ON THE PRINCIPLES OF NATURE: AN INTERPRETATION OF ARISTOTLE'S 'PHYSICS' I.5–8

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I argue that Aristotle in *Phys.* I believes that the pre-existing matter a natural being is made from persists through this making. Some have denied this claim. They have argued that Aristotle there claims that (i) each persisting subject has a diachronic criterion of identity, and, so, (ii) the matter a natural being is produced from persists only if there is a diachronic criterion of identity for it, but (iii) there cannot be such a criterion of identity for matter given how Aristotle construes it. I argue, in contrast, that Aristotle is neutral with respect to (i), and so focus on whether matter, as he construes it, could have a diachronic criterion of identity offers no means of deciding whether he is committed to its persistence in *Phys.* I. If I am right, Aristotle's views of persistence in *Phys.* I have been misunderstood. He remains neutral there about the metaphysics of persistence. Nevertheless, he does claim that each subject persists through that change it is subject for, and so does believe that the pre-existing matter that a natural being is produced from persists through this making. While Aristotle does not focus on the metaphysics of persistence, I argue that he does focus on the scientific question of how things persist as they are being acted upon and changed—which is a different question, I argue, from the question of what the identity through time of any being consists in.

BIOGRAPHICAL SKETCH

Scott O'Connor was born February 3, 1982 in Dublin, Ireland. He received his B.A. in Philosophy from Trinity College, Dublin in 2004 and his B.Phil in Philosophy from Christ Church, Oxford in 2006. He then settled down to his doctoral studies at Cornell University.

For my parents

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LIST OF ABBREVIATIONS

Aristotle is cited by the standard Bekker pages and lines. Plato is cited by the standard pagination. For Aristotle and Plato, I have used the editions in the Oxford Classical Texts, unless otherwise indicated.

Works by Aristotle

An. De Anima

An. Post Posterior Analytics

An. Pr. Prior Analytics

Cael. De Caelo

Cat. Categories

GA Generation of Animals

GC De Generatione et Corruptione

HA Historia Animalium

Met. Metaphysics

Meteor. Meteorologica

PA Parts of Animals

Phys. Physics

Works by Plato

Phaed. Phaedo

Grg. Gorgias

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CHAPTER 1

INTRODUCTION

1.1 Introduction

When you make a blue dolphin from Play-Doh, you press on parts of a blue piece of putty, pull on others, lengthen some bit for a fin and shorten some others for the eyes. You work on and change that bit of Play-Doh and the result of your labour is a nice blue dolphin, a dolphin which is made out of that worked-upon Play-Doh piece.

Real dolphins are also produced from some pre-existing material, material that is worked upon and changed to produce a new dolphin. Does this material persist and make up the new dolphin just as a Play-Doh piece persists and makes up the blue Play-Doh dolphin? Aristotle's answer according to the standard reading of *Physics* I is 'yes'.

My dissertation concerns a challenge to this reading. Some have argued that, for Aristotle, (i) each persisting subject has a diachronic criterion of identity, and, so, (ii) the matter a natural being is produced from persists only if there is a diachronic criterion of identity for it, but (iii) there cannot be such a criterion of identity for matter given how Aristotle construes it. Thus (iv) the pre-existing matter a dolphin is made from is destroyed in the process.

Few interpreters believe that Aristotle accepts (iv). But we will see that most agree that not only does Aristotle claim that each persisting subject has a diachronic criterion of identity, but they also think that this claim structures and organizes his search for the principles of nature. Nevertheless, those who think that, for Aristotle, the pre-existing matter natural beings

are produced from persists, struggle to understand how matter, as Aristotle construes it, could have a diachronic criterion of identity. They either think he is wrong to claim that there is such a criterion or try gallantly to supply one on his behalf.

I think this debate is founded on a mistake. A person can be committed to the persistence of a being without being committed to any particular view about how that being persists. A wine maker, for instance, can believe that some wine persists as they pour it from a casket into a bottle without at the same time having any beliefs about how that wine persists. Similarly, Aristotle really does believe that the pre-existing material a natural being is made from persists through this making. But I argue that, for the purposes of *Phys.* I, he has no commitments about how matter, or any persisting subject, persists. He remains neutral there as to whether matter, or any persisting subject, has a diachronic criterion of identity. So, on my reading, the claim that each subject has a diachronic criterion of identity neither structures his search for the principles of nature nor is assumed by any of the arguments in *Phys.* I. Nevertheless, I argue that the claim that the subject of each change persists does play a central role in *Phys.* I and does structure his search for the principles.

1.2 The Challenge

In the first book of the *Physics*, Aristotle searches for what he calls the principles (ἀρχαὶ) of nature (184a1–16). He argues that these principles are subject (ὑποκείμενον), form (εἶδος), and privation (στέρησις). Most interpret this claim as a claim about the various kinds of entities involved in any change.[1]

[1]See below for citations and discussion.

Aristotle is understood as claiming that (i) for any change, some subject acquires a form that it previously lacked; (ii) for different changes, there are different entities which play these roles of subject, form, and privation. For instance, when a stone becomes warm from being cold, the stone is the subject, the hot is the form, and the cold is the privation. In contrast, when a person becomes musical from being unmusical, the person is the subject, the musical is the form, and the unmusical is the privation.

Disagreement has arisen over how Aristotle applies his general claim about every change to two distinct kinds of changes; unqualified change and qualified change (190a31*ff*). During an unqualified change, a natural being comes into or goes out of existence, e.g. a tree rots and dies. During a qualified change, no new natural being comes into or goes out of existence, e.g. Socrates grows taller.

Interpreters of *Phys.* I have disagreed about Aristotle's various remarks about the subjects of these two kinds of changes. The subjects of qualified changes are individual substances, things like men, dogs, trees, and so on. The subject of an unqualified change is what Aristotle calls 'matter' (ὕλη; 192a31–32).[2] While interpreters agree that the subjects of qualified changes persist through these changes, there has been disagreement about whether Aristotle believes the same for matter in *Phys.* I.

Unfortunately, there is no easy way of presenting the dialectic between these different interpretations. Some framing device is needed. As such a device, I use a problem David Bostock raises with the persistence of Aristotelian matter, a problem which he thinks points to an inherent flaw in Aristotle's views of the principle of nature. I first outline it, and then char-

[2]For the purposes of what follows, I use 'matter' for only the subjects of unqualified changes. However, Aristotle does say that, in a sense, the subject of every change is matter. See, for instance, *GC* 320a2–5.

acterize the various interpretations of persistence in *Phys.* I as responses to this problem.[3]

Before I do so, I want to emphasize two things. First, not all of these interpretations were developed or defended as responses to Bostock's problem. Nevertheless, presenting them as responses to this problem is illuminating and useful, so I will present them as such. Second, my primary interest is not with this puzzle itself. I won't try to defend Bostock's claim that Aristotle's view is inherently flawed, nor will I offer a response on Aristotle's behalf. My interest is in what Aristotle himself commits himself to in *Phys.* I irrespective of the veracity of those commitments. I use Bostock's problem and the various responses merely to articulate commitments interpreters have found in *Phys.* I, and also to explain why identifying these commitments is both interesting and important.

Here's the problem. Aristotle has been taken to commit himself to the following claims in *Phys.* I:

1. The subject of every change persists through that change it is subject for.
2. The subjects of some changes are gooey.
3. There is a diachronic criterion of identity for each persisting subject.
4. There is a diachronic criterion of identity for each persisting gooey subject (from 1–3).

I first explain each of 1–3, then explain why Bostock thinks that 4 is false, why he thinks that there cannot be a diachronic criterion of identity for goos.

[3]Bostock {12, p. 30ff}. A version of the same problem is raised by Jones {51}.

1.3 Gooey Subjects

Aristotle has a particular view about those entities which play the role of matter. Premise 2 says that these entities are gooey. I first explain what I mean by 'the role of matter', then explain this notion of goo.

For Aristotle, matter is always the matter of something or other (194b8–9). However, he recognizes two distinct ways for something to be the matter of another thing, to be ultimate matter or to be proximate matter, e.g. Socrates has both ultimate and proximate matter. While both ultimate and proximate matter are the matter for something else, ultimate matter does not itself have anything which is matter for it. In contrast, proximate matter itself can have something which is matter for it. Clay, for instance, is the proximate matter of a clay statue. But clay itself has as its proximate matter earth and water. If earth and water have nothing as their proximate matter, then earth and water are both the ultimate and proximate matter of the clay, but only the ultimate matter of the clay statue.

The entities which play both the roles of ultimate and proximate matter, according to Aristotle, are stuffs like water, air, bronze, and so on. Stuffs are *prima face* different kinds of entities from individual objects like Socrates, Fido, an oak tree, an atom, etc. This difference is reflected in a difference between the terms we use to refer to stuffs and to individual objects. We refer to stuffs with mass nouns, and we refer to individuals with count nouns. There are syntactic differences between these nouns. Count nouns take the plural and they can be preceded with some number, e.g. 'one dolphin', 'two dolphins'. In contrast, mass nouns do not take the plural and cannot be preceded with some number. We can see the difference by noticing these nonsensical expressions: 'one air', 'two airs', 'three airs'. This is a point

about English and not about Greek. Nevertheless, the point applies to stuffs irrespective of what language we use to describe them: we count objects but measure stuffs—10 liters of water *vs.* 10 dolphins. In *Met.* 1020a9, Aristotle marks this distinction as one between enumerable quantities (objects) and continuous measurable quantities (stuffs). Air, water, fire, and earth are measurable quantities, i.e. stuffs. Dolphins, people, and trees are enumerable quantities, i.e. individual objects.

So stuffs are *prima facie* different kinds of entities from individuals. So what are stuffs? There are several different conflicting views about the nature of stuffs, about what stuffs are and how they differ from individuals.[4] One might, for instance, think that each portion of stuff is ultimately built out of individuals, that some portion of water is ultimately built out of atoms of hydrogen and oxygen, atoms that are themselves individuals.

Aristotle's view is radically different. As Bostock says, Aristotle "does not believe in any kind of atomism."[5] He does not believe that a portion of stuff is composed of some individuals. Rather, Aristotle believes that stuffs are both homoiomerous and infinitely divisible.

Homoiomers are entities whose parts are of the same kind as the wholes they make up. For instance, Aristotle thinks that lines are homoiomerous. A 1 meter line is divisible into parts, each of which is itself a line. This is different from a view which says that lines are composed of points. Similarly, Aristotle thinks that water is homoiomerous—each portion of water is made up of only water parts. This is a very different view from the one that says that (a molecule of) water is composed of hydrogen and oxygen atoms. On Aristotle's view, no portion of water, no matter how small it is, has anything

[4]For discussion, see Cartwright {19, 18}, Chappell {20}, Zimmerman {89}.
[5]Bostock {12, p. 32}.

other than water parts.

Now we could hold two different views about the divisibility of homoiomers. The first says that there is some smallest part of a homoiomer. On this view, a line is divisible into some smallest line parts, parts which themselves have no further parts. Similarly, on this view, a portion of water is divisible into some smallest water parts, parts which themselves have no further parts. The second view says that homoiomers are infinitely divisible into ever smaller and smaller parts. On this view, a line is divisible into ever smaller line parts *ad infinitum*. Similarly, a portion of water is divisible into ever smaller and smaller water parts *ad infinitum*.

Aristotle holds the latter view. He thinks that stuffs are both homoiomerous and infinitely divisible. For ease of presentation, I will use the noun 'goo' and adjective 'gooey' to describe such a view of stuffs. For instance, I will say that water is a goo or that watery is gooey rather than saying that water is homoiomerous and infinitely divisible.[6]

So according to Aristotle, stuffs like water are goo.[7] On this view, any portion of water is infinitely divisible into smaller and smaller water parts *ad infinitum*. This is a radical view and likely false. Portions of water seem composed of water molecules which in turn are composed of hydrogen and oxygen atoms, atoms which are themselves composed further of sub-atomic particles. These atoms and sub-atomic particles are not themselves water.

[6]Goo is different from what Lewis {62, p. 20} calls atomless gunk. Atomless gunk contains an infinite number of actual parts. For Aristotle, goo is potentially infinitely divisible (206a18–19). On one reading, this means goo contains an infinite number of potential parts. On another reading, goo has an infinite number of neither potential parts nor actual parts, but, nevertheless, can still be divided into ever smaller parts *ad infinitum*. On this view, a water part of water exists only after that water has been divided out, i.e. the part is "called into being by an act of division." (Ross {74, p. 555}) See also Bostock {10}, Coope {27}, Hintikka {43}, Lear {59}. I remain neutral about this larger debate as nothing I say will turn on deciding it.

[7]See *Phys.* 206a9ff and *GC* 315a26ff.

So portions of water seem composed of some non-water parts. Nevertheless, this is not Aristotle's view. He thinks of water as gooey, and this raises questions about how he thinks that water can persist through change.

1.4 Diachronic Criteria of Identity

Premise 3 says that, for Aristotle, each persisting subject has a diachronic criterion of identity. For instance, David Bostock reads Aristotle in *Phys.* I as claiming:

> ...any such thing [a persisting subject] must be of a definite sort, so that there is some sortal noun 'A', which in someway embodies its criterion of identity over time. The item can then be referred to as 'this A', and later as 'the same A', where we do understand what it is for this A and that A to be (over time) the same A.[8]

Bostock goes on to argue that there is difficulty applying this point to Aristotelian matter, and ultimately claims that Aristotle's view of matter is inherently flawed. Before I explain the worry, let me tease apart the various features of Bostock's interpretation.

Bostock thinks that, for Aristotle, each persisting subject has a diachronic criterion of identity. Such a criterion tells us what the identity through time of an object consists in. What exactly does this mean? Eli Hirsch explains as follows:

> When we ask with regard to physical objects what their identity through time consists in, we are asking for an account of the unity of a physical object's career. Any physical object has a career which stretches over a period of time, a career which we can think of as comprised of a temporal succession of momentary stages. The successive parts, or stages, of an object's career hang together in some distinctive way; otherwise there would be nothing to prevent us from arbitrarily combining into a single career

[8]Bostock {12, p. 35}.

> the early stages of one object with the later stages of a different object. Evidently not just any succession of object-stages corresponds to a single persisting object; some do and some do not. So in order for object-stages to add up to a single persisting object they must be related in some special way.[9]

Here is an example: Arion's life involved various stages. A young Arion graduated from a music academy. Call this stage *R1*. A slightly older Arion gained critical acclaim. Call this stage *R2*. An even older Arion was washed ashore on a foreign beach. Call this stage *R3*. R1–R3 are each stages in the career of one and the same persisting person, Arion. They are not stages in the career of other persisting persons like Socrates and Plato. One stage of Socrates's career talked to Euthyphro about piety outside a courthouse. Call this stage *C1*. Another stage drank hemlock in a prison cell. Call this stage *C2*. Why are R1 and R2 together stages of one and the same persisting person while R1 and C2 are not? What relation does R1 and R2 stand in that R1 and C2 do not, a relation which binds R1 and R2 into one single persisting object? An answer to this question will tell us what the identity through time of objects consists in.

Philosophers choose to frame debates about diachronic criteria of identity in this way because it allows them to remain neutral about the ontology of persisting objects, about the ontology of these stages.[10] Some philosophers, perdurantists, argue that these stages are temporal parts of temporally extended objects, e.g. R1–R3 are numerically distinct parts of a temporally extended entity, an entity which does not at each moment that it exists possess all its parts.[11] Others, endurantists, think that these stages are stages in the career or history of one persisting object, an object which does at each

[9] Hirsch {44, p. 3–4}.
[10] See Perry {72}.
[11] See Heller {41}, Lewis {61}, Quine {73}, Sider {82}.

moment that it exists possess all its parts. One way of understanding a career and its stages is offered by Sydney Shoemaker: if C is a continuant existing at time t, and P is the set of properties possessed by C at t, then C's stage at t will be the set consisting of the instantiations in C at t of the properties in P.[12] Some commentators have claimed that Aristotle's focus in *Phys.* I is the ontology of persisting objects.[13] This dissertation will not address that debate, and using Hirsch's way of explaining diachronic criteria of identity allows me to circumnavigate it.

Let us consider one view of what the identity through time of an object consists in. Call this *SQ*:

> A succession S of object-stages corresponds to stages in the career of a single persisting object if and only if:
>
> S is spatiotemporally continuous; *and*
>
> S is qualitatively continuous.[14]

SQ tells us that R1–R3 are stages of the one persisting object just because they are parts of a succession of object stages that are spatiotemporally and qualitatively continuous, i.e. there is a succession of stages in Arion's career from when he graduated music school to when he washed ashore on a foreign beach, a succession of stages that are spatiotemporally and qualitatively continuous.[15] On the other hand, if R1 and C2 are not stages of one persisting object, then they should not both be parts of one succession of spatiotemporally and qualitatively continuous object stages.

[12] Shoemaker {81, p. 337–338}.

[13] Code {24, 25} interprets Aristotle as a perdurantist. Matthews {67, 68} sees Aristotle as claiming that objects persist by being parts of different kooky objects, or what Shields {77, p. 156} has labelled 'hyper-finely-individuated-objects'.

[14] Hirsch {44, p. 8}.

[15] See Hirsch for a full discussion of spatiotemporal and qualitative continuity.

SQ can be used to formulate a criterion of identity for persisting objects. A criterion of identity states individually necessary and jointly sufficient conditions for an identity to hold, both at a particular time and across times. They are most associated with Frege who claimed, "[i]f we are to use the symbol a to signify an object, we must have a criterion for deciding in all cases whether b is the same as a, even if it is not always in our power to apply this criterion."[16] An example of such a criterion is the following: the direction of line a is identical to the direction of line b *iff* line a is parallel to line b. Here we have a criterion of identity for directions of lines—they must be parallel.

A diachronic criterion of identity states individually necessary and jointly sufficient conditions for an identity to hold between entities existing at different times. For instance, the boy who graduated the music academy is the man sitting on beach iff φ, where the value of φ states individually necessary and jointly sufficient conditions for the graduate to be the man on the beach. SQ can be used to formulate such a criterion as follows: the boy who graduated music school is the man who washed ashore on a foreign beach iff there is a succession S of spatiotemporally and qualitatively continuous object stages such that S contains both.[17]

Bostock thinks that, for Aristotle, persisting objects require more than being appropriately related to a succession of spatiotemporally and qualitatively continuous object stages. Why? Consider a problem raised by Hirsch for SQ: Suppose we crush an old car in a car crusher and turn it into a cube of crushed metal and plastic. The car that entered the crusher and the cube that leaves the crusher are each part of a succession of object stages that are

[16]Frege {35, §. 62, p. 73}.
[17]Hirsch {44, p. 9}.

spatiotemporally and qualitatively continuous. Nevertheless, the car did not persist as it was crushed. It was destroyed. But if SQ were sufficient, then the car should have persisted. To put the point slightly differently, if you trace the career of the car and only consider qualitative and spatiotemporal continuity, you would have no reason to think that the car perished rather than altered.[18]

In general, considerations like these lead philosophers to argue that the object stages that combine into one persisting object must also be of the same sort. Consider the car which is crushed. There is a spatiotemporally and qualitatively continuous succession of object stages that has car stages and cube stages as parts. But the cube stages—the stages formed after the crushing—are not cars. So Hirsch, for instance, claims that we must add to SQ the condition: "there is a sortal term F such that S is a succession of F-stages."[19] If 'car' is a sortal, then this explains why the car did not persist:[20] The Mustang entering the crusher and the cube leaving it are not connected by a spatiotemporally and qualitatively continuous sequence of car-stages.

Philosophers who appeal to sortals owe us an account of what terms are sortals. Philosophers like Hirsch, though, tend to distinguish sortals from non-sortals by stipulating that sortals are just those that do provide a criterion of identity. So he claims that a sortal is a term 'F' of English such that it is a conceptual (or "analytic") truth that any continuous succession of F-stages (i.e. object stages to which F applies) corresponds to stages of a single persisting F-thing. So also David Wiggins claims that a sortal is "cor-

[18]Hirsch {44, p. 25–33}.

[19]Hirsch {44, p. 36}.

[20]I say that 'car' is a sortal, rather than car is a sortal. We can disagree whether we should dub as sortals properties, concepts, or terms. Since the outcome of such a disagreement will not affect anything I say below, I will speak of both properties and terms that denote them as sortals, i.e. I assume that Bostock believes that both the kind human and the term 'human' are sortals.

relative with or associated with a principle by which entities of a particular kind may be traced or kept track of and re-identified as one and the same."[21]

1.5 The Persistence of Goo

Bostock thinks that, for Aristotle, each persisting subject has a diachronic criterion of identity. But he asks:

> If matter is to persist over time, then it seems that there must be some appropriate criterion of identity for it. But what is this criterion?[22]

Bostock thinks that Aristotle provides no criterion of identity for matter, and argues that we cannot fill this lacuna on his behalf. Why does Bostock think that no criterion will be forthcoming? He claims that,"[t]he root cause of the difficulty is just the assumption that a stuff (such as water) is strictly homoiomerous."[23]

I will explain the difficulty that concerns Bostock by discussing two putative criteria of identity for goo. The first says that goo persists under a sortal, a sortal which embodies a diachronic criterion of identity for it. The second says that a portion of goo persists only if each of its parts persists.

1.5.1 First candidate criterion

Let us focus again on Hirsch's claim that the object stages which combine into one persisting object must fall under the same sortal. So we may think that for a portion of goo to persist, the stages of a persisting goo must fall

[21]Wiggins {87, p. 22} Note that some have argued that the existence of a succession of qualitatively and spatially continuous F-stages is not sufficient for the existence of a persisting F. See, for instance, Shoemaker {79}.

[22]Bostock {12, p. 36}.

[23]Bostock {12, p. 43}.

under some same sortal, i.e. that the stages of some persisting portion of water must each themselves be water.

Bostock, in effect, thinks that a necessary condition for a term 'F' to be a sortal is that it be non-dispersive.[24] This means that if 'F' is a sortal, and 'F' refers to an object o, then 'F' does not refer to any part of o. Consider the sortal 'car'. The sortal 'car' refers to a Mustang in the parking lot, but it does not refer to any part of that Mustang. In contrast, a noun like 'clay' is dispersive. It both refers to the total piece of clay in the potter's hands, and to parts of that piece in the potter's hands.

We may worry that Bostock is merely stipulating that mass nouns, since they are dispersive, cannot embody diachronic criteria of identity. However, Bostock does have an argument for why dispersive terms cannot embody diachronic criteria of identity. Consider an oak tree and its trunk. A continuous succession of oak tree stages corresponds to one persisting tree. A continuous succession of trunk stages corresponds to one persisting trunk. Both oak trees and their trunks are wooden.

Now 'wood' is dispersive, i.e. parts of wooden things are themselves wood. Thus different wood stages combine in all sorts of different ways. The various successive stages of both the oak tree and the stages of its trunk combine into one persisting wooden object. To see this, call wooden stage at t1 *W1*. W1 combines together with wood stages at times other than t1 into one continuous wooden object. The problem is that there are too many continuous wooden objects. Each trunk stage combines with W1 into one persisting wooden object. So also each oak stage combines with W1 into one persisting wooden object. There are even combinations of trunk stages and oak stages that combine with W1 into one persisting wooden object.

[24]The next three paragraphs follow Hirsch {44, p. 37–42}.

This seem counter-intuitive. We want to know if W1 persists through time. It persists only if it is part of a suitable succession of wood stages. But there are too many of these successions! Allow that at t2 there is an oak tree, *O2*, and its trunk, *R2*. Is W1 identical to O2 or R2? W1 is identical to O1 if there is a succession of wood stages that contains both. W1 identical to R2 there is a succession of wood stages that contains both. So which of these successions exist? Both! W1 is part of both such successions. So W1 is identical to O2 and identical to R2, identical to both an oak tree and that tree's trunk. Identity is transitive. Since W1 is identical to O2 and identical to R2, then O2 is identical to R2; the oak tree is identical to its trunk, one of its several parts.

1.5.2 Second candidate criterion

Our second candidate criterion for goo is that a portion of goo persists only if its parts persist. To understand this candidate, consider a view which says that stuffs are summations. This view has two basic principles:

Fusion Any two non-overlapping portions of a stuff S have a fusion.

Mereological essentialism (ME) Any sub-portion of a portion of S is essential to it.

Fusion says that some water in the river Liffey and some water in my glass have a fusion, a fusion which is itself a portion of water. Irrespective of how spatially apart two portions of water are they still have a fusion. ME says that you cannot add or subtract a sub-portion from a portion. The fusion (itself a portion of water) which has water from the Liffey and water from my glass as sub-portions has these sub-portions essentially. If you were to

destroy either sub-portion, you would destroy the fusion outright. Let us note that adding water to my glass or pouring what was in my glass into the Liffey does not destroy the fusion. (I have used 'water in my glass' to refer to a portion of water, but it is not essential to that water that it be in my glass).

On this summation view of stuffs, the persistence conditions for a portion of any stuff is strict and clear-cut: a portion of stuff S persists only if each of its sub-portion persists. The portion of water that has Liffey water and glass water as sub-portions persists only if both of these sub-portions persists. A portion of bronze persists only if each of its sub-portions persists.

The success of the summation view depends on the persistence of the sub-portions. These sub-portions have diachronic criteria of identity or they do not. If they have such criteria, these will be specified in terms of their sub-portions or in some other way.

Here let us recall that Aristotle believes that stuffs are gooey. The summation view cannot accommodate goo. Suppose that water is gooey. The summation view says that the portion of water in my glass will persist only if each of its sub-portions persists. But each of these sub-portions are themselves water. Since water is gooey, each of these sub-portions has sub-portions which are themselves water. So each sub-portion of the original portion will persist only if each sub-portion of the sub-portion persists. These further sub-portions will be themselves water. Since goo is both homoiomerous and infinitely divisible, there is no leveling out. We never get to a sub-portion of water that has persistence conditions that are determined by anything other than further sub-portions of water.

Of course, one might respond that the persistence conditions for a portion of water need never level out. On this view, we may think that criteria of

identity need never level out, i.e. a criterion of identity can be specified for As in terms of Bs, and a criterion for Bs can be specified in terms of Cs, and so on *ad infinitum*.[25] But even if this were true, there is still a problem: when we specify the persistence conditions of water in terms of its sub-portions, sub-portions which are themselves water, we are specifying the persistence conditions of some water in terms of some water. But why think that the sub-portions enjoy some special privilege over whatever they are sub-portions of? If water is gooey, there is no salient difference between a portion of water and its water sub-portions, a difference which would make the sub-portions more fundamental than the portions they are sub-portions of. [26]

1.6 Three Responses

Recall these four claims:

1. The subject of every change persists through that change it is subject for.
2. The subjects of some changes are gooey.
3. There is a diachronic criterion of identity for each persisting subject.
4. There is a diachronic criterion of identity for each persisting gooey subject (from 1–3).

I here present interpretations of how persistence plays a role in Aristotle's search for the principles of nature by discussing whether they accept 1–4.

[25] See Lowe {65, 64} for discussion about whether each thing has a criterion of identity, whether such criteria can be circular, and whether they must level out.

[26] Zimmerman {89, 90}.

1.6.1 First Response

Our first response says that Aristotle commits himself to each of 1–3 in *Phys.* I. On this view, it is particularly helpful to read *Phys.* I as being concerned with diachronic criteria of identity and as making the claim that matter too has such a criterion. Bostock is the most notable defender of this interpretation. We have seen that he thinks that Aristotle accepts 1–4, and also that 4 is false. So, according to Bostock, Aristotle is mistaken to think that matter has a diachronic criterion of identity.

