3. It refers to the subject, remains true of it, and explains how the subject persists, e.g., being bronze involves the sorts of abilities like malleability that allows some bronze survive being sculpted into a statue. More importantly, a bronze statue is partly analyzable into bronze, i.e., the nature of bronze will determine, in part, the nature of the bronze statue.

However, on Irwin’s view, ‘sperma’ cannot be a D-term. On his reading, ‘sperma’ satisfies N1, but it cannot satisfy N2 or N3. Even though we can use ‘sperma’ to refer to the one subject, he believes that ‘sperma’ does not remain true of that subject as it changes. Thus, it cannot satisfy N2. Hence, the description ‘the animal comes into being from sperma’ is not, on Irwin’s reading, a full description of the generation of that animal. Of course, Irwin never claims that this is a full description; his whole point is that, while a true description, it is not full.

The problem, though, is that, on Irwin’s reading, Aristotle does not provide a full description of natural generations in *Phys.* I.7, i.e., he does not provide us with that D-term which describes the subject through the generation.<sup>25</sup> But this leaves unsolved the very puzzle that Irwin tries to address. Aristotle discusses

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<sup>25</sup> One might try to augment Aristotle’s account by trying to identify elsewhere this persisting entity and what it remains. Irwin in conversation suggests that we may even take Aristotle’s discussion of matter several lines later (190b25) as supplying this kind. On this reading, the subject of natural generations remains matter throughout the generation. Some do think that Aristotle in *Phys.* I.7 defends the existence of prime-matter, a *sui generis* entity. See Charlton (1992, pp. 129–147) for discussion and references. These interpreters accept that Aristotle should identify the subject of natural generations and understand his reference to matter as the relevant identification. But even if Aristotle is committed to the existence of prime-matter in *Phys.* I.7, it is a stretch to say that he claims there that the subject of natural generations persists under the kind prime-matter. If this were his view, we would expect prime-matter to be also the subject of sculpting a statue and chiseling a Hermes from some rock. But Aristotle tells us that the subject of the former is bronze and the subject of the latter is stone. A friend of prime-matter might still insist that the subject of a natural generation is prime-matter. But they should first argue that we cannot take the sperma case literally, i.e., take Aristotle as claiming that the subject is sperma and remains sperma. I argue below that we can and should take the sperma case literally. If I’m right, the sperma case offers no support for friends of prime-matter.

the subjects of natural generations to show that his general account applies to these controversial cases. If he has to defend his general account, he must then identify the kind of thing the subjects of natural generations remain. After all, we have no difficulty applying PER to Aristotle's other cases of unqualified changes. But, on Irwin's reading, we have to suppose that at this crucial point in his argument Aristotle is silent about the kind of thing the subject of natural generations remains.

This silence is not fatal to the Intensional reading. Aristotle himself may just be silent about what the subjects of natural generations remain. His argument then fails at precisely this crucial juncture in *Phys.* I.7. However, if an interpretation can treat the sperma case analogously to the other cases of unqualified change, i.e., show that Aristotle really tells us what kind of thing the subject of natural generations remains, then that interpretation should be preferred. In Section 5, I offer such a reading. Unlike Irwin, I claim that Aristotle explicitly tells us not only what subject persists through a natural generation but also what it remains as such – the subject is both sperma and remains sperma.

## 5 A New Solution: *The Generation of Animals*

### Introduction

I have discussed two responses to the Sperma Puzzle and argued against both. Both fail, I think, because both rest on some implicit assumptions about what sperma must be for Aristotle. If it is assumed, for instance, that ova are sperma, then the Sperma Puzzle is particularly pressing. But I think these assumptions are wrong. In the first book of *GA*, Aristotle talks in detail about the nature of sperma, how it is produced, and just how animals come into being from sperma. By bringing these details into focus, I will show that Aristotle really does believe that sperma persists and remains sperma throughout a natural generation.

### The Nature of Sperma

In *GA* I.18, Aristotle claims:

In the beginning of this investigation and those which follow from it, the first thing to do is understand what sperma is, for then it will be easier to inquire into its operations and the phenomena connected with it. Now the object of sperma is to be of such a nature that primarily from it come into being those things which are naturally formed (724a14–18; *trans.* from Platt slightly modified).