1.6.2 Second Response

Our second response denies that Aristotle commits himself to 1 in *Phys.* I. Notably, Barrington Jones claims that, for Aristotle, while at each moment of an unqualified change, there exists some portion of goo or other, there is no one portion of goo that persists through the change.[27] For instance, at each moment of a sculpting, there exist some portion of clay in the sculptor's hand. However, Jones denies that any one portion of clay persists through the sculpting.

This second response is radical. It denies that persistence has anything at all do with Aristotle's search for the principles of nature. Aristotle does, on this reading, think that each change requires a subject of change. But, on this reading, the subject is whatever can be said to become so-and-so. For instance, the subject of a sculpting is just whatever can be said to become a statue. However, according to this reading, in order for a subject to become so-and-so it need not persist through the becoming, in order for a portion of bronze to become a statue, it need not persist through the sculpting.

[27] Jones {51}.

Our second response comes in both a strong and a weak version. The strong version defended by Barrington Jones and William Charlton takes Aristotle in *Phys.* I to deny that matter persists through an unqualified change.[28] The weak version defended by Sean Kelsey and David Ebrey claims that *Phys.* I is neutral with respect to 1.[29] Even if Aristotle commits himself to this claim elsewhere, Kelsey and Ebrey claim that Aristotle doesn't say anything to commit himself to it in *Phys.* I.

What's vital about both versions of this response is that persistence plays no role in Aristotle's search for the principles of nature. It neither organizes that search nor does it feature in any of the central arguments therein.

1.6.3 Third Response

A third possible response denies 2, denies that gooey subjects are the subjects of unqualified change. The core move in this response is to claim that goo is different from bits or pieces of some goo. For instance, a portion of water is different from a pool of water. A portion of bronze is different from a bit of bronze. A portion of clay is different from a piece of clay. This third response says that, for Aristotle, it is these pools, bits, and pieces that are subject of unqualified changes, and it is these things and not gooey things that have diachronic criteria of identity.

To see this solution, let us recall that count nouns refer to individuals and mass nouns refer to stuffs. If Aristotle thinks that the reference of mass nouns are the subjects of unqualified changes, then we may infer that he accepts 2. But this inference may not be licensed. For we may think that mass nouns can serve as a kind of stand in for count nouns. Consider the

[28] Charlton {23}, Jones {51}.
[29] Ebrey {31}, Kelsey {55, 54}.

sentence, 'the water in my glass is the same water as the water that was in the jug'. We may think that the three occurrences of 'the water' refer to some one portion of water that could be referred to by some count noun, e.g. 'the 10 ounce portion of water'.

'The 10 ounce portion of water' is non-dispersive. No part of this 10 ounce portion of water is itself a 10 ounce portion of water. So Bostock's concerns with supplying a diachronic criterion of identity for goo will no longer apply to the subjects of unqualified changes. Of course, we will still need a criterion for the particular 10 ounce portion of water, the particular 1lb piece of bronze, this particular pool of water, and so on. But it is more likely that Aristotle could supply diachronic criteria of identity for these things than for goo.

So, on this response, goos are not the subjects of unqualified changes. Rather it is something that portions of goo make up, e.g. it is not the bronze which makes up this very piece of bronze here that is the subject of a sculpting, but the very piece itself; a piece distinct from the gooey bronze that composes it.

1.7 Locating Criteria of Identity in *Phys.* I

Interpreters have thought that diachronic criteria of identity are important to Aristotle's search for the principles of nature. But why? There are two reasons:

First, in *Phys.* I.7 Aristotle describes the subject in various ways and privileges certain descriptions over others. For instance, he tells us that when a person becomes musical, the man remains, but the unmusical does not (189b32*ff*). Sarah Waterlow argues that Aristotle privileges these descrip-

tions because he thinks the description embodies a diachronic criterion of identity for that persisting subject.[30] This is also how Bostock understands these descriptions. We have seen that he thinks that, according to Aristotle, "...any such thing [a persisting subject] must be of a definite sort, so that there is some sortal noun 'A', which in someway embodies its criterion of identity over time. The item can then be referred to as 'this A', and later as 'the same A', where we do understand what it is for this A and that A to be (over time) the same A."[31]

Aristotle claims not merely that the subject persists. He also claims that each subject persists under a sortal. Bostock and Waterlow think that since he claims that each subject persists under a sortal, he must think that this sortal embodies a diachronic criterion of identity for that persisting subject. If this were correct, the claim that each persisting subject has a diachronic criterion of identity would be central to Aristotle's view of the principles of nature.

Second, Waterlow thinks that Aristotle claims that each subject persists under a sortal because she thinks this claim is vital to his proposed solution to a puzzle at the heart of *Phys.* I. In *Phys.* I.8, Aristotle discusses an Eleatic argument against the possibility of change. Call this 'The Eleatic Challenge'. The Eleatic Challenge claims that if what-is comes to be, then it comes from what-is (ἐξ ὄντος) or from what-is-not (ἐκ μὴ ὄντος). But, it claims, neither option is possible (191a27-33).

Many interpret the Eleatic Challenge as making two distinct claims: First, sheer replacements are impossible. Second, if changes were to exist, changes must be sheer replacements. Aristotle is then understood as

[30]Waterlow {84, p. 21}
[31]Bostock {12, p. 35}.

meeting the challenge by rejecting the second claim. According to him, a subject persists through each change but nothing persists through a sheer replacement. Mary Louise Gill explains:

> Parmenides denied the possibility of change because, on his view, for coming-to-be to occur, something must come to be from nothing. Aristotle agrees with his predecessor in excluding such absolute emergence, yet accommodates change by insisting that coming-to-be, although involving replacement, and also involves continuity. He thus avoids the charge that, when a change takes place, the pre-existing entity simply perishes into nothing and is replaced by a product that emerges out of nothing.[32]

Let us grant that the Eleatic Challenge turns on the claim that we cannot distinguish sheer replacements (which are impossible) from genuine changes.[33] Let us also grant that Aristotle claims that change differs from mere replacement because something, the subject, persists through a change while nothing persists through sheer replacements. According to Waterlow, Aristotle must defend his claim that a subject persists through each change. And, according to Waterlow, this defense consists in claiming that the subject persists under a sortal.

Why? Waterlow is not so clear here. But suppose that there are no diachronic criteria of identity for persisting subjects. Perhaps Waterlow's concern is that it would be indeterminate whether something has persisted through a change or whether it has been replaced. For instance, suppose we take two snap shots of guards outside Buckingham Palace one hour apart from one another. Perhaps Waterlow thinks that if there is no diachronic criterion of identity for people, then it will be indeterminate whether these two guards are identical, i.e. it is indeterminate whether the latter guard

[32] Gill {38, p. 7}, Waterlow {84, p. 8}, Irwin {48, p. 84-87}.
[33] See Ch.5 for details.

replaced the former guard, or whether one guard merely continued standing for the one hour duration. So since Waterlow thinks Aristotle's solution requires distinguishing sheer replacements from genuine changes, it is reasonable of her to think that diachronic criteria of identity play a role in his solution.

1.8 A New Reading of Persistence in *Phys.* I

I think the import of Aristotle's remarks about persistence in *Phys.* I have been misunderstood. He does not claim that there is a diachronic criterion of identity for each persisting subject, and reading *Phys.* I as being particularly concerned with these criteria is at best unhelpful and at worst misleading; misleading because it obscures the proper import of his claims about persistence. This is not to say that Aristotle nowhere has anything to say about these issues. Nor is it to say that Aristotle need not say something about these issues. But he doesn't say anything about the issues in *Phys.* I.

This is important. We have seen just how questions about diachronic criteria of identity have shaped some interpreters understanding of *Phys.* I. Bostock thinks that Aristotle is there committed to the claim that matter persists, and to the claim that there is a diachronic criterion of identity for matter. He then argues that Aristotle does not have the resources to provide such a criterion, and so concludes that there is an inherent flaw in Aristotle's views about the principles of nature. Others, like Jones, deny that, for Aristotle, matter persists. He thinks that Aristotle does commit himself to there being a diachronic criterion of identity for each persisting subject. Since Jones thinks Aristotle cannot provide such a criterion for matter, he concludes that Aristotle is not committed to its persistence.

On the new reading I develop here, Aristotle does not claim that each persisting subject has a diachronic criterion of identity. So we cannot use that claim to interpret his search for the principles of nature, e.g. decide whether he thinks that matter persists or not. On the view that I develop here, *Phys.* I is neutral with respect to the question of whether persisting subjects have diachronic criteria of identity. To put it another way, *Phys.* I is compatible with the claim that, say, some persisting matter has no such criterion of identity. Such a view says that the persistence of matter is primitive, that there are no reductive criteria in virtue of which some matter M1 existing at one time is identical to some matter M2 existing at some other time. This is not to say that M1 and M2 are distinct. On this view, M1 and M2 are identical. But there being identical is not in anyway explained by or constituted by anything further.

I do not claim that Aristotle defends a primitive view about the persistence of matter. But if interpreters like Waterlow and Bostock are right, then this cannot be Aristotle's view in *Phys.* I. They think that a central claim of Aristotle's is that each persisting subject has a diachronic criterion of identity. In contrast, on my reading, *Phys.* I is compatible both with the view that each persisting subject has a diachronic criterion of identity and with the view that some persisting subjects have no such criterion. The point is that *Phys.* I takes no stand on the issue.

Instead of arguing that individual passages *cannot* be read as concerned with diachronic criteria of identity, I offer an alternative and new reading of Aristotle's views about persistence in *Phys.* I that I think best characterizes the role persistence plays in his search for the principles of nature. I argue that Aristotle does claim that each subject persists, and I argue that this

claim figures prominently in his search for his principles of nature.

To explain how I understand Aristotle's remarks about persistence in *Phys.* I, let me explain how I understand his overall goals and argumentative strategy in this book. Most interpret Aristotle as searching for the most general features of changes. Robert Bolton is one example. He compares changes with two-dimensional magnitudes and uses Aristotle's discussion of two-dimensional magnitudes elsewhere to clarify how subject, privation, and form are principles. In *An. Post* 76a31–6, Aristotle claims that a geometer must assume that two-dimensional magnitudes exist. Bolton claims that this assumption can be clarified and filled out with the claim that points and lines exist.

> This fills out the content of the principle that two-dimensional magnitude exists because these are the basic objects which make all geometrical magnitude possible. All geometrical objects are constructible out of points and line, but the latter are not constructible out of, or otherwise reducible to, each other or to any more fundamental entities.[34]

According to Bolton, Aristotle believes that geometrical objects exist because points and lines exist; geometrical objects are in some way constructible out of points and lines. In a similar way, Bolton suggests that changes are in some way constructible out of subject, form, and privation.[35] Here is an example: warming exists. It is a process of change that has temporal duration. This claim can be filled out with with the claim that, say, a stone (the subject), the hot (the form), and the cold (the privation) exists. In other words, we can say that a warming exists just because a stone is coming to be warm.[36]

[34]Bolton {9, p. 22}.

[35]It is unclear what kind of construction Bolton means here. But, for our purposes, we can set the issue aside.

[36]Bostock {12, p. 1} articulates this view fairly clearly. See also Bolton {9}, Wieland {86}.

On this reading, Aristotle's goal in *Phys.* I is to identify the most general kind of entities that changes are constructible out of: for any change C, C involves some subject, some form, and some privation. Debates about whether Aristotle thinks that the subject of each change persists are debates about whether he thinks each change involves a persisting subject or not.

I agree that Aristotle does seek out those entities that changes are somehow constructible out of (though I offer no view about what kind of construction this requires). However, this is only one of Aristotle's goals. Aristotle also tries to identify those entities that natural beings are constructible out of. Consider how in *Phys.* I.7 Aristotle draws the following conclusion about the principles of nature:

> Plainly, then, if there are causes and principles of natural beings, from which they primarily are and have come to be—have come to be, I mean, what each is said to be in its essential nature, not what each is in respect of a concomitant attribute—plainly, I say, everything comes to be from both subject and form. For musical man is composed, in a way, of man and musical, since you will analyze it into their accounts. It is clear then that what comes to be does so from these things [causes and principles] (190b17–23).[37]

Here Aristotle tells us that he has been searching for the principles of natural beings, beings like Arion, dolphins, dogs, cats, and so on. He concludes that each of these beings is composed (σύγκειται) of a subject and a form, e.g. Arion is composed of some subject and some form.[38] The subject and form

[37] φανερὸν οὖν ὡς, εἴπερ εἰσὶν αἰτίαι καὶ ἀρχαὶ τῶν φύσει ὄντων, ἐξ ὧν πρώτων εἰσὶ καὶ γεγόνασι μὴ κατὰ συμβεβηκὸς ἀλλ' ἕκαστον ὃ λέγεται κατὰ τὴν οὐσίαν, ὅτι γίγνεται πᾶν ἔκ τε τοῦ ὑποκειμένου καὶ τῆς μορφῆς· σύγκειται γὰρ ὁ μουσικὸς ἄνθρωπος ἐξ ἀνθρώπου καὶ μουσικοῦ τρόπον τινά· διαλύσεις γὰρ [τοὺς λόγους] εἰς τοὺς λόγους τοὺς ἐκείνων. δῆλον οὖν ὡς γίγνοιτ' ἂν τὰ γιγνόμενα ἐκ τούτων. Unless otherwise stated, all translations are based on Hardie and Gaye. I do not discuss modifications unless they directly bare on my arguments. I have also consulted Charlton {23}, Irwin and Fine {49}, Waterfield and Bostock {83}.

[38] I translate 'σύγκειται' as 'composed'. I do not mean anything technical by 'composed', e.g. that the subject and form stand to the natural being as parts to whole. We can use 'σύγκειται' for any kind of combination of various things, e.g. 'there was a combination of difficulties

are two of the three principles of nature. While he thinks that these are two of the general kinds of entities involved in every change, Aristotle adds something extra: these two principles compose natural beings. So Aristotle moves from a claim about what changes are constructible out of to a claim about what natural beings are constructible out of. Identifying how Aristotle reaches this conclusion will allow us identify just how persistence figures in his search for the principles of nature.

In what follows, I argue that he reaches this conclusion by considering the causal processes involved in any change. Let me introduce this point with an example. Suppose that you decide to build a sail boat. Building a sail boat is difficult. You need the right materials, and you need the right tools and expertise to turn those materials into a sail boat. How do you decide which materials to use? In order to answer this question, you must attend to two distinct things. First, you must learn what sail boats are; that they are vessels that people use to travel across the water; that they are powered by the wind; and so on. This itself will require learning about the winds, the water, and about the various people who will use the boat. Second, you must learn about the different tools and processes that you could use to turn some materials into a boat, e.g. hammering, nailing, casting, melting, sculpting, sewing, and so on.

What you learn about both will determine which materials you pick to build the boat. Since boats must travel across water, their hulls must be made from some buoyant material. But not any old buoyant material can be made into the hull of the boat. Suppose that the only tools available to

that caused Odysseus to spend so long from Ithaca.' Aristotle does not tell us how he uses the word, and I will avoid interpreting him having some specific relation in mind. Also note here that 'σύγκειται' is frequently used as the passive of 'συντίθημι'. In *Phys.* I, Aristotle uses cognates of this verb, 'σύνθεσις' and 'σύνθετος'. For instance, he tells us at 190b8 that a house is something that comes into being by a process of combination ('σύνθεσις').

you are a hammer and a saw. This will limit the kinds of buoyant material that could be *turned* into the hull of boat. For instance, even though plastic is buoyant, you could never turn that plastic into the hull of a boat with just a hammer and a saw: nailing bits of plastic together will never create a watertight firm hull.

So you cannot turn just any material into a sail boat. Rather, after learning what boats are and identifying the tools available to you, you must search out those materials which can be turned into a sail boat by your available tools. There is nothing you can do to cheese, chocolate, and wine to turn them into a sail boat. But, if you know some carpentry and something about the art of fabrication, you can turn wood and fiberglass into the hull of your boat.

Here's the point of the analogy: Aristotle is interested in the products of changes. He wants to identify what makes up these products. He concludes that the product of every change is a complex of two distinct contributions, a passive and active contribution. The product of a musical lesson is a musical man, an entity which was made by imposing musicality on to a man. The product of sculpting is, say, a statue, a product that was made by imposing a shape upon some bronze.

I think that Aristotle's focus on production shapes his interest in persistence in *Phys.* I, shapes it in a way that has not been noticed by other interpreters. The subject is the patient that the actor acts upon, and this places constraints on what entities can be the subject of certain changes, i.e. a subject must be able to be acted upon and changed by the actor. So, for instance, glass cannot be subject of that change that produces a boat: since surviving a hammer blow requires absorbing the force of the hammer, and

since glass cannot absorb such a force, glass cannot be turned into the hull of a boat. Wood, though, can absorb such a blow and be turned into the hull of a boat. So wood can be the subject of that change that produces a boat.[39]

For Aristotle, the subject must be able to undergo that process of being acted upon and changed by some actor. I argue that, for Aristotle, to be able to undergo a process of being acted upon requires being able to survive as it is being acted upon. The stone survives as it is being warmed up, survives as heat is being imposed upon it. This is why, I argue, he privileges certain descriptions of the subject over others.

Recall that Waterlow and Broadie think that Aristotle privileges these descriptions because they embody diachronic criteria of identity, i.e. he says that Arion remains a man as he learns music because 'man' embodies a diachronic criterion of identity for persisting men. I disagree. I argue that Aristotle thinks that being a man explains how Arion can survive as music is being imposed him, and, I argue, this is different from explaining what the identity through time of Arion consists in.

To explain this, let us suppose that the famous Terpander taught Arion how to play the lyre. He will expect two things of Arion. First, he will expect that Arion can complete the intensive music lessons. Arion won't complete the lessons if he is weak-willed, sickly, distractable, and so on. He is likely to quit half way through even if he was able to begin the lessons. Second, he will expect that Arion is ready and able to start learning how to play the lyre. After all, Arion won't be able to start learning if he is still a child, so young he has yet to sufficiently develop cognitively and physically to begin learning anything at all. Similarly, if Arion has suffered some catastrophic

[39]Many others think that action and passion play key and central roles in *Phys.* I, most notably Waterlow {84} and more recently Ebrey {31}. I discuss their interpretations in Ch.3 and explain just how mine differs from theirs.

injury in his life, there is little that Terpander can do to teach him music. So Terpander needs Arion to be able to both begin and complete a music education.

If Terpander believes Aristotle, he will think that it is only unmusical men who are able to do both. First, not every man can learn music. It is only those who are in the appropriate state that can do so, i.e. they are unmusical. Second, Aristotle thinks that it is by remaining a man that Arion survives as his music teacher imposes their knowledge of music upon him. Being a human is a reasonable explanation for how Arion could be acted upon in this way: being a human involves possessing those cognitive capacities required to assimilate the relevant information as it is being passed down by the teacher, also involves the appropriate physical features and capacities to support music learning, e.g. being strong enough to hold the lyre, not exploding at a certain frequency of pitch, and so on.

Being a human may not be a suitable explanation for how Arion can undergo other changes. For instance, when Arion swims into cold water on a hot day, he cools down. On the reading I develop, Aristotle thinks that there is some explanation as to why Arion can survive as his body is being acted upon and cooled down by the cold water. This will involve complex facts about Arion's physiology. The explanation, though, may be something more general than the fact that Arion is a man. Perhaps the explanation is that Arion is an animal, something entailed by Arion's being a man. This is not a problem for my account. After all, being an animal cannot explain how Arion can survive a music lesson. It is being a man that is relevant. So my account predicts that Aristotle will cite 'man' as opposed to something more general like 'animal' when he explains why Arion can survive as he

assimilates his teacher's music lesson.

1.9 Outline

In what follows, I elaborate and defend this reading. In Ch.2, I focus on *Phys.* I.5. There Aristotle argues that of all the pairs of opposites, some of these pairs are the principles of nature. I show that Aristotle's argument relies on a background theory of production, a theory that I think shapes the rest of *Phys.* I. While *Phys.* I.5 says little about persistence, the goal of Ch.2 is both to argue that this background theory is operative and to clarify it.

In Ch.3 I argue that the question of how a being can survive a process of being acted upon is different from the question of what the identity through time of that being consists in. For instance, in order to survive the force of a hammer blow, a piece of bronze must be both malleable and retain its malleability as I continue to hammer it. Explaining how bronze can survive hammering in this way differs from providing a diachronic criterion of identity for that persisting bronze. Further, one can explain how bronze retains its ability to survive a hammer blow while remaining neutral on what exactly the diachronic criterion of identity for bronze is. Thus Aristotle need not offer any such criteria for bronze for the purposes of *Phys.* I, and so it is not surprising that he does not say anything about such criteria there (though he may have views about such criteria elsewhere).

In Ch.4 I discuss *Phys.* I.7 and a classic problem about the persisting subject of natural generations: Aristotle seems to tell us he will make some general claims about the subject of each change, and he seems to say that the subject persists (190a9–10). Thus it seems that Aristotle believes that

the subject of an unqualified change, matter, persists through an unqualified change.[40] However, Aristotle claims that plants and animals come into being from *sperma* (ἐκ σπέρματος)(190b4–5).[41] This suggests that sperma is the subject, i.e. matter, of those unqualified changes in which plants and animals come into being. If the subject of every change persists, and if sperma is the subject of the generation of plants and animals, then sperma persists. But this is peculiar. Let us assume that the unfertilized egg is a sperma. If you dissect Socrates, you find a heart, a liver, blood, and tissues. Nowhere do you find in him the unfertilized egg that he came into being from. So the claim that plants come into being from sperma seems to entail that the subject of some unqualified change does not seem to persist through them.

This is a clear difficulty. In the very same chapter, Aristotle seems to make one claim that entails that matter persists through an unqualified change, and make another claim that entails that matter does not persist through an unqualified change. I think that we can ease this tension by focusing on Aristotle's biological works. I show that, for Aristotle, when properly understood, one kind of sperma is blood. So understood, sperma does persist through a natural generation and is present in the newly generated animal. Nevertheless, sperma on this reading is blood and blood is a goo. The general difficulty about supplying diachronic criteria of identity for goo applies also to blood. But, I argue, since Aristotle says nothing about such criteria in *Phys.* I it should not concern us that his *Phys.* I account offers us no diachronic criterion of identity for blood.

In Ch.5 I offer a new interpretation of the Eleatic Challenge. Unlike many interpreters, I deny that the Challenge turns on issues of replacement.

[40] Bostock {12, p. 6}.

[41] I translate 'ἐκ σπέρματος' as 'from sperma'. We could also translate it as 'from seed'. See Ch. 4.

Instead, I argue that the Challenge turns on issues of production. Both the Eleatic Challenger and Aristotle assume that it is a requirement for the existence of a change C that there exists a subject which can persist through C. However, the Challenge argues that this requirement cannot be met. Aristotle's solution, in turn, is to show that, on the correct view of the principles of nature, this requirement can be met. Persistence does play a prominent role, then, in the Eleatic Challenge and Aristotle's response. Nevertheless, I argue that this solution does not rely upon the claim that each persisting subject has a diachronic criterion of identity. Indeed, on my reading, Aristotle's solution is available to him even if he were to claim that the persistence of each subject is primitive.

CHAPTER 2

ON OPPOSITES: *PHYSICS* I.5

2.1 Introduction

In *Phys.* I.5, Aristotle begins the positive stage of his inquiry into the principles of nature. In this first stage of his inquiry, he does not speak of persistence nor do his arguments rely on any considerations of persistence. However, as I claimed in Ch.1, there are certain background assumptions about change operative in Aristotle's search for the principles of nature, assumptions about how the product of every change comes about by some actor acting upon and changing some patient. This chapter has two goals. The first is to argue that these assumptions are operative in the arguments of *Phys.* I.5. The second is to offer some initial clarification and explanation of them. In Ch.3, I will elaborate them further and there show how they play a role in Aristotle's understanding of persistence in *Phys.* I.

Phys. I.5 is concerned with showing that the principles of nature are opposites.[1] Opposites are a pair of beings such that an appropriate subject must possess one of them (or an intermediate), but can never possess both together. For instance, the hot and the cold are opposed to one another and an appropriate subject, like a loaf of bread, must possess one of them (or an intermediate), but never both together.[2] Aristotle's goal is to show that of all

[1] I translate the Greek word 'ἐναντία' with 'opposites'. We can also translate it with 'contraries'. Aristotle speaks of opposites in four different ways: "Things are said to be opposed to each other in four ways, either as relatives, or as contraries, or as privation and possession, or as affirmation and negation" (*Cat.* 11b17–19). Λέγεται δὲ ἕτερον ἑτέρῳ ἀντικεῖσθαι τετραχῶς, ἢ ὡς τὰ πρός τι, ἢ ὡς τὰ ἐναντία, ἢ ὡς στέρησις καὶ ἕξις, ἢ ὡς κατάφασις καὶ ἀπόφασις. Ackrill {2, p. 109–111} explains how these four differ from one another. In *Phys.* I.5, Aristotle speaks only of one opposition, the contraries; though I continue to use 'opposite' throughout.

[2] Note that opposites are not merely contradictories. The opposite of the hot is not the

the pairs of opposites, some of these pairs are the principles of nature.

Call the claim that the principles of nature are opposites *PO*. Most interpret PO as a claim about the structure of change. For instance, William Charlton argues that Aristotle tries to establish "the purely logical doctrine that change is within definite ranges".[3] By this, he means that for any change C, there is some pair of opposites F and F-, such that C occurs between F and F-. What 'occurs between' means is best illustrated. Temperature is a spectrum with the cold at one extreme, the hot at another extreme, and various intermediate temperatures, like luke warm, falling in between these two extremes. Suppose that a dolphin swims into some warm water and so becomes warmer. According to Charlton, PO says that the dolphin must have changed from being colder to being warmer, i.e. she changes from one point on the temperature spectrum to another point on that spectrum.

My focus is how Aristotle argues for PO. What are the premises and structure of this argument? This has been a source of disagreement. When Charlton calls PO a logical doctrine, he means that Aristotle's support for PO lies in how we think and speak about change. In contrast, Sean Kelsey claims that Aristotle accepts PO because Aristotle holds what Kelsey calls a destructive view of change.[4] On this view, Aristotle has a particular view of the causal processes involved in every change: each change comes about when an opposite drives out or destroys its opposite. For instance, suppose that Arion changes from being cold to being warm. Kelsey sees Aristotle claiming that this change comes about when heat destroys or drives out the coldness that was in Arion. So, on Kelsey's reading, these claims about

mere absence of heat. If the opposite of the hot were the mere absence of heat, then the number 4 would possess the opposite of heat.

[3]Charlton {23, p. 66}.

[4]Kelsey {54, p. 188–190}. See also Ebrey {31}.

causality feature as premises in Aristotle's argument for PO. Terence Irwin too stresses that causal considerations lie behind Aristotle's argument for PO:

> Aristotle assumes that every becoming is the causal influence of one thing on another, and that every case of causation involves something non-random; if x causes y, there is some general law relating types of which x and y are token.[5]

In this chapter, I too argue that Aristotle argues for PO from a background assumption of the causal processes involved in any change, and I offer some initial characterization of this assumption. Noting this is not itself an innovation. However, the way I see this assumption playing a role in Aristotle's understanding of persistence in *Phys.* I is novel. So my goal here is to clearly explain this background assumption and to argue in agreement with others that it is operative in *Phys.* I.5.

An outline of what's to come: in Sections 2.2–2.5, I discuss Aristotle's claims that his predecessors accept PO. This claim fits poorly with the other ways Aristotle characterizes his predecessors' views about the principles in *Phys.* I. However, I argue that we can reconcile these different characterizations by bringing to focus the background causal considerations in Aristotle's discussion. In sections 2.5–2.9, I show just how these causal considerations play a role in Aristotle's own argument for PO. In 2.10, I step back form *Phys.* I.5 and clarify these causal claims further.

2.2 Aristotle's Predecessors

At the beginning of *Phys.* I.5, Aristotle claims:

[5]Irwin {48, p. 70}.

> (a) All thinkers agree in making the opposites principles, (b) both those who describe the All as one and unmoved, for even Parmenides treats hot and cold as principles under the names fire and earth, (c) and those too who use the rare and the dense. (d) The same is true of Democritus also, which his plenum and the void, both of which exists, he says, the one as being, the other as not-being. Again he speaks of differences in postion, shape, and order, and these are genera of which the species are opposites, namely, of position, above and below, before and behind; of shape, angular and angle-less, straight and round (188a19–26).[6]

In (a) Aristotle says that his predecessors accept PO. In (b)–(d), he discusses some of his predecessors and says which opposites they think are principles, e.g. Parmenides thinks that the hot and cold are principles.[7] The 'some' in (c) refers to a group of natural philosophers that Aristotle discussed in *Phys.* I.4. One group of these philosophers, he says, believe that rarity and density generate everything out of one underlying body. This one underlying body is either air (Anaximenes), fire (Heraclitus), water (Thales), or something more condensed than fire, and less condensed than air (187a11–16).[8] So in (c) Aristotle refers back to these natural philosophers, and he adds that, for these philosophers, the opposites density and rarity are principles.[9]

[6]Πάντες δὴ τἀναντία ἀρχὰς ποιοῦσιν οἵ τε λέγοντες ὅτι ἓν τὸ πᾶν καὶ μὴ κινούμενον (καὶ γὰρ Παρμενίδης θερμὸν καὶ ψυχρὸν ἀρχὰς ποιεῖ, ταῦτα δὲ προσαγορεύει πῦρ καὶ γῆν) καὶ οἱ μανὸν καὶ πυκνόν, καὶ Δημόκριτος τὸ πλῆρες καὶ κενόν, ὧν τὸ μὲν ὡς ὂν τὸ δὲ ὡς οὐκ ὂν εἶναί φησιν· ἔτι θέσει, σχήματι, τάξει. ταῦτα δὲ γένη ἐναντίων· θέσεως ἄνω κάτω, πρόσθεν ὄπισθεν, σχήματος γεγωνιωμένον ἀγώνιον, εὐθὺ περιφερές. ὅτι μὲν οὖν τἀναντία πως πάντες ποιοῦσι τὰς ἀρχάς, δῆλον.

[7]For brevity, instead of saying that 'according to Aristotle, his predecessors say such and such', I will say that 'his predecessors believe such and such'. I will not pause to examine whether Aristotle correctly understands his predecessors.

[8]Ὡς δ' οἱ φυσικοὶ λέγουσι, δύο τρόποι εἰσίν. οἱ μὲν γὰρ ἓν ποιήσαντες τὸ [ὂν] σῶμα τὸ ὑποκείμενον, ἢ τῶν τριῶν τι ἢ ἄλλο ὅ ἐστι πυρὸς μὲν πυκνότερον ἀέρος δὲ λεπτότερον, τἆλλα γεννῶσι πυκνότητι καὶ μανότητι πολλὰ ποιοῦντες. Ross {74, p. 481–3} discusses why Aristotle excludes earth. See also *Met.* 989a6–9. Ross {74, p. 482–483} for this intermediate element, and also Ross {74, p. 487–488} for Aristotle's discussion of Parmenides in (b).

[9]In *Phys.* I.4, Aristotle also discusses Plato, Anaximander, Empedocles, and Anaxagoras. He says that each of these philosophers also make opposites principles: Plato makes the great and small matter and he makes the one form (187a17–20).

So Aristotle thinks that PO has universal support and so should be taken seriously in our search for the principles of nature. However, there is something deeply puzzling about Aristotle's claim that all his predecessors accept PO, a puzzle which threatens to undermine his appeal to the universal acceptance of PO as *prima facie* evidence of its veracity. Earlier in the work, Aristotle characterizes his predecessors in a different and apparently conflicting way from how he characterizes them in our passage above. He says:

> The principles must be either one or more than one. If one, it must be either motionless, as Parmenides and Melissus assert, or in motion, as the physicists hold, some declaring air to be the first principle, others water (184b15–18).[10]

Here Aristotle says that Parmenides believes that there is just one principle. He also tells us that a certain natural scientist, Thales, believes that there is only one principle, water. Yet in the passage above, we see that Aristotle also characterizes Parmenides as believing that there are two principles, the hot and the cold. And he also characterizes Thales as believing that rarity and density are principles. So, according to Aristotle, Parmenides thinks that there is just one principle and also that there are two principles. Similarly, Thales thinks that there is both only one principle, water, and also that there are two principles, rarity and density. These characterizations are in tension with one another: there cannot be just one principle and also two principles.

This tension is useful for us interpreters because it forces us to think hard about Aristotle's use of 'principle' in *Phys.* I. There is good evidence that Aristotle distinguishes different kinds of principles in this work. First, in *Phys.* I.6, he tells us that his predecessors each believe that there are passive and active principles (189b11–16). By this, he means that his predecessors

[10] Ἀνάγκη δ' ἤτοι μίαν εἶναι τὴν ἀρχὴν ἢ πλείους, καὶ εἰ μίαν, ἤτοι ἀκίνητον, ὥς φησι Παρμενίδης καὶ Μέλισσος, ἢ κινουμένην, ὥσπερ οἱ φυσικοί, οἱ μὲν ἀέρα φάσκοντες εἶναι οἱ δ' ὕδωρ τὴν πρώτην ἀρχήν·

believe that each change occurs when an actor acts upon and so changes some patient (more below). Barring Plato, his predecessors think that some pair of opposites are the active principles and the underlying body is the passive principle. For instance, Thales believes that Socrates comes into being when density acts upon some water.

Second, Aristotle says that his predecessors do not merely search for principles, they also search for elements. This is from *Phys.* I.5:

> Up to this point we have practically had most of the other writers on the subject with us, as I have said already: for all of them identify their elements, what are called principles by them, with the opposites, giving no reason indeed for the theory, but constrained as it were by the truth itself (188b26–30).[11]

I will discuss this passage further below. Here note that Aristotle tells us that his predecessors believe that the elements are opposites. Aristotle's mention of elements is no mere anomaly. In *Phys.* I.2, he tells us that he will structure his inquiry into the principles by examining his predecessors' different theories about how many principles there are and what they are (184a15–22). Yet there he characterizes their inquiry into the principles of nature as an inquiry into the primary constituents and elements of natural beings (184b22–25). Again, in *Phys.* I.6, he claims that his investigation has so far shown that there are either two or three elements (189b27–30).

So in *Phys.* I, Aristotle characterizes his predecessors as accepting each of the following claims about opposites:

1. The principles of nature are opposites.
2. The active principles are opposites.
3. The elements are opposites.

[11] μέχρι μὲν οὖν ἐπὶ τοσοῦτον σχεδὸν συνηκολουθήκασι καὶ τῶν ἄλλων οἱ πλεῖστοι, καθάπερ εἴπομεν πρότερον· πάντες γὰρ τὰ στοιχεῖα καὶ τὰς ὑπ' αὐτῶν καλουμένας ἀρχάς, καίπερ ἄνευ λόγου τιθέντες, ὅμως τἀναντία λέγουσιν, ὥσπερ ὑπ' αὐτῆς τῆς ἀληθείας ἀναγκασθέντες.

(1)–(3) are different claims. Seeing this will ultimately allow us to solve the apparent tension in Aristotle's various characterizations of his predecessors. But this will require a few different steps. First, it requires that we step back and clarify the notions of 'principle', 'element', and a related notion of 'cause'.[12]

2.3 Principles, Causes, and Elements

Element (στοιχεῖον) is the easiest to explain. For Aristotle, an element of a thing is a basic constituent of that thing. It is indivisible into things that are the same form of whatever it is an element of. So, for instance, syllables are the elements of speech. Parts of speech, like words, are divisible into syllables, but syllables are themselves indivisible into further parts of speech. Similarly, the elements of a body are indivisible into further bodies (*Met.* 1014a26–31).

Aristotle offers little formal characterization of the relation 'being an element of'. However, he seems to use it in cases where we would intuitively say that one thing is ultimately built out of certain things that are present in it, e.g. cakes are ultimately built out of the most basic bits of matter. Aristotle does recognize that his predecessors have radically different views about what things are ultimately built out of. For instance, he says that some believe that universal things like genera and differentia are elements of those things they are genera of, e.g. one might claim that the genus animal and differentia rational are elements of Socrates (*Met.* 1014b9–15). In other words, some might think that the genus animal and differentia rational are present in and somehow make up an individual man.

[12]See Mann {66} for a full discussion.

Cause (αἴτια) is harder to explain, but a few simplified remarks will suffice here.[13] In *Phys.* II.3, Aristotle claims that there are four causes, the material, the formal, the efficient, and final cause (see also *Met.* V.2.):

The material cause: "that out of which", e.g. the bronze of a statue (194b23–26).

The formal cause: "the form", "the account of what-it-is-to-be", e.g. the shape of a statue (194b26–29).

The efficient cause: "the primary source of the change or rest". e.g. the artisan, the art of bronze-casting the statue, the man who gives advice, the father of the child (194b29–32).

The final cause: "the end, that for the sake of which a thing is done", e.g. health is the end of walking (194b32–35).

Aristotle thinks that the scientist must cite each of these causes in order to explain why certain (but not all) natural phenomena occur. Consider why a heart pumps blood. The heart pumps blood to all parts of the body, blood which carries oxygen and nutrients. The final cause for why a heart pumps blood is the sustaining and nourishing of a body, i.e. a heart pumps blood in order to sustain and nourish the body.

The efficient cause is the source of this movement, of this pumping. Hearts pump blood through a process of contraction and expansion, which in turn are caused by breathing. So the efficient cause for a heart pumping blood just is the organism who owns this heart.[14]

[13]Interpreters debate whether to translate 'αἴτια' as 'cause', or 'explanation', or 'explanatory factor'. See Freeland {34}, Frede {33}, Hocutt {45}, Moravcsik {70}.

[14]Or perhaps the organism breathing. See Fine {32} for discussion of the efficient cause.

The formal cause for the heart pumping blood will be the essence of the heart, i.e.a heart pumps blood because it is precisely that organ which pumps blood in order to sustain and nourish the body.

Finally, the material cause is the parts which constitute the heart. For it is these various chambers and blood vessels which contract and expand during the pumping of blood, i.e. the heart pumps blood because it is made up of those chambers and vessels which contract and expand when blood is pumped.

Principle is difficult. In non-technical uses 'ἀρχή' can be translated as 'starting-point', 'origin', 'beginning'. Fortunately, we need not try to map Aristotle's various uses of 'principle'. For our purposes, we need only note three things: first, Aristotle thinks that every cause is a principle and *vice versa*. For instance, he says in *Met.* D that "causes can be spoken of in an equal number of ways [as principle]; for all causes are principles" (1013a16–17).[15] Second, every element is a principle and cause of whatever it is an element of. The elements are the material cause and, possibly also, the formal cause, i.e. matter is an element of whatever it is matter of, and a form too could be an element of what it is a form of.[16] Third, not every cause is an element of whatever it is a cause of. For instance, the baker is the efficient cause of the cake. However, since the baker is not present in the cake, the baker is not an element of that cake (See *Met.* 1070b22–26).

[15] ἰσαχῶς δὲ καὶ τὰ αἴτια λέγεται· πάντα γὰρ τὰ αἴτια ἀρχαί.

[16] In *Met.* VII.17, Aristotle argues that form is not an element. Mann {66} claims that Aristotle diverges from his predecessors here, e.g. while they think that, say, the shape of a statue is an element of that statue, Aristotle argues that the shape is present in the statue but is not an element of it. There is no evidence that Aristotle draws such a fine distinction in *Phys.* I.

These few remarks allow us to characterize more clearly our difficulty in interpreting Aristotle's reports of his predecessors. Does Aristotle take his predecessors to claim that opposites are efficient causes, or elements, or somehow both? Since he claims that opposites are active principles, this suggests that the relevant opposites are efficient causes. But since he characterizes his predecessors as searching for elements, this suggests that opposites are material (or formal) causes. What we need is some bridge between active causes and elements, some explanation for why Aristotle presents his predecessors as moving from claims about the former to claims about the latter.[17]

2.4 The Bridge

Here's my suggestion: Aristotle thinks that his predecessors explicitly claim only that opposites are active principles, i.e. efficient causes, but he thinks that this entails the claim that opposites are also elements because of some background assumptions about change.

First, they assume that every change has a product. When we heat up some cocoa and milk, the product is hot chocolate. When we warm up in the sun, the product is warm skin. These products come about by something changing.

Second, they assume that in order for something to change it must be changed by something or other. In other words, they believe that in every

[17] In *Met.* I, Aristotle claims that his predecessors are unaware, or at least unclear, about the distinctions that Aristotle draws between the various causes, and also between cause, element, and principle. So we shouldn't expect him to claim that we can precisely and consistently formulate their various claims about opposites with his very own apparatus. Nevertheless, we should and can expect Aristotle to clarify what he himself endorses when he endorses PO, the claim he attributes to all his predecessors.

change there is both something that is acted upon, *a patient*, and something which acts upon that patient, *an actor* (More below).

Third, they assume that an actor brings about a change in a patient by causing that patient to possess that very feature or part that the change is directed towards, e.g., if a dolphin is becoming hot, this is because some actor is causing the dolphin to become hot. Similarly, if Socrates is turning pale, this is because some actor is causing him to become pale.

Fourth, Aristotle's predecessors assume something about the nature of that feature the actor causes the patient to possess. Namely, this feature must be one of a pair of opposites, e.g. the heat some hot water transfers to a dolphin is one of a pair of opposites.

Fifth, they believe that the active cause ends up as an element of the product of the change. For instance, Thales thinks that a dolphin is made from density acting upon water. Aristotle thinks that Thales should also thereby accept that density is an element of that dolphin. So, according to Aristotle, Thales must think that by density acting upon a patient, density ends up as an element of the resulting product, of that dolphin.

Above, I outlined an apparent tension in Aristotle's characterizations of his predecessors, and I suggested a reconciliation to that tension: Aristotle sees his predecessors as moving from claims about efficient causation to claims about the elements of natural beings. I asked what licenses this move, and outlined the assumptions I think lie behind it. How do these assumptions help?

Consider how some natural philosophers think that density and rarity make natural beings out of one underlying body, air, water, or fire (187a11–16). This claim could mislead us. We may think that it says only that density

acts upon water to make a dolphin, and so we may also think that density is in no way an element of that dolphin. Similarly, when a baker makes some bread out of some dough, the baker constitutes no part of the the resulting bread. So we may think that if density is the active cause of this change, then it could not also be an element of the product of this change. However, Aristotle's predecessor, Thales, assumes that the resulting product, a dolphin, is a product of both the water and density, of both the patient and the actor.

I do not claim that Aristotle's predecessors were aware that they were treating opposites as elements. But I claim that Aristotle thinks that, given their own commitments, they were treating opposites as elements. Consider again this passage:

> Up to this point we have practically had most of the other writers on the subject with us, as I have said already: for all of them identify their elements, what are called principles by them, with the opposites, giving no reason indeed for the theory, but constrained as it were by the truth itself (188b26–30).[18]

Aristotle says that his predecessors suppose that the elements are opposites, but do so without argument. Perhaps Aristotle means that they were aware of this supposition, but that they did not argue for it. He may also mean that they were unaware of this supposition. This is not unlikely. We regularly do not understand exactly how we make something. For instance, suppose that I am making a chocolate cake. I might report that the ingredients are flour, eggs, and chocolate, and I might also report that in order to mix these ingredients together I had to add water to them. An expert baker watching me bake will understand that water is an ingredient of my cake. I may not

[18] μέχρι μὲν οὖν ἐπὶ τοσοῦτον σχεδὸν συνηκολουθήκασι καὶ τῶν ἄλλων οἱ πλεῖστοι, καθάπερ εἴπομεν πρότερον· πάντες γὰρ τὰ στοιχεῖα καὶ τὰς ὑπ' αὐτῶν καλουμένας ἀρχάς, καίπερ ἄνευ λόγου τιθέντες, ὅμως τἀναντία λέγουσιν, ὥσπερ ὑπ' αὐτῆς τῆς ἀληθείας ἀναγκασθέντες.

have realized that I was using water as an ingredient. Nevertheless, that's what I was doing.

Similarly, we can reconcile the tension in Aristotle's various characterizations of his predecessors' views of the principles if we take Aristotle as offering a diagnosis: his predecessors were unaware that they were treating opposites as elements, e.g. Thales explicitly claims that water is the only element, but since he believes that density and rarity are active causes, he should also, given certain background assumptions, say that rarity and density are also elements.

Admittedly, I have not shown that mine is the only way of reconciling this tension. But it does, at least, explain why Aristotle is both keen to emphasize that his predecessors (except for Plato) think of the opposites as active principles and why he says that his predecessors also think of these opposites as elements. Aristotle must be focusing on some relationship between the causal processes involved in each change and the elements of the product of each change.

2.5 Changes Occur Between Opposites

After telling us that his predecessors accept PO, Aristotle turns to offer an independent argument for PO. This argument has three steps. First, Aristotle speaks about causation. Second, he applies what he says about causation generally to change. Third, he defends this application by discussing some putative counter-examples. I will discuss each stage of Aristotle's argument in turn. Before I do so, it will be useful to sketch Aristotle's strategy as I understand it.

Most interpreters recognize that Aristotle believes that all change in-

volves an actor acting upon some patient.[19] Some of these interpreters, like Sarah Waterlow and David Ebrey, observe that, for Aristotle, actors are limited in what changes they can bring about in some patient. Hot water can warm up a dolphin, but hot water cannot teach music to a small child. Similarly, they think that patients are limited in the various ways they can be acted upon. A dolphin can be warmed up by some hot water, but a dolphin cannot be taught music by a music teacher. According to Waterlow and Ebrey, Aristotle thinks that patients have various features which explain why they can be acted upon and changed in certain ways and not others.

In *Phys.* I.5, Aristotle argues that these various features must be opposed to those features an actor causes the patient to possess. He then infers PO from this claim. Let me illustrate this with an example.

Suppose that you wish to warm up some chocolate brownies. What must brownies be like if they are to be acted upon in this way? Suppose that we discover that it is only cold things that can be acted upon by warm things, that only cold things admit of being acted upon in this way. We may conclude that it is being cold that explains why the brownie can be acted upon by a hot actor. This is not primarily a point about what changes occur between, a point about how a brownie must first be cold before it becomes hot. This is primarily a point about what an object must be like if it is to be acted upon by something in a certain way, i.e. about what a brownie must be like if it is to be acted upon and warmed up by some hot actor. However, this point is related to a claim about the structure of change. For if a patient must be cold in order to be heated up by a hot actor, then that patient will become hot from being previously cold.

The difference between these two claims is perhaps difficult to see. How-

[19]Waterlow {84, c. 1} and Ebrey {31}. See also Kelsey {54}.

ever, they do have different structures:

1. Being cold (and only being cold) explains why a cold brownie can be heated up by a hot actor.
2. A brownie becomes hot from previously being cold.

Claim 1 is a claim about a patient and an actor. It states an explanation for why a patient can be changed by some actor. Claim 2 makes no mention of actors at all. Some theorist may accept claim 2 without accepting 1, e.g. they might think that a brownie can change its temperature without being caused to change its temperature. However, claim 1 entails claim 2. If only cold things can be warmed up by hot things, then anything which is warmed up will become hot from previously being cold. I think this is exactly how Aristotle argues for PO. He thinks that 1 type claims are fundamental and explanatory of 2 type claims. I turn now to defend this sketch by examining the three different stages of the argument.

2.6 The First Stage: Actors and Patients

In the first stage of his argument, Aristotle claims various things about the actors and patients involved in any change:

> (a) We must first assume that nothing is naturally such as to do or suffer any chance thing by the agency of any chance thing, (b) nor does anything come from just anything, unless you consider coincidents (188a31–188a34).[20]

In (a), Aristotle makes two claims: (i) no actor is such as to do a chance thing, and (ii) no patient is such as to suffer some chance thing. In (b), Aristotle

[20] ληπτέον δὴ πρῶτον ὅτι πάντων τῶν ὄντων οὐθὲν οὔτε ποιεῖν πέφυκεν οὔτε πάσχειν τὸ τυχὸν ὑπὸ τοῦ τυχόντος, οὐδὲ γίγνεται ὁτιοῦν ἐξ ὁτουοῦν, ἂν μή τις λαμβάνῃ κατὰ συμβεβηκός·

connects (i) and (ii) to a claim about the structure of change, a claim which we will see is PO. So Aristotle thinks that (i) and (ii) are connected to PO, but he does not state the connection. It is worth dwelling on this omission. Aristotle motivates his argument for PO by drawing some intimate connection between the *termini* of change and the nature of actors and patients. Indeed he argues from claims about the latter to some claim about the former.

Some readings of Aristotle's argument for PO ignore this argumentative strategy. As I discussed in the introduction, William Charlton thinks that, for Aristotle, PO is a logical doctrine. By this, Charlton means that Aristotle argues for PO from claims about how we think and speak about change. This interpretation ignores how Aristotle supports PO by considering the nature of actors and patients, which is hardly equivalent to a claim about how we think and speak about change. Instead of ignoring the fact that Aristotle draws a connection, we need to identify and correctly characterize it. To this, I now turn.

In both (i) and (ii), Aristotle mentions a chance thing. By 'chance thing', Aristotle means something which does not occur always or for the most part (196b10–14).[21] For instance, when I walk to the store, I do not always meet a student who wants to discuss their latest paper. So when I did walk to the store and met a student who wanted to discuss a paper, this was a chance occurrence. In contrast, when I teach, there are students who are learning. This is not a chance occurrence. It happens always or for the most part that when a teacher teaches, there are students who are learning.

There is much to be said about how Aristotle understands chance occurrences, but while a detailed treatment is not needed here, it is important

[21] Πρῶτον μὲν οὖν, ἐπειδὴ ὁρῶμεν τὰ μὲν ἀεὶ ὡσαύτως γιγνόμενα τὰ δὲ ὡς ἐπὶ τὸ πολύ, φανερὸν ὅτι οὐδετέρου τούτων αἰτία ἡ τύχη λέγεται οὐδὲ τὸ ἀπὸ τύχης, οὔτε τοῦ ἐξ ἀνάγκης καὶ ἀεὶ οὔτε τοῦ ὡς ἐπὶ τὸ πολύ.

to note the following: the difference between a chance and a non-chance occurrence is not merely a statistical one.[22] For we may think that it just so happens that when I walk to the store, I rarely meet students who wish to discuss their papers. And so we may think that if I did happen to meet students always or for the most part when I walk to the store, then this would be a non-chance occurrence. However, Aristotle would still judge the latter event a chance occurrence. For him, the difference between a chance occurrence and a non-chance occurrence is not merely a statistical one. He also thinks that there is some relation between the co-occurring events that explain their correlation. So, for instance, we can explain why it happens always or for the most part that there are students who learn from me when I teach. By its nature, teaching is a relational activity, an activity that requires both a teacher and a student. This explains why it so happens that when a teacher performs this activity there are students who are learning. In contrast, even if I met students every time I walked to the store, nothing about the nature of walking to the store explains this correlation. Hence the correlation is still a chance occurrence for Aristotle. It is important to understand this when interpreting (i) and (ii).

In (i), Aristotle claims that actors are not such as to do chance things. By this, Aristotle does not mean that an actor never does a chance thing. For instance, doctors do sometimes build houses. But this is only a chance occurrence: doctors do not always or for the most part build houses. Aristotle's point is that an actor is not *such* as to do a chance thing. This 'suchness' refers to a feature of the actor which explains why actors of that type always or for the most part perform certain types of actions. Sarah Waterlow explains this point nicely:

[22]For discussion, see Meyer {69}.

> By 'any chance thing' he [Aristotle] means a thing such that its role in a given situation might just as well have been filled by anything else. This is precisely what would be true of everything if nothing had any intrinsic character determining the changes it undergoes or produces. A given agent or patient can of course be described in terms denoting properties that are irrelevant ('accidental'), but there would not be an agent and patient acting and being acted upon unless they were also truly describable in terms of characteristics in which the causal relationship is grounded.[23]

Here is an example: One person, say Galen, can have many skills, he can be both a doctor and a house-builder. But only one of these skill sets explains why Galen can build houses, being a house builder. There is no mere statistical correlation between being a house-builder and having the ability to build houses: someone is a house-builder because they have the ability to build houses.

Similarly, in (ii), Aristotle says that patients are not such as to suffer a chance thing. By this, Aristotle does not mean that a patient never suffers a chance thing. For instance, doctors do get sick and receive treatment from other doctors. When a doctor is treated by a colleague, the doctor is treated as a medical patient. But a doctor being treated as a medical patient is a chance event: doctors are not always or for the most part treated as medical patients, i.e. not every medical patient is also a doctor.

What Aristotle does mean is that the patient is not *such* as to suffer a chance thing. This means that, say, medical patients possess some features which explain why they always or for the most part can be healed by a medical doctor. This feature is not being a medical doctor: while Galen is himself a medical doctor, it is not this which explains why he can be treated by his peers. Rather, Galen can be treated because he is, for instance, a sick medical patient. There is no mere statistical correlation between being a sick

[23] Waterlow {84, p. 6–7} See also Ebrey {31}.

medical patient and being able to be treated by doctors. One is defined in terms of the other.

2.7 The Second Stage: Applied to Change

In the second stage of the argument, Aristotle applies these general claims about causation to change: a changing being is not such as to change in chance ways.

> (a) We must first assume that nothing is naturally such as to do or suffer any chance thing by the agency of any chance thing, (b) nor does anything come from just anything, unless you consider coincidents. (c) For how could the pale come from the musical, unless the musical were a coincident of the not pale or the dark? (d) Rather, the pale comes from the not pale, and not from any not pale, but from the dark or something in between. And the musical comes from the not-musical, and not from any not-musical, but from the unmusical, or from something in between (if there is something in between). (e) Nor, on the other hard, does anything perish into the first chance thing, for example, (f) the pale does not perish into the musical, unless it does so coincidentally, for the pale perishes into the not pale, but not into what happens not to be pale but into the dark or something in between (188a31–188b6).[24]

In (b), Aristotle applies the claim about causation in (a) to change, and in (c)–(f) he defends this application by discussing some example changes. This application and its defense raise two questions: how exactly are the causal claims related to a claim about change, and just how exactly do these examples support the application?

[24]ληπτέον δὴ πρῶτον ὅτι πάντων τῶν ὄντων οὐθὲν οὔτε ποιεῖν πέφυκεν οὔτε πάσχειν τὸ τυχὸν ὑπὸ τοῦ τυχόντος, οὐδὲ γίγνεται ὁτιοῦν ἐξ ὁτουοῦν, ἂν μή τις λαμβάνῃ κατὰ συμβεβηκός· πῶς γὰρ ἂν γένοιτο λευκὸν ἐκ μουσικοῦ, πλὴν εἰ μὴ συμβεβηκὸς εἴη τῷ μὴ λευκῷ ἢ τῷ μέλανι τὸ μουσικόν· ἀλλὰ λευκὸν μὲν γίγνεται ἐξ οὐ λευκοῦ, καὶ τούτου οὐκ ἐκ παντὸς ἀλλ' ἐκ μέλανος ἢ τῶν μεταξύ, καὶ μουσικὸν οὐκ ἐκ μουσικοῦ, πλὴν οὐκ ἐκ παντὸς ἀλλ' ἐξ ἀμούσου ἢ εἴ τι αὐτῶν ἐστι μεταξύ. οὐδὲ δὴ φθείρεται εἰς τὸ τυχὸν πρῶτον, οἷον τὸ λευκὸν οὐκ εἰς τὸ μουσικόν, πλὴν εἰ μή ποτε κατὰ συμβεβηκός, ἀλλ' εἰς τὸ μὴ λευκόν, καὶ οὐκ εἰς τὸ τυχὸν ἀλλ' εἰς τὸ μέλαν ἢ τὸ μεταξύ.