In this quotation, Aristotle tells us he will begin an investigation into the nature of sperma. This claim by itself flags how important it is to attend to Aristotle's biological works when trying to understand his claim from *Phys.* I.7 that animals come into being from sperma: it behooves us interpreters to first investigate what Aristotle thinks sperma is before rushing to any judgment as to whether he believes it survives being turned into an animal. And in this quotation, he offers some initial remarks about sperma: those things that are naturally formed come into being from it. These things that are naturally formed are animals. So Aristotle here offers a criterion for sperma: sperma is that from which animals come into being. He then turns to clarify this criterion and identify those entities that satisfy it. His most important clarification is the following:

Sperma is a useful residue of nutriment in its last stage (726a26–29).

Here Aristotle characterizes sperma as a useful residue of ultimate nutriment, i. e., a useful residue of food. If we put this characterization together with the last, we get the following:

**SP1:** Sperma is a useful residue of ultimate nutriment from which an animal comes into being.

While SP1 tells us that animals comes into being from sperma, a more precise version of SP1 is as follows:

**SP2:** Sperma is a useful residue of ultimate nutriment from which the parts of the body come into being (725a11–13).

SP2 is a rich characterization of sperma that tells us: (i) the role sperma plays in the generation of an animal. Namely, it is that from which an animal comes into being. (ii) Sperma is first and foremost what the parts of the animal come into being from, e.g., tissues come into being from sperma. (iii) The entities that play this role, i.e., these entities are useful residues of ultimate nutriment. (iv) The origin of sperma. We will see that sperma is produced from the ultimate nutriment.<sup>26</sup>

Now SP1 and SP2 contain an ambiguity. According to Aristotle, we can read 'come into being from' in four different ways:

1. One thing comes after the other, e.g., day comes from night, man comes from boy.
2. Opposites come from opposites, e.g., unmusical comes from musical, sickness from health.

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<sup>26</sup> I am here following Henry (2009, pp. 369–370).

3. A whole comes into being from some matter being shaped, e.g., a statue comes into being from some bronze being appropriately shaped, a bed comes into being from some wood being appropriately shaped.
4. The beginning of the movement comes from another, e.g., the beginning of movement in artifacts is the arts, and the burning of a house is the torch (724a20–35).

While Aristotle characterizes sperma as a residue from which the parts of an animal come into being, the phrase ‘from which the parts of an animal comes into being’ can be understood in several different ways, and so SP2 can be understood in different ways. For ease of presentation, I will explain the point by focusing on the phrase ‘animals come from sperma’ instead of ‘the parts of the animal come into being from sperma’.

1–4 offers four different ways to understand the phrase ‘animals come from sperma’. It could mean that the animal merely comes after the sperma in a similar way to how night comes after day in 1. It could also mean that something changes from being sperma to being an animal. In a similar way, Socrates would change from being musical to unmusical if he suffered a catastrophic brain injury (2). Alternatively, it could mean that animals come from sperma as matter, e.g., a dolphin comes into being from some sperma being appropriately informed. This would be similar to how a bed comes into being from some wood being appropriately worked upon (3). Finally, it could mean that animals come from sperma as efficient cause, e.g., a dolphin comes into being from some sperma acting upon some matter. In a similar way, a statue comes from a sculptor working upon some material.

Aristotle believes that 3 and 4 are the only plausible ways of reading ‘come into being from’ in SP2.<sup>27</sup> His goal is to show that SP2 describes two different entities for each of these readings. First, he argues that semen (σπέρμα) is a useful residue of ultimate nutriment that acts upon and creates an animal from some material, i.e., animals come from semen as efficient cause. Second, he argues that the menses, or menstrual blood, (καταμήνια) is also a residue, but it is the residue out of which the embryo is constructed, i.e., animals come from the menses as matter (726a28ff).<sup>28</sup> So Aristotle thinks that SP2 describes semen when ‘come into being

<sup>27</sup> He quickly dismisses (1) and (2). See 724b2–4.