2.7.1 From actors and patients to PO

The first question may seem particularly puzzling. Suppose a philosopher believes that all changes are uncaused, that an object becomes warm without there being any cause of its becoming warm. Now suppose Aristotle wishes to convince this philosopher that this object must have been previously cold before becoming warm. Aristotle could not convince his interlocutor by any general appeal to causation. However, this is clearly Aristotle's strategy. He moves from some general claim about causation to a general claim about what changes occur between. The question is what relation he sees between these claims.

We can begin answering this question by considering what Aristotle means by a chance change. Here is an example: suppose that when a doctor treats a group of patients, different patients change in many unpredictable and different ways. One patient becomes musical. Another patient becomes an architect. Another grows tall. Another becomes hungry. All of these changes would be instances of a medical patient changing in a chance way. For it does not happen always or for the most part that a medical patient becomes an architect, or becomes musical, or becomes hungry, etc. In contrast, medical patients always or for the most part become healthy. So when a medical patient regains her health, this is a non-chance change.

Of course, Aristotle does believe that changing beings can change in chance ways. For instance, a pale student can learn music. But Aristotle's claim is that changing beings are not such as to change in non-chance ways. By this, he means that there is an explanation as to why certain types of changing beings can change in certain ways. For instance, there is no mere correlation between being a musical student and being able to become a mu-

sician: this correlation is explained by the fact that, by definition, music students can learn music.

Our answer to our first question, then, is that the claim that changing beings are not such as to change in chance ways is entailed by the claim that patients are not such as to be acted upon in chance ways. For instance, a brownie has various features which explain why it can be acted upon and affected in non-chance ways. But these various features also explain why it can change in non-chance ways: the explanation for why a brownie can be *changed* in non-chance ways by some actor also explains why that brownie can *change* in non-chance ways.[25]

This is not yet an argument for PO. Aristotle needs to argue from the claim that changing beings are not such as to change in non-chance ways to the claim that change always occurs between opposites. According to Gail Fine and Terence Irwin, his argument turns on a particular view of the properties which ground the ability of a being to change:

> If something that was pale and nonmusical becomes musical, it does not do so because it was previously pale, or because it was nonmusical in some other way; in order to become musical, it must have had the right sort of contrary (or intermediate) property that made it capable of the relevant change (in this case it must have been unmusical).[26]

Fine and Irwin agree that PO is not some mere logical doctrine. They think that Aristotle is interested in how a being can come to possess a certain opposite, how a dolphin can become warm, how Arion can become a musician. They think that, for Aristotle, the ability of a being to become F is

[25]Irwin {48, p. 70} explains this as follows: "Aristotle assumes that every becoming is the causal influence of one thing on another, and that every case of causation involves something non-random; if x causes y, there is some general law relating types of which x and y are token."

[26]Irwin and Fine {49, p. 85}

explained by the fact that this being initially possesses the opposite of F (or some intermediate), being cold explains why a dolphin can be warmed up, being unmusical explains why Arion can learn music.[27] This, of course, entails PO. I think this reading is on the right track. However, Fine and Irwin think that the relevant abilities are abilities to become, e.g. hot. This description of the ability makes no reference of actors or patients, and so leaves unexplained why Aristotle begins his argument for PO by claiming that his first assumption is one about actors and patients.

We can modify Fine's and Irwin's reading to explain how this assumption figures in the argument for PO. Aristotle's focus is not merely on the ability to become F, but on the ability to be made into an F. For instance, his focus is not merely on the ability to become warm, but on the ability to be warmed up. His focus is not merely on the ability to become musical, but on the ability to be taught music.

On this modified reading, Aristotle makes an assumption about the explanation not merely for why beings can change in various ways, but why patients can be acted upon in various ways. Namely, Aristotle is assuming that it is possessing the opposite of F which explains why a patient can be turned into an F by some actor.

Consider a dolphin. A dolphin can be warmed up by some warm water, but the number 4 cannot be acted upon in this way. Why can a dolphin be heated up while the number 4 cannot? The suggestion that I've developed here is that, according to Aristotle, it's being cold that explains why the

[27]Irwin once held a different view. He says, "Aristotle might insist that only those unmusical things that are also capable of becoming musical are suitable termini of a change resulting in something's being musical; the demand for contraries and intermediates will then be simply a symptom of the demand for reference to the appropriate potentialities. But though potentiality and actuality are prominent in later books of the *Physics* (*cf* 191b27, 193a31-b8), he omits them here. He simply appeals to common sense, citing ordinary ways of speaking about contraries and intermediates." Irwin {48, p. 510, n. 64}.

dolphin can be heated up and turned warm. This entails that the dolphin will become warm from being previously cold. And so, in general, the claim that the opposite of F grounds the ability of a being to become F entails PO.

2.7.2 Defense of application

Of course, we may doubt that it is possessing the opposite of F that explains why a being can be appropriately acted upon and become F. Aristotle himself will raise worries for this claim in *Phys.* I.6 and ultimately modify it (see Ch.3). But he does offer some small defense in our target passage: he argues that some other candidates fail to play this explanatory role, namely, contradictories fail to play this explanatory role.

Contradictories are such that a being must possess one of them, but never both together. However, unlike opposites, this claim is not restricted to certain kinds of beings. For instance, the hot and the not-hot are contradictories. Each being, it seems, must be either hot or not-hot. However, the opposite of the hot is the cold, and it is not the case that each being must be hot or cold. For instance, we might say that the number 4 is not hot, but we would not say that it is cold.

Aristotle is right to consider contradictories here. After all, it *always* happens that the pale comes from the not-pale, e.g. only not-pale things can be acted upon and turned pale. There are many examples of these kind of occurrences, e.g. coincidental changes are always also examples of change between contradictories. Aristotle defines 'coincidental' as follows: 'A thing is said to be coincidental if it may, but equally may not, be an attribute of something, or if, in order to define what it is, you have to mention what it

is an attribute of' (186b18–20).[28] For instance, unmusical men become pale, hot things become straight. When the musical becomes pale, since the musical is not-pale, the not-pale becomes pale. Similarly, when the hot becomes straight, since the hot is not-straight, the not-straight becomes straight. So every coincidental change is a change that occurs between contradictories, e.g. the stick changes from being not-straight to being straight.

Nevertheless, Aristotle does not think that contradictories can fully explain why changing beings can change in non-chance ways. For instance, being not-pale fails to explain why not-pale things can become pale. To see this, consider the following: the not-pale is either nothing at all or the not-pale is some other feature, e.g. the musical, or the round. And these cannot explain why a being can become pale. For instance, the number 4 is not pale. But the fact that the number 4 is not pale does not explain why the number 4 can be acted upon and made pale. For the number 4 cannot become pale at all. So if the mere absence of pallor could explain how beings can become pale, then everything can be appropriately acted upon and turned pale. But this is absurd, and so Aristotle claims that change does not occur between every pair of contradictories but only between contradictories that are also opposites.

2.8 Third Stage: Problem Changes

Aristotle's choice of music lessons and sun tans are good examples of the general claim that changes occurs between opposites. But Aristotle anticipates that his reader will doubt whether all changes occur between opposites. To

[28] συμβεβηκός τε γὰρ λέγεται τοῦτο, ἢ ὃ ἐνδέχεται ὑπάρχειν καὶ μὴ ὑπάρχειν, ἢ οὗ ἐν τῷ λόγῳ ὑπάρχει τὸ ᾧ συμβέβηκεν.

address this concern, he turns to discuss some hard cases:

> The same holds of all other cases: even things which are not simple but complex follow the same principle, but the opposite state has not received a name, so we fail to notice the fact. For it is necessary that the ordered should always come from the disordered, and the disordered from the ordered, and the ordered should pass away into the disordered, and not just any chance disorder, but the disorder opposed to this order (188b8–15).[29]

In this passage, Aristotle says every change occurs between opposites even though we are unable to name the opposites that certain changes occur between. This is a strong claim that requires a good argument. Aristotle is imagining his reader pointing to certain changes and claiming that there is no linguistic or observable evidence that these changes occur between opposites. Aristotle responds by saying that there are strong *a-priori* reasons for accepting that all changes occur between opposites and so that, despite the lack of linguistic or observational evidence, these problematic changes do in fact occur between opposites.

Let us suppose that when we assemble a jigsaw puzzles we order all the pieces together: once put together, the jigsaw pieces stand in some order. Before being put together, the jigsaw pieces lay haphazardly in the puzzle box. Aristotle claims that the jigsaw pieces must have been in some initial disorder and that this disorder is the opposite to the way we ordered them (or some intermediate between the disorder and order). The difficulty is why anyone should accept that this disorder is really opposed to the attained order.

[29] ὁμοίως δὲ τοῦτο καὶ ἐπὶ τῶν ἄλλων, ἐπεὶ καὶ τὰ μὴ ἁπλᾶ τῶν ὄντων ἀλλὰ σύνθετα κατὰ τὸν αὐτὸν ἔχει λόγον· ἀλλὰ διὰ τὸ μὴ τὰς ἀντικειμένας διαθέσεις ὠνομάσθαι λανθάνει τοῦτο συμβαῖνον. ἀνάγκη γὰρ πᾶν τὸ ἡρμοσμένον ἐξ ἀναρμόστου γίγνεσθαι καὶ τὸ ἀνάρμοστον ἐξ ἡρμοσμένου, καὶ φθείρεσθαι τὸ ἡρμοσμένον εἰς ἀναρμοστίαν, καὶ ταύτην οὐ τὴν τυχοῦσαν ἀλλὰ τὴν ἀντικειμένην.

Aristotle offers little argument. He just insists that disorder, shape, and arrangement and so on have opposites. But one way of appreciating his point is by recognizing how focused he is on the processes involved in an actor acting upon a patient and changing it. Before being assembled, the jigsaw pieces can be acted upon in certain ways but not others. They can be arranged and ordered, but they cannot be made to run. Aristotle assumes that there is some feature that the jigsaw pieces share which explain why they can be arranged and ordered. We can agree with him that this feature has no name. We can also agree that this nameless feature cannot be the mere absence of the relevant order (for not everything which lacks this order can be appropriately ordered). We may not readily agree with Aristotle that this nameless feature must be the opposite of the relevant order. Nevertheless, there is nothing special about this hesitancy. Aristotle offers no argument that it must be the opposite of F which explains why x can become F. This applies to both putting together jigsaw puzzles as well as music lessons. While we might agree with Aristotle that the contradictory of F cannot explain why a being can acted be upon and become F, we might still doubt that it is the opposite of F that plays this role. Aristotle himself will raise worries for this view in *Phys.* I.6. (See Ch. 3).

2.9 A Problem and a Solution

Here I address one problem for my interpretation that will help clarify it. On my reading, Aristotle believes opposites ground the ability of an entity to be made into something new, e.g. a stone's being cold explains why that stone

can be turned into a hot stone.[30] However, we may doubt that opposites can play this role at all. For we may think that things like density, rarity, different shapes and sizes, are very different from the various abilities that they are supposed to ground. For instance, consider heat and the ability to be cooled down; I shall coin the word 'coolable' for this ability. We may think that the property of being hot and the property of being coolable are very different properties altogether. And so we may doubt that being hot grounds the ability of hot things to be cooled down. Similarly, we may doubt that it is being compressed that explains why some compressed soil can be loosened.

However, some philosophers believe that a property like being coolable is, in a way, part of the nature of a property like the hot. For instance, Sydney Shoemaker argues that properties are second order causal powers (and first order causal power are part of their nature).[31] Briefly, Shoemaker claims we must make two kinds of distinctions, a distinction between dispositional and non-dispositional predicates and a distinction between dispositional and non-dispositional properties. He says of dispositional predicates: "Sometimes it belongs to the meaning, or sense, of a predicate that if it is true of a thing then under certain circumstances the thing will undergo certain changes or will produce certain changes in other things."[32] For example, 'flexible' and 'soluble' are dispositional predicates. It is part of the meaning of these predicates that, if they are true of a thing, then under certain circumstances that thing will undergo certain changes, e.g. salt will dissolve when added to water. On the other hand, other predicates like 'square', 'copper' are non-dispositional. Shoemaker claims that "[there are causal powers

[30] I take grounding as a relation that holds between properties and a thing rather than a relation between facts about these properties and things. See Schaffer {75}.

[31] Shoemaker {80}.

[32] Shoemaker {80, p. 255}.

associated with being made of copper – for example, being an electrical conductor. But presumably this association is not incorporated into the meaning of the term 'copper'.'[33] So dispositional predicates ascribe powers while non-dispositional predicates do not seems to ascribe powers.

Nevertheless, Shoemaker argues that this difference between dispositional and non-dispositional predicates does not track a difference between dispositional and non-dispositional properties. For he thinks that what makes apparently non-dispositional properties like copper the properties that they are is the causal powers that they contribute to those things which possess them. He says that "while properties are typically not powers of the sort ascribed by dispositional predicates, they are related to such powers in much the way that such powers are related to the causal effects which they are powers to produce."[34] So Shoemaker thinks that a property like copper contributes causal powers to whatever is copper, e.g. whatever is copper has the power to conduct electricity. And he thinks that "the identity of a property is determined by its causal potentialities, the contributions it is capable of making to the causal powers of things that have it."[35]

There is no need to focus on Shoemaker's claim that the identity of a property is determined by the causal powers it contributes. We may agree that such causal powers bear a relation to the essence of a property but disagree exactly about the relation. What I want to focus on is Shoemaker's interesting suggestion that apparently non-dispositional properties have causal profiles. For it may appear that properties like being pale are causally inert, but it is not obvious that they are.[36]

[33]Shoemaker {80, p. 255}.
[34]Shoemaker {80, p. 256}.
[35]Shoemaker {80, p. 256–257}.
[36]Beere {5, p. 61–63}, making a similar point in his interpretation of *Met.* IX, says "[t]he idea is not that, over and above the ordinary determinate properties of things, we should

Shoemaker's distinction helps ease what may seem an obvious problem for my interpretation of Aristotle. Aristotle moves from claims about what actors and patients are such as to do and suffer to claims about what changing beings are such as to change. These seem very different issues. Actors and patients clearly have causal profiles. It is essential to being a doctor that a person has various abilities to treat medical patients. Similarly, it is essential to being a medical patient that a person has various abilities to be acted upon and healed by a doctor. It is these causal profiles which explain why actors are such as not to act in chance way and patients are such as not to suffer in chance ways. Yet we might worry that being cold, dense, or tall are radically different from the properties associated with being certain kinds of actors and patients. For we may worry that the former properties do not have causal profiles while the latter do. Nevertheless, Shoemaker shows us that things like being dense and hot could have causal profiles. Whether or not we agree with Shoemaker, Aristotle must be entertaining this claim in *Phys.* I.5. For he believes that being cold explains why cold things can be warmed up. This requires that the cold has a causal profile, part of which is the ability to be warmed up.

2.10 A Production Model of Change

In the first part of this chapter, I reconciled Aristotle's apparent conflicting characterizations of his predecessors by claiming that various assumptions lay behind these characterizations. We have seen that various causal as-

also attribute further properties, the powers, that have an extraordinary and indeterminate character. The idea is rather that the familiar qualities of things, which we are accustomed to regard as determinate, already contain an element of indeterminacy, to the extent that they are the powers exercised in changes whose course depends only in part on the power in question. The powers in things are merely some of their determinate actual properties."

sumptions also lie behind Aristotle's postive argument for PO. In this concluding section, I stand back from the text and offer some characterization of these assumptions, which collectively I call a *Production Model of Change* (PMC). PMC comprises the following 3 claims:

A1: For every change C, there exists some actor X and some patient Y, such that the product of C results when X acts upon Y.

A2: If X acts upon Y, then there is some F such that X causes Y to become an F.

A3: If X causes Y to become an F, then F is one of a pair of opposites.

Aristotle repeats A1 throughout the work. For instance, he characterizes the phenomenon that the physicist must explain as follows: 'We can assume that some or all natural beings are being changed; this is clear from induction (185a12–14)'.[37] Aristotle does not just say that natural beings change. He uses the passive 'being changed' ('κινούμενα'). Throughout the work he repeats this claim that whatever changes is changed by something (e.g. 200b28–32, 241b34). What is changed is the patient. What changes the patient is the actor.[38]

Aristotle offers no direct argument for A1, i.e. an argument that could convince someone who did not already accept it. However, he does discuss problematic cases. For instance, he applies A1 to two different groups of changes. For some changes, the actor and patient are distinct from one another altogether, e.g. some warm water acts upon and warms up a dolphin playing in that water. In this case, the actor is external to the patient. For other changes, the actor and patient are the same thing, e.g. when a dolphin

[37] ἡμῖν δ' ὑποκείσθω τὰ φύσει ἢ πάντα ἢ ἔνια κινούμενα εἶναι· δῆλον δ' ἐκ τῆς ἐπαγωγῆς.
[38] See also *Met.* 1032a11–1032a15.

swims, the dolphin is both the actor and the patient. Aristotle recognizes that his reader might doubt whether A1 is satisfied when there is no external actor, e.g. in cases of self-motion. However, he defends the application in *Phys.* VIII as follows:

> It is clear that it is not through some part of the whole being of such a nature as to be capable of moving itself that the whole moves itself: it moves itself as a whole, both being moved and imparting motion through containing a part that imparts motion and a part that is moved (258a22–25).[39]

So when a being moves itself, one part of the being is a patient, the other part an actor. I do not want here to discuss the many questions that Aristotle's views about self-motion give rise to. Rather, I wish only to stress that Aristotle accepts A1 and believes it has unrestricted scope.

A2 raises several questions. First, what is the relationship between the actor and the feature which it imposes upon that patient? We saw that Aristotle's predecessors believe that the actor possesses and transmits this very feature, e.g. the actor which makes some water hot is itself hot. But A2 is absurd if it requires an actor to instantiate the very features it causes a patient to possess. For instance, it would require that a doctor must herself be healthy in order to act upon and cause her patient to become healthy. But many doctors are infected by the patients they try to cure, and, nevertheless, continue to cure sick patients while they themselves are sick. Similarly, it would require that bees which turn pollen into honey are themselves honey, that a baker which turns dough into bread is herself bread, that a beaver which turns wood into a dam is itself a dam, and so on.

[39] δῆλον δὴ ὅτι τὸ πᾶν αὐτὸ ἑαυτὸ κινεῖ οὐ τῷ αὐτοῦ τι εἶναι τοιοῦτον οἷον αὐτὸ αὑτὸ κινεῖν, ἀλλ' ὅλον κινεῖ αὐτὸ ἑαυτό, κινούμενόν τε καὶ κινοῦν τῷ αὐτοῦ τι εἶναι τὸ κινοῦν καὶ τὸ κινούμενον. See Gill and Lennox {39} for Aristotle's understanding of self-motion.

Aristotle has a nuanced view of the relationship between an actor and the feature it causes a patient to possess. While he does not think that a housebuilder must be a house to impose the form of a house upon some material, he does believe that a housebuilder possesses the form of a house. He thinks she possesses the form in her soul, and she does so just because she possesses the knowledge of housebuilding. She then imposes this form through the motions of her instruments on to the materials that she works into a house.[40]

Aristotle also thinks that the the motions of the housebuilder's instruments possess the form of the house without themselves being a house. He explains this by saying that movement of the instruments contains a definition of the relevant product being made (*GA* 734b37–735a4). Similarly, he thinks that heat can be present in a motion without the motion being hot, e.g. heat is present in a doctor's rubbing of a patient's skin even though the rubbing is not itself hot (*Met.* VII.9). How exactly is heat so present? Jonathan Beere explains this point using the following example:

> The relevant motions occur, and occur in just the way they occur, because of *what* the object that is coming into being is. As a sword comes into being, the smith's hammer moves in such a way as to create a long, narrow, flat piece of metal. The goal is reflected in the way the hammer starts and stops, in the angle at which it strikes the metal, how long it goes on striking a particular point, and so forth. An onlooker, especially an expert onlooker, need not ask a smith what he is making in order to see that it will turn out to be a sword.[41]

Aristotle thinks that both actors and their actions possess the form of the product they are creating without thereby being instances of the type of product they are creating. There are two points to emphasize here. First,

[40]There is a delicate question about how Aristotle applies this locomotion. See Bodnar {8} for discussion. For our purposes, we can set aside these complications.

[41]Beere {5, p. 77}. See also Bodnar {8}.

Aristotle believes that the relevant form is present throughout the action. Second, the relevant form's presence explains certain facts about the actor and action. Actors and actions are always certain kinds of actor and actions, e.g. a housebuilder and housebuilding are a different kind of actor and action from a medical doctor and medical treatment. Aristotle seems to characterize types of actions in terms of what they produce, and so types of actors in terms of what they produce. Hence, the presence of the form in the actor and action, in whatever way it is present, explains why a thing is a certain sort of actor rather than another, and why an action is a certain kind of action rather than another.

So Aristotle need not say that the doctor who cures her patient must be healthy herself, nor that bees must be be honey, nor that the baker be bread, or the beaver be a dam. Rather, each works this form into some patient. To do this, they each need to possess this form. However, Aristotle does not think that they always possess the form by instantiating it. This possession is important for explaining facts about the actor and the action. When bees turn pollen into honey, they act in certain ways to do this. The form (account) of honey is present in bees at least in the sense that it is only by reference to this account that we can understand bees as honey makers and some of their actions as honey making.

A3 seems obviously false. Consider building the hull of a sail boat. Let us agree that there is a passive contribution, namely, the timber that we use to build the boat. And let us agree that there is an active contribution, namely, the form of the boat that we will impose upon those materials. Why should we accept that this form is one of a pair of opposites?

We have seen that Aristotle does provide reason for thinking that the form is not one of a contradictory. All I propose to do here is to show that he accepts A3, although slightly modified. This can be seen from *Phys.* I.7. There he claims that for every pair of opposites, one opposite is the form and another opposite is the privation. Let us call the form F and the privation F^-. Aristotle claims that any change that occurs between F and F^- involves F coming to be present or ceasing to be present in some being (191a5–7). For instance, in the opposition hot/cold, hot is the form and cold is the privation. Aristotle thinks that every change in temperature involves heat coming to be present in some patient, or the heat in some patient being destroyed.[42]

Aristotle argues for this claim by saying that there is an account of the form, but not the privation, i.e. of F but not of F^- (191a12–14). This means that (i) there is something such to be F, and (ii) to be F^- is to lack whatever it is to be F in a particular way.[43] For instance, 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.

Concluding: We have seen that Aristotle argues for PO by assuming some background views of the causal processes involved in any change. Most importantly, Aristotle's focus is how a being can be changed by some actor. In *Phys.* I.6, Aristotle raises a problem for PO. Roughly, if change occurs between opposites, then it seems that there must be some third principle that

[42]It is unclear whether coldness is transmitted to the patient in this latter case. Aristotle might mean that we destroy the heat in a being by transmitting coldness to that being. He may also mean that the destruction of heat in a being does not involve the transmission of coldness.

[43]I here follow how Beere {5, p. 82–89} explains this point.

changes. For instance, if changes in the spectrum of temperature always begin with something cool and terminate with something warmer (or *vice versa*), then we should and can ask what it is that changes from being cooler to being warmer. It is this question that *Phys.* I.5 leaves unanswered and is returned to in I.6.

CHAPTER 3

ON THE SUBJECT OF CHANGE: *PHYSICS* I.6

3.1 Introduction

How do you make a nice steaming mug of tea? You begin with some cold water, you heat it up in a kettle over a stove, and you pour the water into your mug. You let the cup brew and the result is something hot, a hot cup of tea. Your cup of tea was made from something initially cold that was heated up over several minutes.

In *Phys.* I.5, Aristotle argued that all changes occur between opposites. This tells us that our hot tea must be made from something cold, that hot things are made from cold things. Similarly, dense things are made from rare things, and dry things are made from wet things. If we had stopped our search for the principles of nature in *Phys.* I.5, we may think that hot things are made from things that are only cold, that dry things are made from things that are only wet. However, according to Aristotle, this *Phys.* I.5 account is incomplete.

He begins *Phys.* I.6 by taking up his conclusion from *Phys.* I.5 that the principles of nature are opposites (see Ch.2). His main goal in *Phys.* I.6 is to raise a problem for this *Phys.* I.5 account: if the only principles were opposites, each changing being would be one of a pair of opposites. But Aristotle thinks that opposites cannot change. For instance, according to the *Phys.* I.5 account, hot things must be made from cold things, and dry things must be made from wet things. But Aristotle argues that coldness cannot be heated up, and wetness cannot be turned dry. There has to be something else, according to Aristotle, which is heated and dried, something which was

initially but not only cold, something which was initially but not only wet. Aristotle argues that this third thing is a principle of nature distinct from those opposites a change occurs between, a principle which can change.

Aristotle calls this third principle the ὑποκείμενον. 'ὑποκείμενον' is the present participle of the verb 'ὑπόκειμαι'. The basic meaning of this verb is 'placed under' or 'lie under', but it has a range of different uses. For instance, it is used in contexts of supplication, i.e., when one person submits to the authority of the other (*Grg.* 510c). It is also used to describe the subject of predication, e.g. that which lies under a predicate. In *Phys.* I.6, Aristotle uses the phrase to describe whatever admits of being changed, i.e. some bronze admits of being sculpted. He argues that opposites do not admit of being changed, and so argues that there must be some principle that is not an opposite that admits of being changed. In what follows, I translate ὑποκείμενον as 'the subject', though, we may also translate it as 'substratum'. So Aristotle argues that opposites cannot be subjects of change, that coldness cannot be a subject of warming, that wetness cannot be a subject of drying.

Aristotle's introduction of the subject as a third principle is crucial for understanding what role, if any, persistence plays in his search for the principles of nature. The arguments for its introduction are highly condensed and Aristotle leaves unstated and unexplained several key assumptions, assumptions which some believe crucially involve claims about persistence. Different combinations of the following four claims are considered candidates for the suppressed assumptions of *Phys.* I.6:

1. Some feature of the subject explains why that subject can undergo certain changes and not others.
2. The subject persists through that change it is subject for.

3. There is an explanation for how a subject persists through a change.
4. There is a diachronic criterion of identity for each persisting subject.

David Ebrey argues that Aristotle's argument assumes only 1.[1] To understand 1, let us recall how Aristotle spoke about actors and patients in the last chapter. We saw that Aristotle believes that doctors and not house-builders are those who cure sick patients. Nevertheless, the very same person, Galen, can be both a doctor and a house-builder. So if we are to refer to Galen in a way that picks him out as an appropriate actor, then we must refer to Galen with the proper expression, e.g. 'the house-builder'. When we describe Galen as a house-builder, we say both that he is identical to a house-builder *and* also refer to what grounds his ability to build houses, e.g. his being a house-builder. Similarly, Ebrey sees Aristotle as searching out those entities which are such as to be acted upon and changed by some actor, where the suchness refers to some feature that grounds its ability to change. He thinks that opposites neither ground this ability nor do they themselves possess it. When we describe a dolphin as a cold thing, we do refer to an object that has the ability to be warmed up. However, we do not also refer to what grounds the ability of that dolphin to warm up. So we need a third principle, a third principle that has by its nature an ability to warm up.

David Bostock thinks that Aristotle assumes 2. He argues that the phrase 'what underlies'—which I translate as 'subject'—is synonymous with 'what persists'.[2] On this reading, Aristotle assumes, but does not explicitly state in *Phys.* I.6, that a necessary condition for x to be a subject of

[1] Ebrey {31}. For Ebrey, explaining how a subject undergoes a change is different from explaining how it persists through a change. According to him, Aristotle remains neutral as to whether the subject persists. And so even if the subject does not persist through a change, Ebrey believes that, for Aristotle, there is still an explanation of how that subject undergoes that change.

[2] Bostock {12, p. 7–8}.

change C is that X can and does persist through C. Since opposites cannot persist through a change, Aristotle concludes that there must be something else which persists through a change. For instance, coldness cannot persist through a warming. So, on this reading, Aristotle concludes that there must be something distinct from both the cold and the hot, something which can survive as it is becoming hot from being cold.

Finally, Sarah Waterlow thinks that the arguments assume 1–4. For instance, she claims:

> A given agent or patient can of course be described in terms denoting properties that are irrelevant ('accidental'), but there would not *be* an agent or patient acting and being acted upon unless they were also truly describable in terms of characteristics in which the causal relationship is grounded.[3]

According to Waterlow, Aristotle believes that changing beings have intrinsic characteristics that determine the changes which they can undergo. However, according to Waterlow, to explain what change a being can undergo requires explaining how a being can persist through that change; to explain how a dolphin can be heated up requires explaining how that dolphin can persist through that heating. Waterlow believes further that claim 3 entails claim 4. According to her, the explanation for how a subject persists is supplied by a diachronic criterion of identity for that persisting subject. The explanation for how a dolphin persists as she warms up is supplied by the diachronic criterion of identity for dolphins.

In this chapter, I will argue against each of these interpretations by examining a key argument in *Phys.* I.6 for the claim that the subject is a third principle. On the new reading I develop here, that argument assumes 1–3. However, I will argue that 3 does not imply 4, and so the argument does

[3]Waterlow {84, p. 6–7}.

not turn on 4. The issue is important. Waterlow assumes that 3 entails 4. Thus she thinks that diachronic criteria of identity play a role in Aristotle's search for the principles of nature and organizes that search. But there are different explanations for persistence, explanations that are different from explaining what the identity through time of any being consists in:

5. There is an explanation for how a subject can survive as it is being acted upon and as it is being changed.

My main goal in this chapter is to show that Aristotle's argument that the subject is a third principle assumes 5, but that this is no evidence that he is also particularly focused on 4. This is not to say that Aristotle has no views elsewhere about 4, or that he need not say anything about 4. But I think 5 is at the fore of Aristotle's thinking about persistence in *Phys.* I and does organize some of his search for the principles of nature.

An outline of what's to come. In Section 3, I outline one key and central argument for the claim that the subject is a third principle in *Phys.* I.6. This argument is highly condensed, and interpreters debate the suppressed assumptions. This provides both a litmus test and a means for illustrating the differences between the various interpretations I just outlined. In Sections 3–5, I argue against the three interpretations I just pointed to, and in Section 6 I develop my new interpretation.

3.2 The Argument for a Third Principle

Aristotle's argument focuses on what can and cannot be made into a new product. In this section, I introduce the argument and discuss three problems for interpreting it, problems that allow us to adjudicate between the

various interpretations outlined in the introduction. The argument comes in this short passage:

> (a) Granted then, that they are a limited number, it is plausible to assume them more than two. (b) For it is difficult to see how either density should be of such a nature to make rarity something or rarity is such to make density something. (c) The same is true of any other pair of opposites; (d) for Love does not gather Strife together and make things out of it, nor does Strife make anything out of Love, (e) but both make a third thing something. (f) Some indeed assume more than one such thing from which they construct the nature of beings (189a21–27).[4]

In (a) Aristotle introduces an argument for the claim that there cannot be only two principles. By 'two principles', Aristotle means those principles he has been discussing in the previous chapter, opposites. In (b)–(f), he states this argument by using two examples of two pairs of opposites, rarity/density and love/strife. In (c) he says that his argument applies to all opposites. So his argument does not turn on any peculiarities of love/strife, rarity/density. Rather, these examples illustrate a general difficulty for the claim that the only principles are opposites.

This difficulty focuses on what entities opposites can make something. In the phrase 'x makes y something', x picks out some actor and y picks out whatever is acted upon by x. But we can understand the phrase 'to make y something' ('ποιεῖν τι') in different ways:

1. x makes y F, where F is some property that y comes to possess.

[4] ἐπεὶ δὲ πεπερασμέναι, τὸ μὴ ποιεῖν δύο μόνον ἔχει τινὰ λόγον· ἀπορήσειε γὰρ ἄν τις πῶς ἢ ἡ πυκνότης τὴν μανότητα ποιεῖν τι πέφυκεν ἢ αὕτη τὴν πυκνότητα. ὁμοίως δὲ καὶ ἄλλη ὁποιαοῦν ἐναντιότης· οὐ γὰρ ἡ φιλία τὸ νεῖκος συνάγει καὶ ποιεῖ τι ἐξ αὐτοῦ, οὐδὲ τὸ νεῖκος ἐξ ἐκείνης, ἀλλ' ἄμφω ἕτερόν τι τρίτον. ἔνιοι δὲ καὶ πλείω λαμβάνουσιν ἐξ ὧν κατασκευάζουσι τὴν τῶν ὄντων φύσιν. Note that we can translate 'ἡ πυκνότης τὴν μανότητα ποιεῖν τι πέφυκεν' as either 'density is such as to do something to rarity', or 'density is such as to make rarity something'. I presume that these two are equivalent. When the hot tea makes me warm it is doing something to me, i.e. warming me up. Similarly, the cold lemonade does something to me by making me cold. See Charlton {23, p. 3}, Ebrey {31, fn. 11, p. 45} for discussion.

2. x makes y into z, where z is numerically distinct from y.

Drinking hot rum is an example of 1. Drinking hot rum makes Arion warm. Sculpting is an example of 2. A sculptor makes some bronze (into) a statue.[5] 1 and 2 seem very different cases. In the first, an entity, Arion, has altered in some way, but the result of this alteration is not some new entity. In 2 an entity, a statue, comes into existence just because another entity, some bronze, is acted upon and changed.

We may think that we must decide between these two cases, that Aristotle must intend one or the other. However, both 1 and 2 can be treated on a par by noting that we often speak of the product of an alteration as a new product, e.g. Theseus makes Arion into a fighter. Arion makes the child into a musician. So we can use a sentence of the form 'x makes y into z' to describe an alteration; however, in these cases, the product is identical to the patient acted upon. So I will assume that Aristotle means that density cannot create something new by acting upon rarity, where 'something new' ranges over the products of both qualified and unqualified changes (see Ch.1 for this distinction): density can neither merely alter rarity, nor can density bring a new entity into existence by anyway acting upon rarity.

The argument Aristotle presents, then, has this structure:

P1 Density is not such as to make rarity into something and *vice versa*.

P2 Rarity and density make some third thing, which is different from each of them, into something. [From P1]

P3 This third thing is part of the nature of beings. [From P2]

There are three problems with this argument, problems which allow us adjudicate between the interpretations outlined in the introduction. First, as

[5] In English we would use a preposition here, i.e. 'the sculptor makes the bronze into a statue.' Greek does not require the preposition.

stated, the argument is invalid. Aristotle invalidly infers P2 from P1, that rarity and density make some third thing into something just because they do not make each other into something. But in order to validly infer P2 from P1, Aristotle must assume that there is some x such that rarity and density make x into something. This is no mere anomaly. A few lines later, Aristotle summarizes the view of his predecessors by saying that "early thinkers made the two [i.e. the opposites] active and the one passive, whereas some recent thinkers say rather that the one is active and the two passive (189b14–16)."[6] These later philosophers are Plato and the Platonists, philosophers Aristotle discusses in *Phys.* I.9. The older philosophers believe that every change involves opposites turning some patient into something. It is apt for Aristotle to discuss this belief only if he thinks it bears on his argument for the claim that the subject of change is a principle of natural beings. If it bears no relation, then it is mysterious why he emphasizes action and passion both here and throughout *Phys.* I (see Ch.2 for citations).

It is unclear why Aristotle assumes this or what he means by it. Perhaps we can imagine a world in which a sphere rotates for eternity yet was never caused to move. Aristotle does not think that this is possible, but he offers no reason why he thinks it is impossible. More importantly, it is unclear why Aristotle speaks about opposites making things at all. Aristotle has been examining different views about the principles of natural beings. These are different views about the kinds of entities involved in any change. But to infer P2 from P1, Aristotle must link the principles of nature with some view about what causes change, a view he does not state in our target passage. So an adequate interpretation needs to identify the missing assumptions

[6] οἱ μὲν ἀρχαῖοι τὰ δύο μὲν ποιεῖν τὸ δὲ ἓν πάσχειν, τῶν δ' ὑστέρων τινὲς τοὐναντίον τὸ μὲν ἓν ποιεῖν τὰ δὲ δύο πάσχειν φασὶ μᾶλλον.

behind Aristotle's inference from P1 to P2.

The second problem is that Aristotle gives no argument for P1, no argument for why opposites cannot make each other into something. However, this is central to his argument for a third principle. Aristotle does owe us some argument for P1. After all, we do seem to make hot things from cold things. We do seem to make dry things from wet things. So why does he deny that wetness can be dried, or that coldness can be warmed up? He thinks that some requirement must be satisfied if a being is to admit of heat, a requirement that coldness cannot satisfy. An interpretation needs to identify and properly characterize this requirement.

The third and related problem is how to interpret P3.[7] Aristotle does not merely claim that some third thing is acted upon and turned into something. He thinks that this acted upon thing is part of the nature of beings. What does this mean and why does he think it follows from P2?

Here it is useful to look again at 190b17–23, which I discussed in the first chapter. There Aristotle argues that the product of every change is somehow analyzable into the subject of that change and the form which was imposed upon that subject. For instance, a musical man is analyzable into musicality and man. A statue is analyzable into some bronze and the form that was imposed upon that bronze to create that statue. This suggests that Aristotle has been searching out those entities which are parts of the products of certain changes. P3 tells us that he thinks that one of these parts is that entity which is made into that natural being. Since, say, rarity cannot be made into a dolphin while some subject of change can, then that

[7] In (f) Aristotle says that some of his predecessors believe that there is more than one thing acted upon by the opposites. At 189b16–27 he rejects the claim that there is a plurality of things acted upon, but he never rejects the claim that there is one thing acted upon. See Bostock {12, p. 17–18} for discussion.

subject but not rarity is part of the nature of that dolphin.

Each of these three problems is an instance of one general problem: the argument leaves unstated and undefended some key assumptions. This is a problem for Aristotle. His project is to identify the principles of natural beings. That there is a third principle distinct from those opposites that a change occurs between is supposed to be shown by this argument. If the argument's key assumptions can be given no defense, we have little reason to accept its conclusion. This would undermine his overall project.

3.3 Interpretation 1

Our first interpretation of the argument was David Ebrey's, an interpretation that sees no claims about persistence assumed as premises in that argument.

According to Ebrey, opposites cannot change, period. On this reading, neither density nor anything else could make rarity into something because rarity, in virtue of what it is, cannot be changed at all.[8] Neither heat nor anything else could turn coldness into anything because coldness, in virtue of what it is, cannot be changed at all. Ebrey suggests that it is just a category mistake to think that opposites can be changed and made into something new.[9]

Ebrey then takes Aristotle to argue that there is some third thing, something which in virtue of its nature can be acted upon and turned into something new. This third thing can in virtue of its nature be made into something new by rarity. The major upshot of Ebrey's reading is that Aristotle as-

[8]Ebrey {31, p. 49}.
[9]Ebrey {31, p. 50}.

sumes each changing being possesses some nature, a nature which explains why it can be acted upon and changed. It is this nature that opposites lack and the subject of change possesses.

Ebrey's interpretation offers a partial answer to the first problem: how can Aristotle infer P2 from P1? On Ebrey's reading, Aristotle assumes that each change involves an actor acting upon some patient. All that is now required to secure the inference from P1 to P2 is that the relevant actor is an opposite (or possesses an opposite), e.g. that the actor is density (or some dense thing).

However, Ebrey's reading has difficulty with the second problem. He claims that opposites have no ability to be acted upon and so changed. But if Ebrey is to convince us of this claim, he must adequately characterize this ability to be acted upon and changed. For instance, suppose I try to convince you that hot chocolate is unable to perform a handstand. Hot chocolate does lack this ability! And it is easy to explain why. Consider what the exercise of this ability involves. It involves a person holding themselves in an inverted position with their head towards the ground and their feet straight up towards the ceiling. Since hot chocolate has no hands or feet, it is clear why we will never find it exercising the ability to perform a handstand.

Similarly, we can ask Ebrey what the exercise of the ability to be acted upon and changed involves. Unless an answer is forthcoming, he has given us no reason to accept his claim that it is a category mistake to claim that opposites can be acted upon and changed.

Ebrey also offers no answer to the third problem. Surprisingly, when he quotes the passage that contains our argument, he fails to cite the sentence, 'some assume more things, too, and from these they construct the nature of

beings'.[10] This passage suggests that the subject acted upon is part of the resulting product; that when rarity acts upon some subject, that subject is part of the resulting product. This entails that the subject persists through the production: if the milk my hot cocoa is made from is part of that cocoa once made, then that milk persists through the making. Ebrey thinks that persistence plays no role in Aristotle's introduction of the subject of a third principle. So perhaps he ignores this claim because he cannot accommodate it.

This issue is important and I dwell on it for the next several pages. Ebrey thinks that Aristotle's focus is how and why a being can be acted upon and changed. Why can milk be warmed up, but the number 4 cannot? He thinks that explaining why beings can be acted upon and changed does not require that they persist as they are being acted upon and changed. So he thinks explaining how milk can be warmed up neither requires that milk persist as it is warmed up nor requires that there be some explanation of how it persists.

However, Ebrey misconstrues Aristotle's understanding of action and passion. Aristotle does think that in order for x to be acted upon, x must persist as it is being acted upon. And so explaining how something can be acted upon precisely does require explaining how it can persist as it is being acted upon. In order to argue for this point, let me recall the following three claims which together comprise what I called in Ch.2 a Production Model of Change:

A1: For every change C, there exists some actor X and some patient Y, such that the product of C results when X acts upon Y.

[10] Ebrey {31, p. 45}.

A2: If X acts upon Y, then there is some F such that X causes Y to become an F.

A3: If X causes Y to become an F, then F is one of a pair of opposites.

In Ch.2, I discussed one feature of Aristotle's understanding of A2. Not only does he believe that a patient becomes F by some actor making that patient F, he thinks that throughout the change, the actor is making the patient F.

Consider heating. Heating begins when heat starts to be transmitted to some cold patient. Heating is completed when the heat has been so transmitted. In the interim, heat is being transmitted to the patient and the patient is receiving that heat. So the action of heating something up and the passion of being heated up are simultaneous: when one finishes, then so does the other. If actions and passions are simultaneous, then both the actor and patient must persist through the change. Why does it follow? Let me outline the argument before discussing it:

P1 For any action A, there is some actor x who acts.

P2 For any passion P, there is some patient y who suffers.

P3 For any action A, as long as A is occurring x is acting.

P4 For any passion P, as long as P is occurring y is suffering.

P5 For any action A, there is some corresponding passion P such that A and P are simultaneous.

P6 For any passion P, as long as P is occurring there is some actor x acting. (From P1–P5)

P7 For any action A, as long as A is occurring there is some patient y suffering. (From P1–P5)

P1–P4 are straightforward and I assume uncontroversial. P6–P7 follow from P1–P5. The argument turns on P5. P5 does not follow from the previous

premises, and it is controversial. Nevertheless, I think Aristotle both accepts P5 and that this acceptance dictates the particular features of persistence that he is interested in (see the final section).

In Ch.2 I discussed how Aristotle believes that whatever feature the patient comes to possess is imposed by the actor upon that patient. We can see how this claim supports P5 by noting how controversial it is. Consider how a doctor Galen restores a limb to health by rubbing the skin. We may think that rubbing causes friction and, subsequently, heat in that limb and that this heat subsequently causes health. It is natural to think that health is imposed only at the final stage of this process, that health is not being imposed at Galen's first touch.

However, Aristotle disagrees. He does not think that Galen merely imposes some force onto the skin and that this force subsequently causes heat, which in turn causes health. He thinks that Galen imposes health onto the patient throughout his action. So the moment that Galen begins rubbing the skin, he begins to impose that very health the patient will come to possess (see Ch.2).

If we assume that the action of curing begins when the actor begins to impose health upon the patient, and if we assume that the passion of being cured begins when the patient begins to get healthy, then curing and being cured are simultaneous. This may appear a surprising result. Since it is important, I explain why over the next 2 pages.

We may find P5 obviously false if we assume that it expresses the claim that a cause is simultaneous with its effect. Such a claim is in stark opposition to a standard Humean view of causation. Hume argued that causation is reducible to non-causal relations of spatio-temporal contiguity, succession,

and regularity between cause and effect. So he holds that event C causes event E *iff* C is spatio-temporally contiguous to E, E succeeds C in time, and all events of type C (i.e. events that are like C) are regularly followed by (or are constantly conjoined with events of type E (i.e. events like E). On this analysis, C *cannot* be simultaneous with E, i.e. causes are always temporally prior to their effects.[11]

Interpreters debate how Aristotle understands causation and debate how that understanding relates to Humean and post-Humean understandings of causation. While these debates need not concern us here, I wish to stress one way that Aristotle differs from Hume.[12] Later in the *Physics*, Aristotle claims:

> The difference between active and potential causes is that active particular causes exist and cease to exist simultaneously with the effects they cause e.g. this person healing and that person being cured, this house-building man and that house being built. But this is not always true of potential causes for the house and the house builder do not perish simultaneously (195b16–21).[13]

In this passage, Aristotle tells us that an active cause is simultaneous with its effect. My building a house is simultaneous with the house being built. This is a marked difference from Hume. As Jonathan Lear explains, "[o]ne way to characterize the difference between Hume and Aristotle is to say that while for Hume causation must be understood as a relation between two events, for Aristotle there is only one event—a change."[14] Let me illustrate this point with some of Aristotle's examples.

[11]Hume {46, I.iii 14}.

[12]For discussion see, for instance Fine {32}, Frede {33}, Freeland {34}, Hocutt {45}.

[13]διαφέρει δὲ τοσοῦτον, ὅτι τὰ μὲν ἐνεργοῦντα καὶ τὰ καθ' ἕκαστον ἅμα ἔστι καὶ οὐκ ἔστι καὶ ὧν αἴτια, οἷον ὅδ' ὁ ἰατρεύων τῷδε τῷ ὑγιαζομένῳ καὶ ὅδε ὁ οἰκοδομῶν τῷδε τῷ οἰκοδομουμένῳ, τὰ δὲ κατὰ δύναμιν οὐκ ἀεί. φθείρεται γὰρ οὐχ ἅμα ἡ οἰκία καὶ ὁ οἰκοδόμος.

[14]Lear {60, p.31}.

When a teacher teaches a student Greek, a certain event occurs. This one event can be described as a teacher teaching and as a student learning (202a31*ff*).[15] While this event is causal—the teacher teaching brings about a change in the student—this phenomenon is not best analyzed as a relation between two temporally contiguous and successive events: there is not first the event of a teacher teaching and then a later event of the student learning. There is just the one event that is both the teaching teaching and the student learning. So the action of the teacher and the effect of that action—the learning of the student—are simultaneous just because there is one event that is both a teaching and a learning.[16]

Aristotle's view is radical, never more so than when we apply it to locomotion. Aristotle is committed to the claim that a moving object is acted upon for the duration of its motion. For instance, a snooker ball that is moving around the snooker table is being continually acted upon and moved. If nothing caused the ball to keep moving, the ball would stop altogether. This claim violates Newton's Laws of Motion. In particular, it violates the first law which states that every object will remain at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force. In contrast, Aristotle believes that an object only remains in uniform motion as long as it is compelled to maintain its uniform motion, i.e. only as long as it being moved.

Aristotle recognizes his claim is counter-intuitive. In *Phys.* VIII.10, he puzzles about projectiles. He asks how is it that something thrown, like a

[15]Lear {60} and Irwin {47} think there is one event that is both a teaching and a learning. Charles {21} argues that these are two numerically distinct events which are members of an equivalence class. We can set this complication aside. On both readings, the teaching and learning are simultaneous, which is what I want to emphasize here. For ease of presentation, I will continue to speak of there being numerically one event.

[16]Lear {60, p. 32–34} discusses whether to describe this as the claim that cause and effect are simultaneous. See also Shields {78, p. 47–49} for discussion.

spear, continues to move after the thrower lets go of that spear? (266b27*ff*) This is a problem for Aristotle. It appears that the projectile keeps moving even though nothing acts upon and keeps that spear in motion.[17] Aristotle tries to solve the problem by arguing that the thrower also imparts the power to move another thing to some air that spear is in. He thinks that this power is then passed on from one parcel of air to the next as each parcel of air pushes the spear forward. Thus the spear is continually acted upon as it is moved.[18]

I will not try to defend Aristotle's views on motion. At this stage, his mechanics has been superseded. My goal is to emphasize that Aristotle believes that actions and passions are simultaneous, a belief that is central to his mechanics and physics more generally. While this belief may seem counter-intuitive, some observations about English may make it less so: the present indicative of English verbs, e.g. 'act', 'change' are often poor choices for discussing change. The issue is one of aspect. The English present indicative only has perfective aspect, e.g. habitual and simple aspect. In contrast, the English present participle has progressive, or imperfective aspect.[19] So unlike the present participle, the present indicative of English verbs is a poor choice for talking about things which are, well, undergoing.

Consider these sentences: 'the snooker cue hits the white ball' and 'the white ball moves'; 'the snooker cue is hitting (and so moving) the white ball' and 'the white ball is moving, or being moved'. The first set of sentences

[17]Note that this problem arises only when the object is moved by something external to it. A flying bird moves itself when it flies through the sky, but the spear cannot move itself as it moves towards its target.

[18]Waterlow {84, c.IV} discusses the problems Aristotle encounters when trying to identify what she calls a continuing active cause for the motion of those things that do not move themselves.

[19]In Greek the present indicative has both aspects and only attention to context can determine which is being used.

reports actions and changes that have either been completed, or they report actions and changes that are performed regularly. So it is easy to read each sentence as referring to numerically distinct and temporally successive events: the action of one verb is completed and at a later time the action of the other verb is completed. But the latter two sentences do not have this connotation. The event of a snooker cue hitting a white ball cannot be prior to the event of the white ball being hit by the snooker cue. This action and passion are simultaneous with one another.

Ebrey misses these features of Aristotle's views of action and passion. According to him, Aristotle could allow things to be acted upon without persisting through the relevant action. And it is easy to miss Aristotle's particular understanding of action and passion when we use the present indicative of say, 'act'. When we read a sentence like 'Galen acts upon his patient', we might mistakenly direct our attention exclusively to the beginning of his interaction with his patient. To put it another way, it seems that Ebrey focuses only on what is required of a being if an actor is to start acting upon it. But the start of an action is not, for Aristotle, the same as that action. The start of a passion is not, for Aristotle, the same as that passion. So if Ebrey is correct that Aristotle's focus is on the interaction between actor and patient, since the actor acts upon the patient throughout the change, explaining how a patient can be acted upon requires explaining how it can be acted upon throughout the change.

3.4 Interpretation 2

Our second interpretation turns on two claims. The first claim says that the subject must be able to persist through that change of which it is sub-

ject, that whatever subject hot cocoa is made from must persist through this making. The second says that the opposite that the product came from cannot so persist, e.g. while the hot cocoa came from something cold, the cold did not persist.

This interpretation fares poorly with our first problem. It simply ignores Aristotle's claim that rarity and density cannot act upon another and so must act upon something else. So this interpretation cannot explain why action and passion figure in Aristotle's argument for the claim that the subject is a third principle. If his focus is merely persistence, why frame the argument in terms of action and passion?

This interpretation fares better with the second and third problem. The latter first. On this interpretation, the subject must persist through the change, the milk must persist as it is being warmed up. It can then explain why Aristotle thinks that the subject is part of the product of the change, i.e. Aristotle thinks that the persisting subject is one of the elements of the product of the change.

It also fares well with the second problem, for we can at least explain why Aristotle would deny that opposites persist, would deny that coldness persists as you warm up cold milk.

Recall that Aristotle in *Phys.* I.5 argues that changes occur between opposites. For instance, he claims:

> If then this is true, everything that comes to be or passes away comes from, or passes into, its opposite or intermediate. But the intermediates are from the opposites. For example, colors are from pale and dark. Everything, therefore, that comes to be by nature is either an opposite or is from opposites (188b21–26).[20]

[20] εἰ τοίνυν τοῦτ' ἔστιν ἀληθές, ἅπαν ἂν γίγνοιτο τὸ γιγνόμενον καὶ φθείροιτο τὸ φθειρόμενον ἢ ἐξ ἐναντίων ἢ εἰς ἐναντία καὶ τὰ τούτων μεταξύ. τὰ δὲ μεταξὺ ἐκ τῶν ἐναντίων ἐστίν, οἷον χρώματα ἐκ λευκοῦ καὶ μέλανος· ὥστε πάντ' ἂν εἴη τὰ φύσει γιγνόμενα ἢ ἐναντία ἢ ἐξ ἐναντίων.

One way of understanding Aristotle's claim that change occurs between opposites is to understand him as claiming that processes of change occur between opposites. In Plato's *Phaedo*, Socrates explains this difference as follows:

> There is a further point, something such as this about these opposites: between each of those pairs of opposites there are two processes: from the one to the other and then again from the other to the first; between the larger and the smaller there is increase and decrease, and we call the one increasing and the other decreasing. And so there is separation and combination, cooling and heating, and all such things, even if sometimes we do not have a name for the process, but in fact it must be everywhere that they come to be from one another, and that there is a process of becoming from each into the other (71a12–b10; *trans*. G.M.A. Grube).[21]

Let us consider some examples. The sweet and the sour are opposites. But there are also two opposite processes of change between these two opposites. First, there is the process of *souring*, e.g. when milk changes from being sweet to being sour, milk undergoes the process of souring. Second, there is the process of *sweetening*, e.g. when you add sugar to your tea, the tea changes from being sour to being sweet—it undergoes the process of sweetening.

Changings are defined as processes in which certain opposites come to be and perish. For instance, during the process of warming, the cold perishes and the hot comes to be.[22] It follows that opposites cannot persist through those changes which occur between them, e.g. since heating is a process

[21] Τί δ' αὖ· ἔστι τι καὶ τοιόνδε ἐν αὐτοῖς, οἷον μεταξὺ ἀμφοτέρων πάντων τῶν ἐναντίων δυοῖν ὄντοιν δύο γενέσεις, ἀπὸ μὲν τοῦ ἑτέρου ἐπὶ τὸ ἕτερον, ἀπὸ δ' αὖ τοῦ ἑτέρου πάλιν ἐπὶ τὸ ἕτερον· μείζονος μὲν πράγματος καὶ ἐλάττονος μεταξὺ αὔξησις καὶ φθίσις, καὶ καλοῦμεν οὕτω τὸ μὲν αὐξάνεσθαι, τὸ δὲ φθίνειν· Ναί, ἔφη. Οὐκοῦν καὶ διακρίνεσθαι καὶ συγκρίνεσθαι, καὶ ψύχεσθαι καὶ θερμαίνεσθαι, καὶ πάντα οὕτω, κἂν εἰ μὴ χρώμεθα τοῖς ὀνόμασιν ἐνιαχοῦ, ἀλλ' ἔργῳ γοῦν πανταχοῦ οὕτως ἔχειν ἀναγκαῖον, γίγνεσθαί τε αὐτὰ ἐξ ἀλλήλων γένεσίν τε εἶναι ἑκατέρου εἰς ἄλληλα·

[22] Aristotle believes that the perishing of the hot and the coming to be of the cold are one in number. See, for instance, *Phys.* 225a12–20, 229a7–229a30.

which essentially involves the perishing of the cold, then the cold cannot endure the heating of whatever patient is heated up. Similarly, sweetening is a process that occurs between the sour and the sweet. This means that during a process of sweetening the sour ceases to be and the sweet comes to be. So the sour cannot persist through a process of sweetening, i.e. it cannot endure the sweetening of whatever patient is sweetened.