<sup>28</sup> Occasionally, Aristotle says that women do not produce sperma (c.f. 727a27–29.) However, when he speaks strictly, he says that the female does not contribute semen (729a20–33, 771b20). For Aristotle, the female produces a different kind of sperma from the male sperma (727b7). This is an impure sperma that needs to be worked upon (728a26–27, 737a27–31). See also Balme and Gotthelf (1992), Henry (2009, n. 5 p. 380).

from' refers to the efficient cause. And he thinks that SP2 describes menses when 'come into being from' refers to the material cause. Thus, both the menses and semen are sperma, albeit in different ways. After first discussing the similarities between the semen and menses, I will then discuss their differences.

## Similarities between semen and menses

Aristotle thinks that each type of sperma, both menses and semen, are residues of ultimate nutriment. Aristotle, then, clearly associates sperma with nutrition. Here it is important to stress that key to Aristotle's understanding of generation is the belief that all living things have the capacity to nourish themselves (DA 415b27–28, 416b9–11). And, so, he thinks, possessing a nutritive capacity or nutritive soul explains why living things are alive (DA 415a24–25). The generation of an organism, then, involves the creation of some entity that has a nutritive soul, i.e., something that has the ability to grow itself. Aristotle compares this to how a son sets up a home away from his father (740a2–23). While a child, the father is responsible for the child's upkeep. Sufficiently grown, the child turns to manage his own affairs. Similarly, Aristotle thinks that by acting upon the menses (one kind of sperma), the semen (another kind of sperma) creates that part of the embryo that allows it to grow itself, i.e., the heart (735a24, 741b16). Once the heart is generated, an organism has the ability itself to control the generation and growth of the rest of its body.

This explains why Aristotle connects sperma with nutrition. But what does he mean by calling sperma a useful residue of nutriment? Aristotle thinks that there are many different types of residues formed at different stages of digestion. The first residues are those formed by the concoction of food in the stomach. For our purposes, let us think of concoction as heating, or, if you like, cooking. Once in the stomach, the food is cooked.<sup>29</sup> Being cooked, the food is transformed into nutriment. As an analogy, consider how potatoes are toxic when raw and nutritious when cooked. Similarly, food, Aristotle thinks, becomes nutriment only when it is concocted in the stomach.

This process has by-products. It is these by-products that Aristotle calls *residues* (724b26–27, 745b18).<sup>30</sup> These first residues are of two types. The first residue can be used to replenish and grow things like fat, hair, nails, and so on (745b15ff). The second residue cannot immediately be used by the body. This

<sup>29</sup> For a book length discussion of concoction see Freudenthal (1995). See also Boylan (1982)

<sup>30</sup> Analogously, consider how after roasting a chicken, the grizzle collects at the bottom of the pan. This grizzle is a residue formed from cooking that chicken.

residue divides into two sub types, a liquid and solid residue. The solid residue is useless and plays no role in growth. It is sent to the intestines where it is condensed and finally excreted (PA 657b29–33). In contrast, the liquid residue passes to the spleen for further processing after which it is useful for growth.<sup>31</sup>

While the residue from the stomach is concocted in the spleen, the original nutriment is further concocted in the liver. We might compare these two stages of concoction to extracting some metal from a rock. Suppose that extracting gold from a rock involves first heating that rock and reducing it to some molten state. Then suppose that we apply a much greater heat to the molten goo and burn off what is not gold. Similarly, Aristotle thinks that, in a sense, we purify food by burning of what is non-nutritious in several distinct stages.

The third and final stage of concoction is the most important stage of digestion. Here the nutriment will finally be purified. Again, there are two products of this process, a residue, and the nutriment. This is the nutriment in its last stage, i.e., the ultimate nutriment. Aristotle thinks that this final nutriment is blood. And blood, for Aristotle, is the purest nutriment that can finally be used to grow and replenish the relevant parts of the body (PA 650a34–35, 651a14–15, 678a6–9, GA 726b1–5, 740a21).<sup>32</sup> All the stages of digestion lead to this point – the creation of blood.

Let us recall that Aristotle defines sperma as a useful residue of the ultimate nutriment. We now see that he means that sperma is a useful residue of that process which produces blood in the heart. In this sense, sperma is the last residue of digestion. Thus, both semen and menses are the last residue of digestion, of that process which forms blood.

## Differences between semen and menses

While Aristotle thinks that both the male and female produce a useful residue of ultimate nutriment, he thinks that the career of these residues differs radically in both the male and female body. In the male body, this residue is carried to the testes where it is further concocted into semen. In contrast, the residue in the female body is collected in the uterus. But unlike the male, Aristotle thinks that the female is unable to concoct this residue into semen. This is why he says that the female is characterized by an inability (728a17–21). Males can produce semen while females cannot. If the female cannot produce semen, what, then, is the residue that collects in her uterus?

<sup>31</sup> For a much fuller description see Boylan (1982).

<sup>32</sup> Aristotle's understanding of blood and the processes by which it replenishes these parts is complicated. We need not concern ourselves with these complications here.

Aristotle's surprising answer is that this residue is just blood (728a17–21). It is blood that is not being used by the mother for her own growth and sustenance. Let me explain: Aristotle thinks that once concocted in the heart, blood flows to various parts of the body through various blood vessels. He believes that many (smaller) vessels terminate in the uterus. These vessels are supposed to transport blood to the various parts to replenish and sustain those parts (738a<sup>ff</sup>). However, Aristotle thinks that there is often a surplus of this blood. This surplus of blood collects near the uterus until ultimately the blood “is excreted through very fine vessels into the uterus, these being unable on account of their narrowness to receive the extra quantity, and the result is a sort of hemorrhage” (738a14–16).

The excretion of the blood into the uterus is an internal excretion. The blood continues to collect in the uterus before finally being fertilized or discharged (an external excretion). But while the blood collects in the uterus, it undergoes no real change. Recall that the female cannot concoct this blood into semen. Instead, Aristotle calls the uterus a receptacle for blood (764b32–36). It is like an overflow tank. It collects the excess blood and discharges it unless fertilized. This excess blood is a byproduct of the process that made the ultimate nutriment, blood. The reason why Aristotle consider the excess blood a residue, even though it is also blood, is that it has not been used by the mother for her own growth and replenishment. Similarly, timber is used to build a ship, but if any timber is left over, then that left-over timber is a residue.

It may seem surprising that Aristotle thinks that semen acts on blood to produce an embryo. But this is why, for instance, he says that women tend not to have nosebleeds when they are menstruating, and *vice versa* (727a1–25). If the blood is expelled from the nose, he thinks there will be no build up of blood in the uterus. Similarly, this is why he thinks that the menstrual blood nourishes the embryo while it is in the uterus, i.e., the embryo ‘eats’ the blood that would normally be discharged once a month (733b26–31, 745b22<sup>ff</sup>, 775b11<sup>ff</sup>).

Of course, we now know that semen does not fertilize blood. However, Aristotle was unaware of the mammalian ovum, and so was unaware that menstrual fluid is a discharge of blood, the ovum, the uterus lining, among other things.<sup>33</sup> On Aristotle's view, the material out of which the body is first formed just is blood. And this blood is as much blood as that which is used to grow and re-

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<sup>33</sup> Aristotle was aware of a second vaginal discharge, which he calls ‘the whites’. This we know now to be secreted by glands both in the cervix and the vaginal lining to wash out old cells. Aristotle considers these to be a useless residue of that nutriment concocted into blood, the surplus of which is the menstrual blood. He correctly points out that they occur before a female's first menstruation and that they play no role in reproduction (736b29<sup>ff</sup>).

plenish the parts of the body, i.e., blood is used to create certain parts of the body, but also grow and sustain those parts.

An analogy will help: Suppose that a builder builds a wall with some red bricks. One year later, she decides to double its height. She will do so by adding some new layers of red bricks. So our builder uses red bricks to initially create the wall and to later increase its size. At each stage, she uses the same kind of material – red bricks. Similarly, Aristotle thinks that blood is used to create the parts of the body, grow those parts, and replenish those parts.