3.5 Interpretation 3

Our third interpretation combines elements of both the first and second. According to Waterlow, Aristotle assumes that some feature explains why the subject can change in certain ways and not others, *and* also assumes that the subject persists. Waterlow crucially sees a connection between both assumptions. She thinks that explaining how a subject can undergo a change requires explaining how that subject can persist through that change, an explanation that she thinks is provided by a diachronic criterion of identity.[23]

Recall here that Aristotle concludes that opposites must act upon some third thing and make it into something. This third thing is the subject of change. Since it can be made into something new, the subject of change is such as to persist through this making. Waterlow believes that this 'suchness' refers to the sortal that the subject falls under, sortals which play two distinct roles. On the one hand, objects that fall under the same sortal will

[23]I assume that Waterlow thinks that explaining how a being can undergo a change is related to diachronic criteria of identity. She does speak of a need to re-identify the cultured man with the uncultured man (Waterlow {84, p. 26}, and speaks about how the individual man must remain a man throughout the change. She thinks that this is central to how Aristotle solves the Eleatic Challenge in *Phys.* I.8. Nevertheless, when she goes on to explain her view in more detail she focuses on the causal processes by which a change comes about in a given subject and stops speaking about identity through time. These are different issues. I don't think that Waterlow sees this, and perhaps this explains why she talks about both issues together.

tend to have the same abilities to be affected and be changed. This is why she claims that sortal membership brings with it internal determinants to change. All objects that fall under a sortal S will possess certain features which determine what changes they can and cannot undergo. Second, these sortals provide a diachronic criterion of identity for objects that fall under them, a criterion that explains how such objects can persist through the change.

We have seen that Aristotle does focus on the first of these two issues, on what changes a being can undergo. He thinks that rarity cannot be made into anything by density, but a subject of change can be so made. So Aristotle does seem to focus on internal determinants of change. Is this sufficient evidence that Aristotle's focus is diachronic criteria of identity? I think not.

On Waterlow's reading an appropriate description of the subject will convey information about what changes that object can undergo. She explains her view by saying this of the appropriate description: 'for a language user of normal experience, the first description on the list provides some indication, however sketchy and incomplete, concerning various possible circumstances under which, and processes by which, the change is likely to have taken place, as well as concerning possible conditions for reversing it.'[24] She thinks that this will normally involve conveying information about various causal powers 'manifested in regularities'.[25] For instance, in order for some clay to be molded into a statue, the clay must be malleable. Waterlow thinks that some description of the clay will convey to us that the clay is malleable. This description will pick the clay out under a relative sortal, i.e. membership of a sortal will specify a set of powers to change and be affected in various

[24]Waterlow {84, p. 25}.
[25]Waterlow {84, p. 25}.

ways. To see how such membership determines the kind of changes that x can undergo, let us distinguish three types of powers:

Identity Entailing Powers: P is an identity entailing power *iff* for any x, if x is P, and P is triggered at t1, then x exists at some other time, tn.

Identity Excluding Powers: P is an identity excluding power *iff* for any x, if x is P, and P is triggered at t1, then x ceases to exist.

Identity Neutral Powers: P is an identity neutral power *iff* for any x, it is not the case that if x is P, and P is triggered at t1, that x exists or fails to exist at other times.[26]

Sortal membership will usually specify mixtures of these types of powers (different sortals will specify different mixtures.) So, for instance, being malleable is an identity entailing power. A piece of bronze will persist as it is being moulded into a statue. The ability to undergo oxidation seems an identity excluding power. For instance, while bronze can undergo oxidation, it is destroyed in this process, i.e. when copper chlorides form. We might consider being able to heat up other things an identity neutral power. Some entities, like water, persist as they pass on their heat to say a cold stone. Others, like matches, do not persist.[27]

It is these powers that determine how a being can be affected and changed. Waterlow's claim is that possession of these powers is explained by sortal membership. So, for instance, she thinks that Arion can be warmed up by the fire he sits at because he is a human being: it is not his being cold, but his being human that explains why he possesses this ability to be affected in this way.

[26] Adapted from Zimmerman {91}.

[27] Here I assume that for a subject to persist through C, the subject must exist both when C begins and when C has been completed.

We may accept that sortal membership is associated with possession of a mixture of powers. The problem for Waterlow is that sortal membership is not the only thing associated with possession of these powers. Consider the ability to displace water. This ability is possessed by Arion, stones, dolphin, and twigs. Their possession of this ability is explained by the fact that each are physical objects with weight. But neither physical object or possessing weight is a sortal that will provide a diachronic criterion of identity.

Often what explains why an object can undergo certain changes is something far more general and less fine grained than the particular sortal that the object falls under. This is a problem for Waterlow. She infers that Aristotle's focus is diachronic criteria of identity just because he focuses on the causal features which determine what changes a being can undergo. But this is a poor inference. The explanation for why bronze and nickel can conduct electricity is not sortal specific. Their being metal explains why they can conduct electricity. But the fact they are metal does not provide a diachronic criterion of identity for either. This is not to say that they don't have such criteria or that they don't persist. They do persist! The point is that the explanation for how they can undergo these changes need have little to do with their diachronic criterion of identity.

Waterlow herself recognizes this problem.[28] She says that there are many descriptions which tell us about the causal processes in which a given change comes about, descriptions which are not at the same time of the substance sortal that changing being falls under. The problem is significant. Aristotle introduces the subject of change as a third principle by considering the causal processes involved in bringing about a change in a patient: density cannot turn rarity into something new, but it can turn the subject of change

[28]Waterlow {84, p. 26}.

into something new. Waterlow tries to identify a rich metaphysical project about persistence from these discussions. But Aristotle's concern is not the metaphysical one of what the identity through time of objects consist in, but the scientific question of how beings can survive as they are being acted upon and being changed.

3.6 Interpretation 4

I will develop my objection to Waterlow by outlining a new alternative interpretation. Waterlow believes the following four claims:

1. Some feature of the subject explains why that subject can undergo certain changes and not others.
2. The subject persists through that change it is subject for.
3. There is an explanation for how a subject persists through a change.
4. There is a diachronic criterion of identity for each persisting subject.

Waterlow assumes that 1–4 are related. She thinks that explaining how a being can undergo a change requires explaining how it can persist. But she also assumes that explaining how it can persist requires providing a diachronic criterion of identity for that persisting being. This is an invalid inference. I too agree that Aristotle assumes 1–3, but I deny that he is thereby committed to 4, or that reading him as being particularly concerned with 4 is helpful for understanding his argument for the claim that the subject of change is a third principle. Why is the inference from 3 to 4 invalid? It is invalid because there is a different kind of explanation for persistence, an explanation that is not provided by a diachronic criterion of identity. I will stand back from the text of *Phys.* I.6 to introduce and clarify this point.

We have seen that, for Aristotle, changes are essentially two sided processes. In every change, there is the action of some actor imposing some feature onto some patient. On the other hand, there is the suffering of the patient that is receiving the relevant feature. So throughout the process of some patient becoming F, there is something acting upon and causing the patient to become F, e.g. the hot water is acting upon the dolphin throughout the process of the dolphin warming up.

This aspect of Aristotle's mechanics and physics more broadly poses dramatic questions about how beings can persist through change, questions that do not arise for philosophers who deny that actions and passions are simultaneous.

Consider how some metal can undergo a process in which it is being hammered into a sword. Throughout the hammering, the metal is being hit, beaten, dented, and shaped. But as the hammer strikes the metal, the metal is not destroyed outright. The metal must be sufficiently firm to retain its integrity as it is being hammered, but not too firm so as to resist the force altogether. Rather, the metal must be such so as the force of the blow is absorbed and distributed across the metal leaving the right kind of shapes and indents while at the same time not destroying the metal outright.

We could try explain how this piece of metal persists as it is being hammered by saying that the initial metal and sword are connected by a spatio-temporal and qualitatively continuous succession of appropriate metal stages. This answer might tell us what the identity through time of this metal consists in. But this answer tells us nothing about the mechanics of persistence. A material scientist will explain in detail how the force can be absorbed and metal changed in the right way. To put it another way, we

want an explanation of how there could be such a continuous succession of appropriate metal stages. Why didn't the metal disintegrate? Why was the force absorbed in exactly the right way? The material scientist will offer us this explanation. They will tell us how the appropriate succession of object stages came about in the first place.

Perhaps it helps here to point to a scenario where a metaphysical explanation for persistence is completely useless. NASA is currently investigating whether it is possible for humans to travel to Mars. It would be incredibly difficult for any human to survive in space for such a long length of time. Their bones become brittle and their bodies generally disintegrate from exposure to different levels of radiation. Now let us suppose that our astronaut Neil does in fact travel to Mars. We might explain this by saying that the Neil who leaves Earth and the Neil who lands on Mars are connected by a succession of spatio-temporal and qualitatively continuous human-stages. If Neil persists, then it is true that there is such a succession. But it should be clear that this explanation is useless to NASA scientists. NASA scientists are investigating how to bring about such a succession of human-stages. What must they build and how must they prepare Neil's body so that this condition can be satisfied?

Mary Louise Gill has come close to making a similar point (though her focus is the middle books of *Met*). She observes:

> One might think that a product, once generated, remains the product that it is until something deprives it of its identity. Just as the acquisition of a positive character requires a productive agent, so the removal of that positive character might seem to require a destructive agent. But Aristotle had a different version. Although he recognized violent destruction as one means of perishing, he also believed in internal decay due to an entity's matter.[29]

[29] Gill {38, p. 212}.

Let us suppose that an oak tree has come into being from an acorn. Once the oak tree has been generated, we might assume, according to Gill, that there are no active causal processes required to keep the oak tree in existence. Rather, the oak tree will continue to exist until something acts upon it and destroys it. Aristotle's understanding of natural beings is very different. Aristotle thinks that all natural bodies are composed of different amounts of earth, air, fire, and water. These elements have different and incompatible natural tendencies to move in different directions.[30] Earth has a tendency to move downwards towards the center of the universe; fire, has a tendency to move upwards away from the center towards the limits of the sublunary realm (beneath the moon); air moves upwards through water but not fire; water rests between earth and air. These different and incompatible tendencies of the elements to move in different directions raise significant questions about how those beings constituted by these elements can persist.

Gill uses Aristotle's discussion of growth to illustrate this point. In *An.* II.4 Aristotle criticizes Empedocles who explains why the roots of plants grow downwards while the plant grows upwards as follows: the roots of plants grow downwards because the earth in plants naturally moves in that direction. The plants grow upwards because the fire in the plant moves upwards (415b28–416a9). But Aristotle argues that this is unsatisfactory: if plants have one part moving downwards and another moving upwards, the plant should be torn apart and destroyed outright. So, as Gill claims:

> Given the behavior of the elemental constituents, a product once generated cannot quietly enjoy the unity that it has achieved, and no external destroyer is needed to bring about its destruction. Instead, composites are always on the verge of annihilation on account of their own lower material properties, and the project of

[30]For instance, see *Phys.* IV.1.

> remaining the same and avoiding decay is one that demands considerable exertion.[31]

Gill goes on to explain how Aristotle thinks that there is something which actively preserves and maintains an organism once it has been generated, i.e. something which causes its cohesion and ensures that it does not disintegrate due to the behavior of the elements in that organism. She describes this cause as enabling 'an entity to retain a high degree of complexity and to offset the process of internal decay.'[32]

Let me illustrate Gill's claim with a very simple example. The Greeks used to consume a drink called a posset, a mixture of wine, barley groats, cheese, and certain drugs. These ingredients do not mix well together. The solids tend to separate out and sink to the bottom. Let us suppose that a posset exists only when the ingredients are suspended in the wine. It follows that any posset that exists is subject to internal decay, i.e. its ingredients tend to behave in ways that cause the drink to cease to exist altogether. In order to counteract this effect, the ingredients must be continually stirred together. So the persistence of the posset is dependent on its ingredients being stirred. And the process of the ingredients being stirred is what Gill calls an active cause of the posset's persistence.

Again, if we wish to know what the identity through time of the posset consists in, then we might say that there is a succession S of spatiotemporally and qualitatively continuous posset-stages. This is an answer to one question about how the posset persists through time. But this is somehow uninteresting. The posset is a drink that can disintegrate at any moment. What we want is an explanation of how there could be an appropriate suc-

[31] Gill {38, p. 213}.
[32] Gill {38, p. 213}.

cession of posset-stages given that the ingredients behave in ways that tend toward the destruction of that drink.

Similarly, for Aristotle, natural beings are constantly under threat. Their composition continually tends towards their destruction, and it is only by bring kept in a delicate homeostasis that they survive at all. When a natural being changes, it undergoes a process in which it is acted upon for some duration of time. If the natural being is to survive this process, it must suitably change while maintaining its delicate homeostasis. For instance, before Arion takes a drink of water, the already existing water in his body is struggling to move downwards through his organs. It is kept in balance by the tendencies of the other elements and Arion's physiology. But when Arion takes a long drink of water, he risks throwing this delicate balance into chaos and literally tearing his body asunder. So, for Aristotle, to explain how Arion quenches his thirst requires explaining how the tendencies of the elements can be kept in balance as new water enters the body.

3.7 Conclusion

If I am right, Aristotle's focus is how beings can survive as they are changed, e.g. how does Arion survive as he is being warmed up by the heat of the fire. Aristotle's account is general. He does not give specific explanations for specific changes. This project would require detailed scientific analysis, e.g. the metallurgist must investigate metals and explain how they can undergo processes like being smelted, the biologist must investigate organisms and explain how they can undergo processes like growing and heating up. These explanations are explanations of how beings persist through change. But we may miss this if we think that explaining persistence is exhausted by pro-

viding persistence conditions for persisting subjects. A medical researcher who tells us how our immune system fends off the common cold is explaining how sick patients persist through their illness. Nevertheless, while this explanation assumes that the person before and after the illness are identical, it will not tell us what unites these stages into one persisting person.

I have yet to give a knock-down argument that Aristotle is uninterested in diachronic criteria of identity and I don't have one forthcoming. My goal is to offer a coherent reading of *Phys.* I.5–8 that identifies exactly what Aristotle says about persistence in these chapters. So far we have seen that he focuses heavily on action and passion. While this focus raises a clear causal concern for how beings can survive as they are being acted upon, it does not by itself show that Aristotle, at this stage, is concerned with the persistence conditions for changing beings. This does not mean that Aristotle is nowhere interested in the latter issue. But it is vital to recognize that this is not his main focus here, vital because we risk missing the interesting questions about persistence that he is interested in and which do feature in his search for the principles of nature.

CHAPTER 4

THE SUBJECT OF NATURAL GENERATIONS IN *PHYSICS* I.7

4.1 Introduction

What are chocolate cakes made of? A recipe will list as ingredients flour, cocoa, baking powder, eggs, and milk. These ingredients are material. Material ingredients may not be the only ingredients of cakes, or of dolphins, or of motorcycles, and so on. Kathrin Koslicki, for instance, thinks that as well as material parts each ordinary object has a form, which "is a kind of recipe for how to build wholes of that particular kind".[1] The form of the cake is a recipe for how things like cocoa and flour can be built into a cake. Similarly, the form of a dolphin is a recipe for how organic matter can be built into a dolphin.

Call the claim that material objects are built out of material and formal ingredients *hylomorphism*. Hylomorphism is one of Aristotle's signature innovations, an innovation that has defenders like Koslicki even today.[2] Aristotle's search for the principles of nature supposedly results in hylomorphism. In *Phys.* I.5, he argued that of all the pairs of opposites, some of these pairs are principles of nature. We saw that for each pair of opposites, he calls one a form and the other a privation. And in *Phys.* I.6 he argued that there is a third principle of nature, a subject that is acted upon and turned into some new product. In *Phys.* I.7, Aristotle argues that the product of each change is made up of two of these principles, of some subject and the relevant form

[1] Koslicki {57, p. 172}.

[2] This is a simple outline of hylomorphism. Some think that some Aristotelian forms are also material. See Whiting {85, c. 4}. Further, while Aristotelian forms are in some way ingredients of individual substances they are not parts of them. See especially *Met.* VII.17, and Koslicki {57}, Mann {66, c. 6} for discussion. These details are not important for what follows, so I set them aside.

that was imposed upon it, e.g. hot chocolate is made up of chocolate and heat, and a bronze statue is made up of both some bronze and some shape.

Aristotle's argument for hylomorphism, then, assumes as a premise the claim that the matter from which a natural being is produced persists, that the cocoa and milk from which hot chocolate is made persist through this making.[3] But Aristotle seems to deny this claim in *Phys.* I.7, the very same chapter in which he seems to use it as a premise in his argument for hylomorphism.[4]

In *Phys.* I.7 Aristotle says that plants and animals come into being from *sperma*, but this seems to be something that is destroyed in the process. After all, the egg from which a dolphin comes into being does not make up that dolphin. So it seems that Aristotle thinks that the matter from which a dolphin is generated is destroyed in the process.[5] So there is a problem at the heart of Aristotle's search for the principles of nature. That search ultimately leads him to articulate and argue for hylomorphism. This argument requires the persistence of matter, yet Aristotle may deny the persistence of that matter natural beings are generated from.

In this chapter, I argue that Aristotle really does accept the apparently bizarre claim that the sperma from which a dolphin is generated persists

[3]The persistence of matter is also a premise in the arguments of contemporary hylomorphists. Koslicki {57, pp. 176–181}, for instance, argues for hylomorphism by asking us to consider a case in which an entity is made from a single preexisting material ingredient, e.g. a statue is made from a single lump of clay. The single lump of clay is a proper part of the statue. Since no object can have only one proper part, Koslicki concludes that the statue must have some other part, a part which she argues is a formal part. This argument assumes that the lump of clay the statue was made from persisted through this process. If this assumption is false, Koslicki's argument for hylomorphism is unsound. For further discussion of Koslicki, see Bennett {6}.

[4]Ebrey {31}, Kelsey {55} have recently denied the standard view that Aristotle argues for hylomorphism in *Phys.* I.7. My concern is whether Aristotle does commit himself to the persistence of matter in that chapter, so I will not concern myself with their challenge.

[5]For other problems with the persistence of Aristotelian matter see Ackrill {1} and Gill {38}.

and is present in that dolphin once generated. This does not solve every problem about the persistence of Aristotelian matter nor does it tell us just how Aristotle argues for hylomorphism (I will not discuss the other premises in that argument). But it does (i) solve a key tension in Aristotle's discussion of both in *Phys.* I.7, and (ii) show that persistence plays a key role in his understanding of the principles of nature. I argue for my reading by examining what Aristotle explicitly says about sperma in his biological works, in particular the *GA*. First, I begin by explaining why the sperma case is so puzzling and arguing against two responses to it, one by William Charlton, the other by Terence Irwin.

4.2 The Sperma Puzzle

Aristotle begins *Phys.* I.7 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).[6]

By this, Aristotle means that he will make some general claims about the principles involved in every change.[7] These principles, as we have seen, are subject (ὑποκείμενον), form (εἶδος), and privation (στέρησις).

Aristotle says that he will speak generally about the principles involved in every change, and he does so by using the example of an alteration, a music lesson. While a music lesson is an alteration, this example is meant to

[6] Ὧδ' οὖν ἡμεῖς λέγωμεν πρῶτον περὶ πάσης γενέσεως ἐπελθόντες· ἔστι γὰρ κατὰ φύσιν τὰ κοινὰ πρῶτον εἰπόντας οὕτω τὰ περὶ ἕκαστον ἴδια θεωρεῖν.

[7] Note that this is different from defining what change is. In *Phys.* III.I, Aristotle explains how 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 {26}, Graham {40}, Kosman {58}.

illustrate what is common to all change, i.e. to both qualified and unqualified change. First, Aristotle claims that we can describe a music lesson in three different ways:

A The man comes to be musical (189b34–35).

B The not-musical thing comes to be musical (189b35–36).

C The not-musical man comes to be a musical man (190a1–5).

He then claims:

> The man, for instance, remains a man and is still a man when he comes to be musical, whereas the not-musical or unmusical thing, either simple or compound does not remain (190a9–13).[8]

Here Aristotle claims two things. First, he claims that the subject persists, e.g. Arion persists. Second, he claims that the subject remains the same kind of thing, e.g. Arion remains a man throughout his music lesson. Aristotle does not explain why remaining a man is more important than, say, remaining snub-nosed. In the previous chapter, I suggested an answer to this question: in every process of change, a patient is continually acted upon by some actor for the duration of that process. I argued that Aristotle introduces the subject of change to explain how beings can be so acted upon, i.e. being a certain sort of subject involves being able to retain certain capacities to be changed as the actor acts upon and so changes it. If that's right, then Aristotle believes that it is by remaining a man that Arion survives as the music teacher imposes their knowledge of music upon him. Being a human is a reasonable explanation for how Arion could be acted upon in this way: being a human involves possessing those cognitive capacities required to assimilate the relevant information as it is being passed down by

[8] ὁ μὲν γὰρ ἄνθρωπος ὑπομένει μουσικὸς γιγνόμενος ἄνθρωπος καὶ ἔστι, τὸ δὲ μὴ μουσικὸν καὶ τὸ ἄμουσον οὔτε ἁπλῶς οὔτε συντεθειμένον ὑπομένει

the teacher and the appropriate physical features and capacities to support music learning, e.g. being strong enough to hold the lyre, not exploding at a certain frequency of pitch, and so on.

Aristotle also commits himself to both claims in a crucial step in his argument for hylomorphism:

> 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 (190b16–23).[9]

Aristotle believes that the product of each change comes about when some form is imposed upon some subject, e.g. warm chocolate syrup comes about when chocolate is heated, a statue comes about when some bronze is appropriately shaped. He concludes two things:

First, he concludes that the product of each change is made up in some way of this 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 191b16, 191a31–32). This first conclusion entails that the subject persists through the production, e.g. the chocolate persists when we make warm chocolate syrup from it, the

[9] φανερὸν οὖν ὡς, εἴπερ εἰσὶν αἰτίαι καὶ ἀρχαὶ τῶν φύσει ὄντων, ἐξ ὧν πρώτων εἰσὶ καὶ γεγόνασι μὴ κατὰ συμβεβηκὸς ἀλλ' ἕκαστον ὃ λέγεται κατὰ τὴν οὐσίαν, ὅτι γίγνεται πᾶν ἔκ τε τοῦ ὑποκειμένου καὶ τῆς μορφῆς· σύγκειται γὰρ ὁ μουσικὸς ἄνθρωπος ἐξ ἀνθρώπου καὶ μουσικοῦ τρόπον τινά· διαλύσεις γὰρ [τοὺς λόγους] εἰς τοὺς λόγους τοὺς ἐκείνων. δῆλον οὖν ὡς γίγνοιτ' ἂν τὰ γιγνόμενα ἐκ τούτων. 'διαλύσεις γὰρ [τοὺς λόγους] εἰς τοὺς λόγους τοὺς ἐκείνων' is difficult. Ross {74, 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. That is, it leaves open whether the subject and form are merely parts of the account of the product, or whether they are also parts of the product.

bronze persists when we make a statue from it.[10]

Second, Aristotle claims 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. Unfortunately, Aristotle says little to explain this point. For our purposes, we need only observe that he thinks that when we explain what a musical man is, we must do so in terms of being musical and being a man. Similarly, when we explain what it is to be a bronze statue, we must do so in terms of what it is to be bronze and what it is to have the form of that statue. This second conclusion entails that the subject must remain the same kind of thing, i.e. it remains that kind of thing which the product will, in part, be analyzable into. For instance, the music student remains a man as she learns music, the very thing that a musical man is in part analyzable into.

So Aristotle seems to accept 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 has told us he will speak generally about change. So 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, we expect that for any change whatsoever, we can identify a persisting subject and that kind of thing the subject remains; the kind the product will be partly analyzable into. However, PER cannot easily be applied to every change that Aristotle discusses, and Aristotle himself may even offer a counter-example to it.

[10] Aristotle is careful not to offer any specific theory of how they are so made up.

After speaking generally about change, Aristotle turns to distinguish qualified change from unqualified change (190a31–33). During an unqualified change, a natural being comes into or goes out of existence, e.g. a dolphin is born. The subject of an unqualified change is what Aristotle calls *matter* (ὕλη; 192a31–32).[11] A natural being comes into existence when the matter comes to possess some form, and that form and matter together make up that new natural being.

In contrast, during a qualified change, no new natural being comes into or goes out of existence, e.g. a dolphin grows larger.[12] The subjects of qualified changes are individual substances, things like men, dogs, trees, etc.

Aristotle's goal is to defend his general claims by showing that they also apply to the harder case of unqualified change (190b1–3). He argues for this by example:

> 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 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 (190b3–10).[13]

Here are the five examples of unqualified changes:

[11]For the purposes of what follows, I use 'matter' for only the subjects of unqualified changes. However, Aristotle does say that, in a sense, the subject of every change is matter. See, for instance, *GC* 320a2–5.

[12]Some believe that a non-natural entity, a kooky object, comes into or out of existence during these change. Code {25, 24} and Matthews {67, 68} argues that Aristotle believes in kooky objects. Shields {77, c. 6} 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.

[13]ἀεὶ γὰρ ἔστι ὃ ὑπόκειται, ἐξ οὗ τὸ γιγνόμενον, οἷον τὰ φυτὰ καὶ τὰ ζῷα ἐκ σπέρματος. γίγνεται δὲ τὰ γιγνόμενα ἁπλῶς τὰ μὲν μετασχηματίσει, οἷον ἀνδριάς, τὰ δὲ προσθέσει, οἷον τὰ αὐξανόμενα, τὰ δ' ἀφαιρέσει, οἷον ἐκ τοῦ λίθου ὁ Ἑρμῆς, τὰ δὲ συνθέσει, οἷον οἰκία, τὰ δ' ἀλλοιώσει, οἷον τὰ τρεπόμενα κατὰ τὴν ὕλην.

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 alteration of some material: Vinegar is produced by altering the water in some wine.[14]

By addition: Growing things, animals, are generated when sperma is added to in some appropriate way.[15]

This lists five 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. Now we expect Aristotle can apply PER to these five types of unqualified changes. Our expectation seems met in four of these five cases.

When we sculpt a statue 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.

When we chisel a statue 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.

When we build a house from some bricks, the bricks are the subject, the bricks persist, the bricks remain brick, and the bricks along with the form of the house makes up that new house.

[14]This suggestion is from Ross {74, p. 493}.

[15]In what follows, I will speak only of animals and ignore plants. Aristotle's botanical works have been lost.

When we turn some water into vinegar, the water is the subject, the water persists, the water remains water, and the water and form of the vinegar makes up that vinegar.

However, it is difficult to apply PER to the fifth case, the generation of animals. Aristotle says that animals come into being from 'σπέρμα'. I will leave this phrase untranslated and use the transliteration 'sperma'. Thus we expect Aristotle to believe 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.