## The Sperma Puzzle solved

Recall that the Sperma Puzzle arises because the sperma example seems to violate PER:

**PER:** For any change, there is a subject of that change, that subject persists, that subject remains the same kind of thing, and that subject along with some form makes up the product of that change.

PER requires that animals come into being from some subject that persists through the generation. However, Aristotle's candidate for this subject, sperma, does not seem to persist, remain sperma, and make up the newly generated animal. Thus, natural generations do not seem to satisfy PER. Sperma does fail to satisfy PER *if* sperma is something like a mammalian egg, an ovum. Such entities are destroyed in the generative process. But our discussion of Aristotle's biology shows that, for Aristotle, sperma is not an ovum. Sperma is blood, and blood is not an ovum.

Solving the Sperma Puzzle then requires showing that, for Aristotle, the menstrual blood survives as the first parts of the body are made from it. Some good evidence that he does believe this comes from a puzzle he raises about the first source of nutriment available to the fetus. According to Aristotle, the heart is that principle responsible for creating and growing the rest of the body (735a24). And so, as we have seen, he thinks that hearts must be the first thing formed (741b16). In order for the heart to fulfill this role, it must have nutriment to use as material for building the body. It can draw some nutriment through the umbilical cord from the uterus of the mother (751a7, 752a26). So Aristotle claims the heart must straight away develop an umbilical cord to draw this nutriment (745b22). However, this leaves a puzzle about the creation of the umbilical cord:

One could puzzle as follows: if blood is the nutriment, and if the heart, which first comes into being, is infused with blood, and blood is the nutriment, and if the nutriment comes from outside, from where did the first nutriment enter? Perhaps it's not true that all of the nutriment comes from outside. But just as in the seeds of plants there is some-



thing of this nature, something which at first appears milky (and which is its immediate nutriment), so also in the matter of the animal, the residue of which it is formed is its immediate nutriment (740b2–8).

Here Aristotle claims that the first nutriment, the nutriment that the heart will use to create and grow the umbilical cord, is the very blood that the animal came into being from. Thus, some uterine blood must, according to Aristotle, persist through the generation of the animal, a claim he repeats several lines later:

For the matter in virtue of which it [an animal] grows is the same as the matter from which it was first constituted (740b34–35).

In these passages, Aristotle emphasizes that the blood from which an animal is generated persists. Thus, natural generations do satisfy PER. The female sperma is excess blood, blood that is turned into the first parts of the fetus. So, the persistence of (female) sperma requires only that this blood persists and remains blood as the semen makes the first parts of an embryo out of it. In other words, PER is satisfied just because this excess blood persists, remains blood, and is present in the new animal.

In order to clarify this reading, let me raise and respond to three possible objections.

## Objection 1

On my reading, ‘sperma’ is a mass term that refers to some stuff, the uterine blood. One might object that I have yet to explain how this stuff persists through the generation. One way of pressing this objection is by demanding that Aristotle tell us which exact portion of blood persisted, i.e., demand him to point out the exact portion of blood in the mother’s uterus and portion in the offspring’s tissues that are identical. Analogously, suppose that we were to pour a bucket of water into an almost full paddle pool. Did the water in the bucket persist? One might claim that answering this question requires that we determine which exact portion of water in the swimming pool is the very same portion that came from the bucket. Answering this, in turn, is often taken to require identifying an informative diachronic criterion of identity for portions of water, which is particularly difficult given that water is a stuff. One might object, then, that unless I show how Aristotle would supply such a criterion of identity for blood, that I have failed to show that the uterine blood does, for Aristotle, survive the generation of the fetus.<sup>34</sup>

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<sup>34</sup> See Hirsch (1982), Lowe (1989), Merricks (1998), and Williamson (1990) for discussion of criteria of identity and debates as to whether there are such criteria. See also Zimmerman (1995) for discussion of the persistence of stuffs.

Response: I reject the need to show how he would supply such a criterion. It is important to see that an argument for the claim that a being persists can be offered independently of any view about how that being persists. As an analogy, consider the use of heat detectors to locate survivors of a natural disaster. Appropriate heat signatures will provide evidence that a person has survived the disaster and subsequently direct emergency personnel to the appropriate location. This is evidence *that* someone has persisted, but it does not tell us *how* they persisted. To put this point another way, our first responders did not need to first offer a metaphysics of persistence before they went in search of evidence that some survived the disaster.

I have used the biological works to show that Aristotle believes *that* menstrual blood, one kind of sperma, persists through the generation of an animal. Aristotle offers an argument that the blood persists: the heart straightaway grows an umbilical cord from some blood, and since this blood cannot have entered from outside, some blood from the mother must have persisted. This is an argument *that* blood persists. But it is offered independently of any concern with *how* blood persists. Of course, we can go on to raise the interesting question of what the identity through time of stuffs like blood consists in. But irrespective of what Aristotle's answer might be to this question, it's a mistake to think he must provide an answer to it when investigating the nature of sperma *qua* biologist.<sup>35</sup>

I think that something similar holds for *Phys. I.7*. Recall that Aristotle in this chapter aims to show that the product of each change is composed, in a way, of some form and the subject from which the product was generated. This requires showing *that* there is a persisting subject of each change. Aristotle met that goal, in part, by identifying the persisting subject of those unqualified changes that his reader might have difficulty identifying a persisting subject for. Meeting the goal in this way does not require Aristotle to give at the same time an analysis of what the identity through time of any persisting subject consists in, or, indeed, to give any general analysis of what persistence is. Of course, we might hope that Aristotle will elsewhere give a metaphysics of persistence. But my point here is that he is not doing so in *Phys. I.7*. And since he is not offering one there, it's unreasonable to demand an interpreter of that text to identify how Aristotle would explain, given what he says there, how sperma persists.

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<sup>35</sup> One might ask whether noticing that sperma is a stuff is sufficient for solving the Sperma Puzzle. But recall that the Sperma Puzzle requires identifying what the subject remains as such through the generation. Noticing that sperma is a stuff does not, by itself, identify what the relevant stuff remains through the generation.

## Objection 2

A second objection might charge that my reading is incompatible with Aristotle's claim that the product of every change is somehow analyzable into both the persisting subject and form that it acquires, one of the central conclusions of *Phys.* I.7. On my reading, sperma is the persisting subject of natural generations. Thus what it is to be the product of such a process is determined by the natures of sperma and some appropriate form. But I can imagine someone complaining here that this is absurd. Socrates is the product of a natural generation and Aristotle will hardly say that the explanation of what Socrates is must be given in terms of sperma – blood produced by the mother – and some form. My objector will claim that Socrates is an ensouled body and not some informed blood.<sup>36</sup>

Here let us recall SP1 and SP2:

**SP1:** Sperma is a useful residue of ultimate nutriment from which an animal comes into being.

**SP2:** Sperma is a useful residue of ultimate nutriment from which the parts of the body come into being.

SP2 says that sperma is that out of which the parts of the body are formed, e.g., sperma is the blood out of which the tissue, blood vessels, and so on are first formed. Aristotle need only say that it is these parts, rather than Socrates himself, which are analyzable into sperma and some form. And since sperma just is blood, Aristotle can and should say that when one analyzes tissue into sperma and some form, one is analyzing tissue in terms of blood and some form, i.e., blood is part of the nature of tissue.

Perhaps one will object to this response on the grounds that it would then be misleading of Aristotle to claim that animals come into being from sperma. One might object that Aristotle should say that it is the parts of animals that come into being from sperma. I do concede that Aristotle could provide more details in *Phys.* I.7. Fortunately, these details are provided by his discussion of sperma in *GA*. For we saw there that Aristotle claims SP1, but also uses SP1 as shorthand for SP2. So, we have good evidence that Aristotle says that animals come into being from sperma, but that he also thinks that this is to be spelt out with the claim that the parts of animals come into being from sperma.<sup>37</sup>

<sup>36</sup> See Charlton (1992, p. 76) for a similar objection.