This is puzzling. Let us, for the moment, assume that Aristotle thinks of mammalian eggs as sperma. Socrates comes into being from his mother's egg being fertilized. However, the following claim is false: the egg persists, the egg remains an egg, and the egg along with the form of Socrates makes up Socrates. But this is absurd. The egg is destroyed in the process of being fertilized.

This is a clear difficulty. In the same chapter, Aristotle seems to claim PER and also to give a counter-example to PER. I will present this difficulty as what I call *the Sperma Puzzle*. The Sperma Puzzle 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 while A1 and A2 together do not entail A3, they clearly suggest A3, i.e. that the subject remains sperma throughout the change. Similarly, when Arstotle says that a Hermes is made from stone, there is little reason to deny that he thinks the subject remains stone throughout the change. 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.

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 persist. The second accepts A1 and A2, but not A3. It claims that while the subjects of natural generations do persist, they do not remain sperma.

Neither of these responses examines Aristotle's biological works in detail. This is unfortunate. In the first book of *Generation of Animals*, Aristotle offers a sophisticated view about the nature of sperma. 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.

4.3 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 of all change. He seems to commit himself to PER when doing so. So we expect Aristotle to apply PER to the sperma case.

However, William Charlton rejects this reading of *Phys.* I.7. He denies that Aristotle ever accepts PER. According to Charlton, Aristotle only commits himself to a restricted version of PER:[16]

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.

So Charlton denies that Aristotle accepts PER. According to Charlton, the subject of every qualified change persists, but the subjects of unqualified changes do not. Charlton explains this by saying that even though animals are *made from* sperma they are not *made of* sperma.[17] He generalizes from this example to the claim that while each natural being is made from some

[16]Charlton {23, pp. 70–79}. See also Jones {51}.
[17]Charlton {23, pp. 76–77}.

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 clay is made of. Charlton says little to explain the difference being made from and made of. However, he clearly has in mind the distinction Karen Bennett nicely draws between synchronic and, what she calls, diachronic composition relations.[18] I will use her discussion to clarify Charlton's interpretation.

Bennett argues that synchronic and diachronic composition are two distinct kinds of composition relations. She argues for this claim by considering various examples. Take some flour, yeast, salt, and water. By mixing these ingredients together and baking the resulting dough, you make a loaf of bread. This loaf of bread is composed of the flour, yeast, salt, and water. But these ingredients compose the bread in a different way from how some pieces of wood compose a chair. According to Bennett, the relation between the wood and chair is both a diachronic and synchronic relation. However, the relation between the bread and the yeast, flour, salt, and water is only a diachronic relation.

Bennett argues that diachronic composition and synchronic composition are different relations by considering how the ingredients something is made from are changed when they are made into that new thing. For instance, the flour and eggs are destroyed when you make them into a cake. Similarly, squash and onions are destroyed when you slice and mash them to make butternut squash soup. In contrast, the wood is preserved when you make it into a chair. So the flour and egg *diachronically compose* the bread. But since the flour and egg are destroyed when you make them into bread, they do not *synchronically compose* the bread.[19]

[18]Bennett {7}.

[19]Others have offered controversial examples. Earley {30} claims that atoms are destroyed when they are made into molecules. Burke {17, 16} claims that a piece of bronze is

While Bennett offers further details, her relevant claim for our purposes is that what diachronically composes an entity need not synchronically compose that entity.

Bennett's distinction between synchronic and diachronic composition provides a useful way of stating Charlton's interpretation. He believes that (i) sperma diachronically composes an animal, but the sperma does not synchronically compose that animal. (ii) Nothing else which diachronically composes an animal synchronically composes that animal. Charlton offers three arguments for this reading. Each argument is unconvincing.

Argument 1

Charlton's first argument focuses on the matter that synchronically composes, say, a dog. According to Charlton, if the dog were dissected, no sperma would be found. Thus the dog is not synchronically composed of sperma. His argument has the following steps:

1. A dog is synchronically composed of flesh and bones.
2. It is not the case that a dog is diachronically composed of flesh and bone.
3. A dog is diachronically composed of sperma.
4. Flesh and bones are distinct from sperma. (From 1–3)
5. It is not the case that a dog is synchronically composed of sperma. (From 1&5)[20]

destroyed when it is made into a statue. Similarly, glass is made from lightning striking sand, ash is made from burning wood, and diamonds are made from compressing coal. But there is no sand in the glass, there is no wood in the ash, there is no coal in the diamonds. (Consider whether a clear window is sandy).

[20]Charlton {23, pp. 76–77}.

Claim 1 is meant to be supported by the fact that animals have material bodies that are made up of flesh and bones. Charlton argues for Claim 2 by claiming that flesh and bones do not become a dog. That is, flesh and bone undergo no process of change that brings a dog into existence. Rather, flesh and bones are parts of the product of that process which results in a new dog, i.e. they are parts of the body of the dog. Claim 3 comes from Aristotle's claim that animals come into being from sperma. Claim 4 follows from 1–3: if sperma is identical to x, then sperma should have the various properties of x and *vice versa*. Since bones and flesh never diachronically composed the dog while sperma did, then they must be distinct from sperma. And, according to Charlton, 5 follows from 1–4.

However, premise 1 turns on an important ambiguity. In order for the argument to be valid, we must read 1 as 1*:

1*. A dog is *only* synchronically composed of flesh and bones.

When we read 1 as 1*, the argument is valid. Sperma would then be distinct from each of those things that synchronically composes a dog. But if Charlton intends 1*, then he is mistaken to attribute it to Aristotle. Dogs are also composed of things like organs and blood. Charlton needs to provide an argument that, for Aristotle, sperma is also distinct from each of these things, an argument that he does not provide.

The general problem here is that Charlton assumes that, for Aristotle, sperma is distinct from each of those things that synchronically composes the dog. However, he does not defend this assumption by examining Aristotle's biological works. In these works, Aristotle offers a rich account of both the generation and make up of animals. In the last two sections, I discuss this account and show that sperma is identical to something which

synchronically composes the dog.

Argument 2

Charlton's second argument is the following: sperma is "the factor the disappearance of which makes the change to an animal a coming into existence."[21] According to Charlton, Aristotle distinguishes qualified change from unqualified change by saying that the subjects of qualified changes persist while the subjects of unqualified changes do not. This argument turns on two claims: (i) Unqualified changes and qualified changes are distinct kinds of changes. (ii) What distinguishes one kind of change from the other is that the subjects of qualified changes persist while the subjects of unqualified changes do not.

Claim (i) is uncontroversial. Aristotle does say that he will first talk generally about all change before distinguishing different kinds of change (189b30–32). So we expect Aristotle to tell us how unqualified change differs from qualified change. On Charlton's view, Aristotle satisfies this expectation by telling us that the subjects of qualified changes persist while the subjects of unqualified changes do not (claim (ii)).

Claim (ii) would distinguish unqualified change from qualified change. But 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? Aristotle tells us how they differ as follows:

> (a) A thing is said to come into being in many ways, and (b), in some cases, some things are said not to come into being, but, in these cases, a thing comes to be something; (c) only substances are said to come into being without qualification (190a31–33).[22]

[21] Charlton {23, p. 77}.

[22] πολλαχῶς δὲ λεγομένου τοῦ γίγνεσθαι, καὶ τῶν μὲν οὐ γίγνεσθαι ἀλλὰ τόδε τι γίγνεσθαι, ἁπλῶς δὲ γίγνεσθαι τῶν οὐσιῶν μόνον.

In (a), Aristotle says that change is said in many ways. He distinguishes two different ways that change is said in (b) and (c). This 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 colour. These non-substantial entities are said to come into being insofar as some substance comes to be qualified. 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 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).[23]

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.[24] 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.

[23] κατὰ μὲν τἆλλα φανερὸν ὅτι ἀνάγκη ὑποκεῖσθαί τι τὸ γιγνόμενον καὶ γὰρ ποσὸν καὶ ποιὸν καὶ πρὸς ἕτερον [καὶ ποτὲ] καὶ ποὺ γίγνεται ὑποκειμένου τινὸς διὰ τὸ μόνην τὴν οὐσίαν μηθενὸς κατ' ἄλλου λέγεσθαι ὑποκειμένου, τὰ δ' ἄλλα πάντα κατὰ τῆς οὐσίας·

[24] Unfortunately, Aristotle does not tell us what he means by 'qualities come into being'. The phrase can be understood in at least two different ways. First, when a dolphin warms up, a new entity comes into existence. This could be either some hot object or the property instance of heat which is related to but numerically distinct from that dolphin. Second, 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. I see no way of deciding the issue here, but I do not think we need to. Aristotle does believe that the sentence 'the hot comes into being' and 'the hot perishes' are true, but we can remain neutral about what underlying metaphysics he thinks makes these sentences true. We can be neutral because no understanding of the ontology of qualifications is required to understand his initially plausible distinction between qualified change and unqualified change.

In 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 subject of the former persists, but the subjects of the latter do not. This is compatible with what Aristotle explicitly says. 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. qualifications 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 qualifying the subject of change. In unqualified changes, substances come into being but not by qualifying the subject of change. But while Charlton's interpretation is compatible with what Aristotle says, nowhere in our text does he try distinguish the changes as Charlton suggests.

So Charlton needs to argue that what Aristotle explicitly says entails that the subjects of qualified changes persist while the subjects of unqualified changes do not. I do not deny that some argument might be forthcoming. But some argument is needed.[25]

Argument 3

Finally, Charlton observes that Aristotle does not explicitly say that sperma persists.[26] He is right. Aristotle nowhere explicitly says that sperma per-

[25]Charlton {23, p. 77} does mention *GC* I.4. Some, like Broadie {14} agree that Aristotle in *GC* I.4 distinguishes unqualified change from qualified change by claiming that the subjects of the latter persist, but 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 {22}, Williams {88, pp. 211–219}.

[26]Charlton {23, p. 77}.

sists.

However, this omission is no evidence that Aristotle does not believe that sperma persists. First, Aristotle speaks generally about the subjects of every change. Doing so, he says that the subject persists. Since Aristotle does not explicitly say that sperma persists, according to Charlton, Aristotle somehow retracts his general claims about all change. But there is a more plausible explanation: Aristotle said that in every change the subject persists. After he says that sperma is a subject, he does not explicitly say that sperma persists because doing so would be redundant.

4.4 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 synchronically composed of sperma? Our second 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 A2 and A3:

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 is present in the newly generated animal.

Terence Irwin argues that Aristotle accepts A2, but denies that Aristotle accepts 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. In order to explain Irwin's proposed solution, let me say something about his general interpretation of the chapter. He explains his view 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.[27]

I will call Irwin's interpretation of Aristotle's general claims about change *the intensional reading*. I call defenders of the intensional reading *intensionalists*.[28] 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 (189b34–35).

B The not-musical thing comes to be musical (189b35–36).

C The not-musical man comes to be a musical man (190a1–5).

[27] Irwin {48, p. 88}.

[28] Most accept the intensional reading: Bostock {12}, Waterlow {84}, Charlton {23}, Dancy {29}, Ebrey {31}, Jones {51}, Irwin {48}, Gill {38}, Kelsey {54}, Ross {74}.

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.[29]

Although [A]–[C] describe the same change, intensionalists say that each description says different things about that change. For instance, when we describe the change as 'the unmusical becomes musical' we say that the privation unmusical is possessed by something that becomes musical. But by describing the change in this way, we do 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 to describe a change fully, intensionalists claim that we must use a term that says what the persisting subject is and what it remains.[30]

So intensionalists think that Aristotle's focus is on the full descriptions of the change. In order for a description to be full, it must contain what I call a *D-term*. Let me summarize what a D-term is by stating the following 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.

[29]Quoting [A]–[B], Waterlow {84, 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.

[30]Waterlow {84, 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.'

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).[31] While 'snub-nosed' satisfies N1 and N2, it does not satisfy N3. Thus it is not a D-term.

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 de-

[31] On the view I arued for in the last chapter, 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, Waterlow {84, 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." And she conjectures (Waterlow {84, p. 25}) that in order for a term to import C, that term must import principles of individuation for the subject we refer to with that term.

fense 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 what is sperma is the matter which synchronically composes sperma, 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."[32] This matter first composes sperma, then a zygote, then an embryo, etc. Thus Irwin claims that the matter persists, but does not remain sperma.

An analogy will help: suppose a sculptor makes a statue out of a bronze pot. The bronze pot does not persist through this sculpting. Rather, it is the bronze that synchronically composes the pot which persists and comes to synchronically compose the statue. This bronze does not remain a pot once it has been made into a statue, nevertheless, it persists through the process. So when we say that the statue is made from the pot, Irwin thinks that 'pot' can refer to the bronze which synchronically composed that pot.

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 it 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 deficient argument for what appears one of his main claims in *Phys.* I.7. Recall PER:

PER For any change, there is a subject of that change, that subject persists,

[32]Irwin {48, n. 26, p. 515}.

> 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. We have also seen that Aristotle thinks the product of a change is analyzable partly into the subject of change. So he requires the subject to remain the same kind of thing. He turns to defend his general claims about all change by showing that they also apply to unqualified changes. He does by giving five examples (see Section 2). If Aristotle is to convince us that his general claims do apply to these five cases, he must provide the 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. A bronze statue will also partly be analyzable into bronze.

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. So 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 Aristotle would

not provide a full description of natural generations in *Phys.* I.7, i.e. he would not provide us with a D-term to compose such a description.[33] His argument is then inadequate. Aristotle discusses these examples to show that his general account applies to these controversial cases. Since animals are paradigmatic natural beings, we expect Aristotle to tell us which kind of thing the subject of natural generations remains. After all, we have no difficulty applying PER to Aristotle's four other cases of unqualified changes. But, on Irwin's reading, we have to suppose that 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. However, if an interpretation can treat the sperma case analogously to the other four 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 Sections 4–5, 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.

[33]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 interpreters do think that Aristotle in *Phys.* I.7 defends the existence of prime-matter, a *sui generus* entity. See Charlton {23, pp. 129-147} for discussion and references. These interpreters accept that Aristotle should tell us the subject of natural generations and what that subject remains. They puzzle about the sperma case and try use his reference to matter to alleviate their puzzlement. 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 remains 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.

4.5 A New Solution: *The Generation of Animals*

I have discussed two responses to the Sperma Puzzle and argued against both. Both fail, I think, because they pay little attention to Aristotle's biological works. In those works, particularly 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. I will divide my discussion across two sections. In this section, I summarize the salient details about the nature and production of sperma, as well as its role in the generation of an animal. In the next section, I discuss the persistence of sperma.

In *GA* I.18, Aristotle discusses the nature of sperma:

> 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).[34]

In this quotation, Aristotle speaks of those things that are naturally formed. 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. Aristotle turns to both clarify this criterion and discuss those candidates which satisfy it. His most important claim is the following:

> Sperma is a useful residue of nutriment in its last stage (726a26–29).[35]

[34] Ἀρχὴ δὲ καὶ ταύτης τῆς σκέψεως καὶ τῶν ἑπομένων πρῶτον λαβεῖν περὶ σπέρματος τί ἐστιν· οὕτω γὰρ καὶ περὶ τῶν ἔργων αὐτοῦ καὶ τῶν περὶ αὐτὸ συμβαινόντων ἔσται μᾶλλον εὐθεώρητον. βούλεται δὲ τοιοῦτον τὴν φύσιν εἶναι τὸ σπέρμα ἐξ οὗ τὰ κατὰ φύσιν συνιστάμενα γίγνεται πρώτου

[35] Ὅτι μὲν οὖν περίττωμά ἐστι τὸ σπέρμα χρησίμου τροφῆς καὶ τῆς ἐσχάτης

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 come 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 which 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.[36]

Now SP1 and SP2 contain an ambiguity. This ambiguity is crucial for understanding Aristotle's discussion of sperma in *GA*. 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.

[36]I am here following Henry {42, p. 369–360}.

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 artefacts is the arts, the burning of a house is the torch (724a20–35).

We have just seen that Aristotle characterizes sperma as a residue from which the parts of an animal come into being. However, we can understand the phrase 'from which the parts of an animal comes into being' in several different ways, and so understand SP2 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) offer four different ways to understand the phrase 'animals come from sperma'. We could mean that the animal merely comes after the sperma in a similar way to how night comes after day in (1). We could also mean that something changes from being sperma to being an animal. In a similar way, Arion would change from being musical to unmusical if he suffered a catastrophic brain injury (2). Alternatively, we 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, we could mean that sperma is what acts upon and makes an animal out of the material. In a similar way, a statue comes from a sculptor, i.e. the sculptor is what acts upon the material to create the statue.

Aristotle believes that (3) and (4) are the only plausible ways of reading

'come into being from' in SP2.[37] His goal is to show that SP2 describes two different entities for each of these readings. First, he argues that semen (γονὴ) is a useful residue of ultimate nutriment which 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 comes from the menses as matter (726a28*ff*).[38] So Aristotle thinks that SP2 describes semen when 'come into being from' refers to the efficient cause. And he thinks that SP2 describes menses when 'come into being from' refers to the material cause. So both the menses and semen are sperma, albeit in different way. First, I will discuss the similarities between the semen and menses, then I discuss the differences.

4.5.1 Similarities: Residues

Aristotle thinks that each type of sperma, both menses and semen, are residues of ultimate nutriment. So Aristotle 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 (*An* 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 which has a nutritive soul, i.e. something which has the ability to grow itself. Aristotle compares this to how a son sets up a home away from

[37] He quickly dismisses (1) and (2). See 724b2–4.

[38] Occasionally, Aristotle says that women do not produce sperma (*c.f.* 727a27–29.) This can be confusing. However, when Aristotle 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 {3}, Henry {42, n.5 p.280}.

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 those parts of the embryo that allow it grow itself, i.e. the heart (735a24, 741b16). Once these parts are 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.[39] Being cooked, the food is transformed into nourishment. As an analogy, consider potatoes. Raw potatoes are toxic. But when they are cooked, they become nutritious. Similarly, food, Aristotle thinks, becomes nourishment only when it is concocted in the stomach.

This process has a by-product. It is these by-products that Aristotle calls *residues* (724b26–27, 745b18).[40] These first residues are of two types. The first is a residue that can be used to replenish and grow things like fat, hair, nails, and so on (745b15*ff*). The second is a residue that cannot immediately be used by the body. This 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

[39]For a book length discussion of concoction see Freudenthal {36}. See also Boylan {13}

[40]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.

after which it is useful for growth.[41]

While the residue from the stomach is concocted in the spleen, the original nourishment 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 nourishment 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 nourishment 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).[42] 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. So both semen and menses are the last residue of digestion, of that process which forms blood.

[41]For a much fuller description see Boylan {13}.

[42]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. For further discussion, see Freudenthal {36}.

4.5.2 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. So if the female cannot produce semen, what is the residue that collects in her uterus?

This may appear surprising, but Aristotle thinks 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*ff*). 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 haemorrhage" (738a14–16).[43]

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,

[43] ἐκκρίνεται διὰ λεπτοτάτων φλεβῶν εἰς τὰς ὑστέρας, οὐ δυναμένων διὰ τὴν στενοχωρίαν δέχεσθαι τὴν ὑπερβολὴν τοῦ πλήθους, καὶ γίγνεται τὸ πάθος οἷον αἱμορροΐς.

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 extra blood and discharges it unless fertilized. The reason why this blood is a residue is that it has not been used by the mother for her own growth and replenishment. Similarly, if surplus timber remains after building a ship, that timber is a residue.

4.6 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 which persists through the change. However, Aristotle's candidate for this subject, sperma, does not seem to persist, remain sperma, and make up the newly generated animal. Thus is seems not to satisfy PER. Sperma does fail to satisfy PER *if* sperma is something like a mammalian egg or ovum. These entities are destroyed when they are turned into new products. But our discussion of the biology shows that sperma is not an ovum. Sperma is blood, and blood is not an ovum.

It may seem surprising that Aristotle thinks that semen makes an embryo out of blood. But this is why, for instance, he says that women tend not to have nose bleeds 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 embryo is nourished by the menstrual blood while it is in the uterus, i.e. the embryo 'eats' the blood that would normally be discharged once a month (733b26–31, 745b22*ff*, 775b11*ff*).

Of course, 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, ovum, the uterus lining, among other things. 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 replenish the parts of the body, i.e. blood is used to create certain parts of the body, but also grow and sustain those parts.[44] This is why Aristotle says that the matter out of which something is produced is also that out of which it grows (740b2–8, 740b34–35).

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.

So by bringing the biological details into focus, we can see that sperma does satisfy PER. Just as in his biological works, in *Phys.* I.7 Aristotle describes the process by which animals come into being from sperma as growth (190b3–10). This is as we expect. Growth requires blood. The female sperma

[44]To put the point vividly, there is little difference between the blood that the semen turns into an embryo and the blood that flows from the nose during a nose-bleed.

is excess blood. This excess blood is turned into the first parts of the embryo. 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 as long as this excess blood persists, remains blood, and is present in the new animal.

I have no direct argument that blood does persist through this process. Instead, let me respond to two objections to the view I have put forward.

First, one might raise a new version of the Sperma Puzzle by questioning whether the very same blood remains as it is used to construct the tissue, blood vessels, heart, and so on, i.e. one might still question whether the blood that was in the mother's uterus is identical to any blood in the offspring's tissues. Analogously, suppose that we were to pour a bucket of water into a small paddle pool. The pool is mostly empty. Now suppose that the pool is filled up by rainfall over a long period of time. Which exact portion of the water persisted through the filling of the pool? If we cannot aswer this question, we might doubt that any portion did, in fact, persist.

Answering this question requires that we determine what the identity through time of portions of water consists in. Similarly, if we are to know which portion of blood persists through a natural generation we must determine what the identity through time of portions of blood consists in. One might object that I must show how Aristotle would answer these questions, but that I have yet to do so.

However, Aristotle's goal in *Phys.* I.7 is to show that there is a persisting subject for each change. But meeting that goal does not require that he also give an analysis of what the identity through time of objects consists in, or indeed to give any general analysis of what persistence is. I have used the

biological works to show that Aristotle believes that menstrual blood is one kind of sperma and that this menstrual blood persists. It would also be out of place for him to offer a metaphysics of persistence there. So while I agree that my reading raises the interesting question of what the identity through time of stuffs like blood and water consists in, I disagree that my reading is undermined by the fact that Aristotle does not try answer this question in *Phys.* I.7 or *GA*.

Second, recall how Aristotle claims that the product of every change is somehow analyzable into both the persisting subject and form that it acquires:

> It is clear that everything comes into being 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 (190b19–23).[45]

By this, Aristotle means that when we explain what a musical man is we must do so in terms of being musical and being a man. On my reading, sperma is the persisting subject of natural generations. Thus when we explain what it is to be the product of such a process, we must do so in terms of sperma and some appropriate form. But I imagine someone complaining here that this is absurd. Socrates is the product of a natural generation. However, why would Aristotle say that when we explain what Socrates is we must do so in terms of sperma—blood produced by the mother—and some form? Socrates is an ensouled body and not some informed blood.

Here let us recall SP1 and SP2:

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

[45] ὅτι γίγνεται πᾶν ἔκ τε τοῦ ὑποκειμένου καὶ τῆς μορφῆς· σύγκειται γὰρ ὁ μουσικὸς ἄνθρωπος ἐξ ἀνθρώπου καὶ μουσικοῦ τρόπον τινά· διαλύσεις γὰρ [τοὺς λόγους] εἰς τοὺς λόγους τοὺς ἐκείνων.

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.

Perhaps one will respond that if I am right then it is 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. However, I deny that, on my reading, Aristotle is misleading. For we saw in the biological works that Aristotle claims SP1, but uses SP1 as a shorthand for SP2. So we have good evidence that Aristotle says that animals come into being from sperma, and that he also thinks that this is to spelt out with the claim that the parts of animals come into being from sperma.[46]

Third, one might object that, on my reading, even if the subject from which Arion comes into being persists, it does not persist throughout the life of Arion. To bring this objection into focus, consider again the musical lesson. When Arion learns music, he is the subject of musicality. And he will remain the very same subject of musicality for as long as he remains

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

musical, e.g. the Arion who plays his first concert is one and the same as the Arion who plays his last. So the subject from which the musical man comes into being 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. So 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. So, 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 a natural being, at the moment it comes into being, is composed, in a way, of a form and the subject from which that natural being is produced. This requires that the matter from which the natural being is produced persists through the production and is part of that natural being at the moment of its production. But this claim is compatible with the claim that this matter is replaced throughout the life of the natural being. So, at least from the perspective of *Phys.* I.7, (iii) poses no problem for my reading.

4.7 Conclusion

In this chapter, I have 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. PER is a premise in Aristotle's argument for hylomorphism in *Phys.* I.7. So 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, they each respond by trying to dampen 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 never says PER at all. Irwin responds by allowing Aristotle claim PER, but leaving Aristotle silent about what kind of thing the subject 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. When doing so, he claims PER. So Charlton has to read Aristotle as retracting this general claim. 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 that subject remains. I submit that we should accept this reading which is both simple and literal.

CHAPTER 5

AN ELEATIC CHALLENGE IN *PHYSICS* I.8.

5.1 Introduction

In *Physics* I.8, Aristotle responds to a puzzle that led some philosophers to deny that change exists. Persistence has been taken as key to understanding this puzzle and Aristotle's solution. My goal in this chapter to explain how persistence plays a role in both this puzzle and Aristotle's response. He reports the puzzle as follows:

> (1) They say that no being either comes to be or perishes. (2) For, they say, it is necessary that what-comes-to-be comes to be either from what-is or from what-is-not, and (3) it is not possible for what-comes-to-be to come to be from either; (4) for what-is cannot come to be (since it already is), (5) while nothing can come to be from what-is-not (since there must be some subject). (6) And then, having reached this result, they make things worse by going on to say that there is no plurality, but only being itself (191a27–33 *trans*. Irwin and Fine slightly modified).[1]

In (1)–(6), Aristotle refers to an argument for the claim that being is one. Call the claim that being is one *monism*, and call defenders of this view *Monists*. Call the argument in (1)–(6) *the Eleatic Challenge*. The Challenge has two stages. In the first stage, the Monist argues that change is impossible. In the second stage, the Monist argues that, since change is impossible, being is one. In (1)–(5), Aristotle reports the first stage of the argument, and he devotes *Phys.* I.8 to discussing and responding to it. In (6) he reports the conclusion of the second stage of the argument. However, he does not explain

[1] φασιν οὔτε γίγνεσθαι τῶν ὄντων οὐδὲν οὔτε φθείρεσθαι διὰ τὸ ἀναγκαῖον μὲν εἶναι γίγνεσθαι τὸ γιγνόμενον ἢ ἐξ ὄντος ἢ ἐκ μὴ ὄντος, ἐκ δὲ τούτων ἀμφοτέρων ἀδύνατον εἶναι· οὔτε γὰρ τὸ ὂν γίγνεσθαι (εἶναι γὰρ ἤδη) ἔκ τε μὴ ὄντος οὐδὲν ἂν γενέσθαι· ὑποκεῖσθαι γάρ τι δεῖν. καὶ οὕτω δὴ τὸ ἐφεξῆς συμβαῖνον αὔξοντες οὐδ' εἶναι πολλά φασιν ἀλλὰ μόνον αὐτὸ τὸ ὄν.

what (6) means nor does he discuss why the impossibility of change entails (6) in *Phys.* I.8. But these omissions do not affect his overall strategy: he argues that the first stage of the argument fails. If the Monist's arguments for the impossibility of change fails, their argument from the impossibility of change to monism is unsound. It is unsound because it would assume the false premise that change is impossible. So by rebutting the first stage of the Eleatic Challenge, Aristotle argues that this argument for monism fails.