<sup>37</sup> One might still ask Aristotle just how blood makes up the first parts of an animal. But Aristotle need not offer any details for the purposes of *Phys.* I.7. Recall that he carefully says that a

### Objection 3

Finally, one might object that, on my reading, even if the subject from which Socrates comes into being persists, it does not persist throughout the life of Socrates. To bring this objection into focus, consider again the example of the musical lesson. When Socrates learns music, he is the subject of musicality. And he will remain the very same subject of musicality for as long as he remains musical, e.g., the Socrates who plays his first concert is one and the same as the Socrates who plays his last. So, the subject from whom the musical man was produced not only persists through this production, it persists at least as long as the musical man does.

Natural generations, as I describe them for Aristotle, cannot be like this. The sperma, which persists as it is being made into the first parts of the animal, is the subject of the form of the animal at the very early stages of development. Sufficiently grown the animal will produce blood for itself. The blood that the animal produces for itself is not sperma – surplus blood from the mother. Thus, once the body of the animal has sufficiently grown, the subject of the form of the animal is not the blood from which it came into being. Hence, on my reading, (i) sperma is the subject from which the animal comes into being, (ii) sperma is the subject of the form of the animal at the initial stages of its life, but (iii) sperma is not the subject of that form at later stages in the animal's life.

Is (iii) a problem for my reading? It is a problem if Aristotle claims or needs to claim that the form of the animal must have one and the same material subject throughout the life of that animal. But Aristotle need not accept this claim for the purposes of *Phys.* I.7. He needs to show that the animal, at the moment it comes into being, is composed, in a way, of a form and the subject from which it was produced. This requires that the matter be part of it at the moment of its production, which is satisfied even if that matter is subsequently replaced. Indeed, one can imagine a view which says that the material subject of the form of the animal undergoes continual replacement throughout the life of that animal. To be sure, *Phys.* I.7 does not commit Aristotle to such a view. But that's the point. The chapter is silent as to whether the matter that initially makes up that animal must remain one and the same throughout its life. All Aristotle commits himself to is the claim that the matter from which it is produced persists through the production. He does not commit himself to the claim that this same matter will be the subject for any other changes the animal undergoes. And

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musical man is *in a way* composed of musical and man, but he doesn't tell us what this way is. He thereby leaves open the larger question of just how the subject and form compose the product of a change.

being the subject of the generation, as opposed to being the subject for future changes the animal undergoes, requires only the matter to survive and to exist, even momentarily, at the beginning of the animal's life. It does not require the same matter to survive and to exist throughout the life of the animal. So, at least from the perspective of *Phys.* I.7, (iii) poses no problem for my reading.

## 6 Conclusion

In this paper, I discussed an apparent deep tension in *Phys.* I.7. Recall PERSISTENCE:

**PER:** For any change, there is a subject of that change, that subject persists, that subject remains the same kind of thing, and that subject along with some form makes up the product of that change.

Aristotle seems committed to PER, but he also offers a counter-example to PER. Moreover, PER is a premise in Aristotle's argument for hylomorphism in *Phys.* I.7. Thus, not only does Aristotle seem to contradict himself, he also seems to undermine his own argument for hylomorphism, one of his signature innovations.

While interpreters have responded to this puzzle in different ways, each response tries to deflate the most obvious and simple reading of the sperma example: Sperma persists, remains sperma, and is present in the new animal. Charlton responds by arguing that Aristotle does not commit himself to PER. Irwin responds by allowing Aristotle claim PER, but leaving Aristotle silent about what kind of thing the subjects of natural generations remains. Both responses fit poorly with the natural flow of *Phys.* I.7. First, Aristotle tells us he will speak generally about all change. PER is one such general claim, which Charlton has to read Aristotle as retracting. Second, Aristotle defends PER by showing how it applies to controversial cases. Natural generations are one such case. But, on Irwin's reading, Aristotle does not tell us how natural generations satisfy PER.

By focusing on the biological details, I have shown that we need no such intricate moves to interpret the sperma example. Aristotle tells us which subject persists and what it remains – sperma. My reading offers a new, straightforward, and literal interpretation of the sperma example that leaves Aristotle endorsing PER, telling us which subject persists, and telling us what kind of thing that subject remains. I submit that we should accept this simple and literal reading.<sup>38</sup>

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