Aristotle summarizes his rebuttal to the Challenge at the end of the chapter:

> And so, as we have said, we have solved (7) the puzzles that compelled people to do away with some of the things that we have mentioned. For (8) this is why earlier thinkers were also diverted from the road leading them to <an understanding of> coming to be, perishing, and change in general. (9) For if they had seen this nature <of the subject>,[2] that would have cured all their ignorance (191b30–34).[3]

In (7) Aristotle speaks about those philosophers who deny that change exists, and in (8) says that they deny that any kind of change exists. For example, they deny that people either come into being, move, grow, or alter.[4] Aristotle believes that this denial rests on a misunderstanding. In (9) he diagnoses and corrects this misunderstanding: they misunderstand the principles of nature. In particular, they misunderstand the nature of the subject of change. If they understood what the subject of change is and

[2]Aristotle does not mention the word 'subject'. But one Bekker page previously, he speaks about the nature of the subject of change (ἡ δὲ ὑποκειμένη φύσις) (191a7–8). So I follow Irwin and Fine when they supply 'subject'('ὑποκειμένη'). See also Ross {74, p. 497}.

[3]ὥσθ' (ὅπερ ἐλέγομεν) αἱ ἀπορίαι λύονται δι' ἃς ἀναγκαζόμενοι ἀναιροῦσι τῶν εἰρημένων ἔνια· διὰ γὰρ τοῦτο τοσοῦτον καὶ οἱ πρότερον ἐξετράπησαν τῆς ὁδοῦ τῆς ἐπὶ τὴν γένεσιν καὶ φθορὰν καὶ ὅλως μεταβολήν· αὕτη γὰρ ἂν ὀφθεῖσα ἡ φύσις ἅπασαν ἔλυσεν αὐτῶν τὴν ἄγνοιαν

[4]Aristotle says that these philosophers deny that 'γένεσις', 'φθορά' and 'ὅλως μεταβολή' exists. 'μεταβολή' is Aristotle's most general word for change: it includes unqualified change, growth, alteration, and locomotion, *c.f. Phys.* 225b7–9. Morison {71, p. 11–15}, and Ross {74, p. 7–8} discuss how Aristotle uses different words for change and they discuss how these words are related.

what role the subject plays in change, they would not puzzle about whether change is possible. Subsequently, they would not deny that change exists and be ultimately led to endorse monism.[5]

Reconstructing the Eleatic Challenge and Aristotle's response to this Challenge is difficult. We expect that the source of the disagreement is one over principles: Aristotle thinks that it is because the Monist has mistaken views about the principles that they deny that change exists. But on the correct understanding of the principles, he argues that the Eleatic Challenge fails. So Aristotle instills the following expectations: first, he will show us why his predecessors views of the principles impale them on both horns of the dilemma. Second, he will show us how his own view of the principles allows him to escape either one or both horns of the dilemma. However, it is difficult to reconstruct the argument and Aristotle's solution in a way that satisfies these expectations. For instance, some reconstructions of the Challenge leave an argument that is obviously invalid and requires no understanding of the principles to see that it is invalid (see below for details).

An adequate reconstruction requires that we identify how exactly Aristotle's disagreement with his predecessors over principles is at the heart of the Eleatic Challenge and his response. Several think that the core of the disagreement lies in issues of persistence. For instance, several see the

[5]In *Phys.* I.8, Aristotle argues that the Eleatic Challenge fails to establish the impossibility of change. Doing so, he argues that change is possible. Showing that change possibly exists does not show that change exists. However, earlier in the *Physics* Aristotle says: "We can assume that some or all natural things are changing; a survey of instances makes it clear that this is the case. At the same time, it is not our business to correct all mistakes, but to do so only where someone has drawn false inferences from principles, and not otherwise (185b12–16)."ἡμῖν δ' ὑποκείσθω τὰ φύσει ἢ πάντα ἢ ἔνια κινούμενα εἶναι· δῆλον δ' ἐκ τῆς ἐπαγωγῆς. ἅμα δ' οὐδὲ λύειν ἅπαντα προσήκει, ἀλλ'ἢ ὅσα ἐκ τῶν ἀρχῶν τις ἐπιδεικνὺς ψεύδεται, ὅσα δὲ μή, οὔ. Some philosophers mistakingly believe certain things about the principles of nature. And so they mistakingly argue that the assumption that natural beings exist and change is false. Aristotle's strategy is to correct these mistakes. While correcting these mistakes does not prove that change exist, it does undermine a challenge to our common belief that natural beings exist and change.

Eleatic Challenge as containing a sub-argument for the first premise in the following argument:

1. Sheer replacement is impossible.
2. If change exists, then change is identical to sheer replacement.
3. Thus change is impossible.

Here is an example of a sheer replacement: suppose that God were to completely annihilate Arion and every part that composes Arion. This annihilation is not the same as squashing Arion flat or otherwise killing him (for in these cases some of the material composing Arion survives). Now suppose that a short while later God creates a bronze statue in the place where Arion once stood. She doesn't do this by, say, moulding some pre-existing bronze. Rather, with one wave of her cosmic wand, she brings into being both the material that composes the statue and the statue itself. If God were able to do this, then the statue would have replaced Arion. The Eleatic Challenge, supposedly, contains an argument that this kind of sheer replacement is impossible. Mary Louise Gill, for instance, writes:

> Parmenides denied the possibility of change because, on his view, for coming-to-be to occur, something must come to be from nothing. Aristotle agrees with his predecessor in excluding such absolute emergence, yet accommodates change by insisting that coming-to-be, although involving replacement, also involves continuity. He thus avoids the charge that, when a change takes place, the preexisting entity simply perishes into nothing and is replaced by a product that emerges out of nothing.[6]

On this reading, the Eleatic Challenge claims that sheer replacement requires that objects come into being from nothing and perish into nothing. But the Eleatic Challenge argues that this is impossible. So if change is identical to sheer replacement, then change is impossible. In order to show that

[6]Gill {38, p. 7}. See also Waterlow {84, p. 8} and Irwin {48, p. 84–87}.

change is possible, we have to explain just how changes differs from sheer replacements. On this reading, Aristotle distinguishes the two by claiming that something persists through changes while nothing persists through sheer replacements. So on this way of reading *Phys.* I.8, persistence is key to Aristotle's solution. He recognizes that change requires some persisting subject while the Monist was unaware of this requirement.

For some interpreters, diachronic criteria of identity are central to this response. Sarah Waterlow, for instance, thinks that Aristotle must defend the claim that something does persist through a change by convincing us that the subject before and after the change are stages of the one continuing subject.[7] According to Waterlow, his defence consists in claiming that diachronic criteria of identity are provided by the substance sortal that the persisting subject falls under. For we recall that Waterlow thinks that Aristotle privileges a certain description of the subject of change because this description embodies a diachronic criterion of identity for that persisting subject.[8]

In this chapter, I offer a new reading of the Eleatic Challenge and Aristotle's response. I argue that both Aristotle and the Monist accept the following two claims: (i) since changes occurs between opposites, a changing being must be able to admit these opposites. (ii) Since an actor acts upon and changes a changing being for the duration of the change, a changing

[7] See Ch.1 for further discussion.

[8] Waterlow {84, p. 20} Gill {38} agrees that, for Aristotle, something continues through each change. However, according to her, what persists through an unqualified change are features and properties of the pre-existing entity. For instance, when I turn some hot iron into a sword, the heat of the iron persisted through the change. See Furth {37} for a similar interpretation and Shields {76} for discussion of Gill. While these interpreters disagree on the details, they agree that *Phys.* I.8 provides reasons for accepting that something persists through each change, i.e. I.8 tells us that change is distinct from sheer replacement, and so possible, because something persists through change but not sheer replacement. In contrast, Ebrey {31} and Kelsey {53} deny that persistence has anything to do with Aristotle's solution.

being must be able to persist as it is being so acted upon. The Eleatic Challenge states an argument that (i) and (ii) cannot be simultaneously satisfied by any being. If a being satisfies (i), it cannot satisfy (ii) and *vice versa*. And if no being can simultaneously satisfy (i) and (ii), then no being can change. Aristotle deploys his own view of the principles to show that (i) and (ii) can be simultaneously satisfied.

This reading differs from alternatives in two ways. First, it finds support for the main premises of the Eleatic Challenge in the text of *Phys.* I. For, on my reading, the Challenge argues that there is a tension between the conclusion of *Phys.* I.5—the principles of nature are opposites—with the conclusions of I.6—the subject of change is also a principle. Aristotle's solution uses the material from *Phys.* I.7 to show that there is no such tension. All interpreters agree that Aristotle uses his own view of the principles to solve the Eleatic Challenge. But no interpreter has argued that support for the main premises of the Challenge comes from earlier in *Phys.* I. Some interpretations leave the main premises of the puzzle undefended. Other interpretations defend the premises from outside the text of *Phys.* I.

Second, my reading offers a unique reading of how persistence plays a role in *Phys.* I.8. On my reading, both the Monist and Aristotle assume that it is a requirement for the existence of change C that there exists a subject which can and does persist through C, something from which the product comes into being and something which is subject for the form of that product once it has come into being. Their debate is over whether this requirement can be satisfied. Someone who denies this requirement will find no argument in *Phys.* I.8 to convince them otherwise, e.g. they will not find Aristotle using persistence to distinguish changes from sheer replacements.

5.2 The Earlier Philosophers

Aristotle begins *Phys.* I.8 by saying the following:

> (1) This is also the only solution to (2) the puzzle raised by (3) the earlier philosophers, as we shall now explain (191a23–24).[9]

In (1) Aristotle says that his previous discussion will allow him solve a puzzle raised by those earlier philosophers he refers to in (3). So what Aristotle writes in this chapter builds upon what he wrote in prior chapters, though Aristotle does not say how. The puzzle he refers to in (2) is the Eleatic Challenge that I quoted in the introduction. Aristotle says that this is not his own puzzle, but something argued by some of his predecessors; though he does not say who. In this section, I explain how *Phys.* I.8 relates to the investigation of principles by discussing how *Phys.* I.8 relates to *Phys.* I as a whole and identifying Aristotle's targets.

In (1) Aristotle says that 'this' is also a solution to the Eleatic Challenge he goes on to discuss. 'This' refers to Aristotle's own view of the principles of nature and how those principles are related. I will return to this below when I discuss his solution to the challenge. What I want to flag here is that Aristotle indicates that some or all of his own view of the principles will help us to solve the Eleatic Challenge. This places a constraint on any adequate interpretation of that challenge: an interpretation must explain why Aristotle thinks that the Challenge can only be solved by deploying his view of the principles. We will see that several interpretations of the Eleatic Challenge fail to meet this constraint: they interpret the argument in such a way that we can meet the challenge independently of any investigation of the principles of nature.

[9] Ὅτι δὲ μοναχῶς οὕτω λύεται καὶ ἡ τῶν ἀρχαίων ἀπορία, λέγωμεν μετὰ ταῦτα.

In (3) Aristotle refers to the earlier philosophers, but nowhere in *Phys.* I.8 does he state their names. Nevertheless, we can identify these philosophers by one thing that he says about them: they believe that since change is impossible, there is no plurality of beings but only being itself (see Introduction). Aristotle speaks about the same philosophers earlier in the *Physics*. He begins *Phys.* I.2 as follows:

> There must be either just one principle or more than one principle. If there is one principle, this principle is either unchangeable, as Parmenides and Melissus say, or changeable as the physicists say (184a15–18).[10]

Parmenides and Melissus both believe that there is one principle, and they both deny that there are a plurality of beings.[11] This principle is one and unchangeable (184b25–185a1). It is also worth noting here that Aristotle begins *Phys.* I.3 as follows:

> If we examine the matter in this way, then, it seems impossible for all things to be one. Nor is it difficult to rebut those arguments used to show that all things are one, because both of them—Melissus and Parmenides—argue sophistically (186a4–7).[12]

Here Aristotle says that Parmenides and Melissus use certain arguments to prove that being is one.[13] He spends *Phys.* I.2–3 discussing and rebutting

[10] Ἀνάγκη δ' ἤτοι μίαν εἶναι τὴν ἀρχὴν ἢ πλείους, καὶ εἰ μίαν, ἤτοι ἀκίνητον, ὥς φησι Παρμενίδης καὶ Μέλισσος, ἢ κινουμένην, ὥσπερ οἱ φυσικοί· Aristotle uses the word 'κίνεσις' here. We could translate this word as 'movement'. If we translate the word in this way, Aristotle characterizes Parmenides and Melissus as denying that only movement exists. But Parmenides and Melissus deny that all change exists.

[11] In this quote, Aristotle says that they believe that there is one principle. He does not say that they believe there are no plurality of beings. A monist like Thales believes that there is only one principle—water—but he also believes that there are a plurality of beings. Nevertheless, Aristotle clearly thinks that Melissus and Parmenides believe both that there is one principle and that there are no other beings in addition to this one principle, *c.f.* 187a9–10.

[12] Τόν τε δὴ τρόπον τοῦτον ἐπιοῦσιν ἀδύνατον φαίνεται τὰ ὄντα ἓν εἶναι, καὶ ἐξ ὧν ἐπιδεικνύουσι, λύειν οὐ χαλεπόν. ἀμφότεροι γὰρ ἐριστικῶς συλλογίζονται, καὶ Μέλισσος καὶ Παρμενίδης.

[13] In *Phys.* I.2. Aristotle discusses what Parmenides and Melissus could mean when they say that being is one. For example, do they mean that only one individual exists, e.g. that

some of those arguments. *Phys.* I.8 also refers to an argument that being is one: since change is impossible, there is no plurality of beings but only being itself. So while Aristotle does not mention Parmenides and Melissus by name in *Phys.* I.8, he has these Eleatics in mind and is taking up again the issues he introduced and discussed in I.2&3; the arguments of those who believe that change is impossible and that being is one.

Some further evidence that Aristotle speaks about Parmenides in *Phys.* I.8 is that Aristotle uses a certain metaphor to describe those who deny change: they were diverted on their path of inquiry into the truth and nature of beings (191a24–32, 191b31–33). This metaphor should remind us of Parmenides. In his poem 'On Nature' Parmenides describes himself as a traveller being carried beyond the beaten paths of mortal men (DK 28 B1' 1–12). He is carried along the path of night and day in a chariot guided by daughters of the Sun, and finally brought to meet a Goddess. This Goddess describes different paths of inquiry to him and explains which paths of inquiry he can pursue and which he cannot. He can pursue the path of persuasion: that something is and cannot not be. But he cannot pursue the path of inquiry into what is not and that it must not be (DK 28 B2' 3–8.). When Aristotle speaks of someone denying the existence of change being misled on their path of inquiry, we easily hear him saying that Parmenides was misled by the Goddess on his (Parmenides') journey of inquiry.[14]

One might object that the philosophers who were misled by the puzzle also include the natural philosophers. In *Phys.* I.4, Aristotle speaks of these predecessors as follows:

only one human exists? Or do they mean that there are many individuals that exist but that each individual is the same kind of thing, e.g. there are many things but each of them is human? Aristotle argues that however we interpret 'being' and 'one', being cannot be one (184b20–185b25).

[14]In addition, the next chapter begins by explicitly mentioning Parmenides (192a1).

> It seems likely that Anaxagoras posited an infinite number of things in this way because he assumed the truth of the view held by all the natural scientists that nothing comes into being from non-being....They reasoned as follows: necessarily, everything which comes into being comes either from things with being or from things without being; but it is impossible for anything to come into being from non-being (all the natural scientists are unanimous on this point); therefore, the only remaining possible conclusion, they thought, was that anything which comes into being comes from things with being, which are already present in the source (187a26–187b1).[15]

In this quote, Aristotle refers to a puzzle similar to the Eleatic Challenge he reports in *Phys.* I.8. He says that this puzzle was tackled by the natural philosophers: they accept that if X comes to be, then X cannot come to be from what-is-not, but they argued that X can come to be from what-is. So perhaps one might argue that the protagonists of *Phys.* I.8 include the natural philosophers. However, this cannot be the case. The natural philosophers do not deny that change is possible nor do they deny that there are a plurality of beings. They try to solve the Eleatic Challenge and do not endorse the conclusion of that challenge. However, their response is inadequate, according to Aristotle, for he believes that their particular understanding of the principles is inadequate.

This inadequacy is important for understanding the Eleatic Challenge and Aristotle's solution: Aristotle's solution must be unavailable to these natural philosophers, i.e. there must be some unique features of Aristotle's view of the principles that he thinks are precisely what is required for meet-

[15] ἔοικε δὲ Ἀναξαγόρας ἄπειρα οὕτως οἰηθῆναι διὰ τὸ ὑπολαμβάνειν τὴν κοινὴν δόξαν τῶν φυσικῶν εἶναι ἀληθῆ, ὡς οὐ γιγνομένου οὐδενὸς ἐκ τοῦ μὴ ὄντος (διὰ τοῦτο γὰρ οὕτω λέγουσιν, ἦν ὁμοῦ πάντα, καὶ τὸ γίγνεσθαι τοιόνδε καθέστηκεν ἀλλοιοῦσθαι, οἱ δὲ σύγκρισιν καὶ διάκρισιν)· ἔτι δ' ἐκ τοῦ γίγνεσθαι ἐξ ἀλλήλων τἀναντία· ἐνυπῆρχεν ἄρα· εἰ γὰρ πᾶν μὲν τὸ γιγνόμενον ἀνάγκη γίγνεσθαι ἢ ἐξ ὄντων ἢ ἐκ μὴ ὄντων, τούτων δὲ τὸ μὲν ἐκ μὴ ὄντων γίγνεσθαι ἀδύνατον (περὶ γὰρ ταύτης ὁμογνωμονοῦσι τῆς δόξης ἅπαντες οἱ περὶ φύσεως), τὸ λοιπὸν ἤδη συμβαίνειν ἐξ ἀνάγκης ἐνόμισαν, ἐξ ὄντων μὲν καὶ ἐνυπαρχόντων γίγνεσθαι, διὰ μικρότητα δὲ τῶν ὄγκων ἐξ ἀναισθήτων ἡμῖν.

ing the Eleatic Challenge.

So here's a plausible account of how *Phys.* I.8 is integrated into the rest of *Phys.* I: Parmenides and Melissus both misunderstand the principles of nature. This leads them to deny that change exists and subsequently argue for monism. Aristotle believes that he must correct these mistakes. To do this, he had first to investigate the principles of nature. He discusses how his predecessors understand the principles, but thinks their particular theories are inadequate. Aristotle finished outlining his own view at the end of *Phys.* I.7. In *Phys.* I.8, he turns to discuss the Eleatic Challenge. So the Eleatic Challenge serves as a kind of litmus test for an adequate theory of the principles: an adequate theory must allow us meet the challenge. Aristotle's goal in *Phys.* I.8 is to show that his own theory of the principles passes this test.[16]

This places two constraints on an adequate interpretation of *Phys.* I.8. An adequate interpretation must (i) identify the theory of principles that fails the test, and explain just how this failure functions in the Eleatic Challenge. (ii) It must explain just how Aristotle's view of the principles passes the test. Over the next several sections, I will discuss different reconstructions of the Eleatic Challenge. We will see that several fail to meet the first constraint, failing to explain how some failed view of the principles functions in the Eleatic Challenge.

[16]Waterlow {84, p. 9} puts the point as follows: "From the very first, Aristotle tells us, this dilemma shaped attempts to philosophize about change and becoming. He himself, as his own approach shows, saw the paradox as defining a necessary adequacy-condition for any theory of change: whatever else a theory might offer, it must at least solve or dissolve the paradox."

5.3 The Eleatic's Target

Since understanding an argument requires understanding what the argument tries to establish, I'll begin by asking what this Challenge is trying to establish in the first place. Before I begin, let me alert the reader that I discuss some translation issues in this section and the next few sections. Unfortunately the passage in which we find the Eleatic Challenge is horribly abstract. It can be read in a myriad of different and incompatible ways, and it raises several difficult problems about how to translate Greek sentences about being, non-being, and becoming into English. Reconstructions vary radically over these translation issues. This can be seen from how one can translate the conclusion of the first stage in different ways:

> They say that no being either comes to be or perishes.

This is difficult to interpret because we can understand the verbs 'come to be' ('γίγνομαι') and 'perish', or 'cease to be', ('φθείρω') in at least two different ways. First, we can understand both verbs completely, e.g. Socrates neither comes into being nor ceases to be altogether. Second, we can understand both verbs incompletely, e.g. Socrates can neither come to be warm, cold, musical, etc.; nor can Socrates cease to be warm, cold, musical, etc. So it seems that we can interpret the conclusion of the first stage in one of two ways: it either denies that unqualified change exists, or it denies that qualified change exists (see below for this distintion). I will argue that it can be read as denying both, but first let me say why discussing this issue is important.

Qualified change and unqualifed change are different phenomena. And denying the existence of one can be done independently of denying the existence of the other. To see this, consider a view upon which qualified change

exists but unqualified change does not. For instance, one can imagine a view which says that matter never comes into or out of being, only matter exists, and matter can (only) undergo qualified change. Similarly, one can imagine a view upon which unqualified change exists, but qualified change does not. For instance, one can imagine a view which says that composite objects are composed of collections of atoms, and that whenever an atom is added or subtracted from that collection, the composite object is destroyed and replaced by another.[17] So an argument against the existence of unqualified change need not be an argument against the existence of qualified change and *vice versa*. Thus the details of the Eleatic Challenge may differ depending on whether its target is qulified or unqualified change.

There is some evidence that the Challenge is focused solely on unqualified change. Aristotle reports the conclusion of the first stage using the verbs 'become' ('γίγνομαι') and 'perish' ('φθείρω') together, and the associated nouns 'generation' ('γένεσις') and 'destruction' ('φθορά') together. Elsewhere Aristotle uses these words together to speak about unqualified change as distinct from other changes. For example, in the *Cat.* he says that there are 6 kinds of change: generation, destruction, increase, diminution, alteration, and change of place (*Cat.* 15a13–14).[18] At least here Aristotle uses the words 'coming to be' ('γένεσις') and 'destruction' ('φθορά') to refer to some kinds of changes as opposed to other kinds of change. So we might think that the Eleatic Challenge only concludes that unqualified change exists.

However, there is also evidence that the Challenge denies that all kinds of change exists. When Aristotle concludes the chapter, he says that the

[17]Perhaps such a view would require the atoms to move, and so it could not completely eliminate the existence of qualified change. Nevertheless, on such a view, there are some entities, composite objects, that cannot undergo qualified change even though they can come into and out of existence.

[18]Κινήσεως δέ ἐστιν εἴδη ἕξ· γένεσις, φθορά, αὔξησις, μείωσις, ἀλλοίωσις, κατὰ τόπον μεταβολή.

deniers of change deny that coming to be (γένεσις), perishing (φθορά), and change in general (ὅλως μεταβολή) exist (191b30–34). 'μεταβολή' is Aristotle's most general word for change: it includes unqualified change, growth, alteration, and locomotion. So Aristotle concludes the chapter by saying that he has discussed an argument that no kind of change exists, i.e. that neither qualified nor unqualified change exists. This suggests that the Eleactic Challenge argues that neither qualified nor unqualified change exists.

So some evidence suggests that the Challenge targets only unqualified change while other evidence suggests that the target is both unqualified and qualified change. This is confusing since it seems that we must translate the conclusion as a denial of either qualified or unqualified change. However, I think that we can understand the conclusion as a denial of all kinds of change by focusing on how Aristotle distinguishes between qualified and unqualified change in *Phys.* I.7:

> 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).[19]

Here Aristotle says that change is said in many ways and he distinguishes two different ways that change is said. He first says that some entities do not come into being without qualification. These are entities from non-substantial categories, e.g. musical, heat, and colour. These non-substantial items are qualifications of a substance: they are predicated of substances, but substances are not predicated of anything else (190a33–190b1). The hot and other qualifications of a substance only come into being insofar as some substance comes to be them. For instance, the hot comes into being only inso-

[19] πολλαχῶς δὲ λεγομένου τοῦ γίγνεσθαι, καὶ τῶν μὲν οὐ γίγνεσθαι ἀλλὰ τόδε τι γίγνεσθαι, ἁπλῶς δὲ γίγνεσθαι τῶν οὐσιῶν μόνον.

far as Socrates or some other substance comes to be hot.[20] Qualified change contrasts to unqualified change. Aristotle characterizes unqualified change in terms of those entities that unqualifiedly come-into-being, substances. So unqualified change is different from qualified change in part because substances are different from qualifications of substances. Unlike the hot and the musical, Socrates is not a qualification of a substance. So when Socrates comes into being, there is no substance that becomes qualified by Socrates.

What is important for our purposes is that Aristotle says that both substances and qualifications of a substance come into being, and we can assume, perish. They differ in that substances unqualifiedly come into being while qualities qualifiedly come into being.

Recall that Aristotle reports the conclusion of the Eleatic Challenge as follows: no being comes to be or perishes. We can understand this claim to be about about both qualified and unqualified change by (a) taking 'no being' ('τῶν ὄντων οὐδὲν') to include both qualifications of substance and substances, and (b) taking both the verbs 'come to be' ('γίγνομαι') and 'perish' or 'cease to be' ('φθείρω') completely. On this reading, the Monist denies that either substances or qualities can come into being or perish (full stop). I discuss some examples to illustrate this point.

The hot and the musical are qualities. Nevertheless, they are beings. The Challenge, I suggest, denies that these beings can come into being or cease to be altogether. If qualities cannot come into being or perish, then qualified change, as Aristotle describes it, is impossible.

Fido and Socrates are also beings. But unlike the hot and the musical, they are substances. The Challenge, I suggest, also denies that these beings

[20]Recall that while I claim that Aristotle thinks the sentence 'the hot comes into being' is true *iff* some substance becomes hot, I remain neutral about whether he endorses any metaphysics of qualities in *Phys.* I.

come into being or cease to be altogether. If substances can neither come into being or cease to be altogther, unqualified change, as Aristotle describes it, cannot exist.

So I take the conclusion of the first stage to have unrestricted scope: for any X, if X is a being, irrespective of what ontological category X belongs to, X can neither come into being or perish. Given how Aristotle characterizes the difference between qualified and unqualified change, this entails that neither qualified nor unqualified change exists. Read in this way, the Eleatic Challenge argues for an extremely radical claim. It asserts that if any being exists, irrespective of what that being is, it cannot alter, grow, or move; nor could it have come into being, nor will it ever cease to be. Such a being exists eternally and is unchanging in all respects.[21]

5.4 What-is or What-is-not

Now that we have the conclusion in focus, I turn to discuss the argument for that conclusion. Most of the difficulties that arise for interpreting the Challenge arise in interpreting the phrases 'what-is' and 'what-is-not'. Consider the first premise:

> For, they say, it is necessary that what comes to be comes to be either from what-is or from what-is-not (191a27–33).[22]

[21] See Loux {63, p. 281} for a similar reading. Kelsey {53} believes that the Challenge is about the coming into being of substance, i.e., the Challenge argues that substance must come into being from either what-is-substance or from what-is-not-substance but that both are impossible. This restricts the Challenge to unqualified change, which I see no reason for doing. Finally, note that while Aristotle uses the words 'γένεσις' and perishing 'φθορά' to speak abut unqualified change as opposed to other kinds of change in the *Cat.*, I see little evidence that he does so in this book of the *Physics*. When Aristotle explains the difference between qualified and unqualified change, he uses 'γένεσις' and 'φθορά' to describe both these changes. He uses 'unqualified' ἁπλῶς to mark the difference between the two. The hot only qualifiedly comes into being while Socrates unqualifiedly comes into being. So Aristotle distinguishes different kinds of change differently in both works.

[22] φασιν οὔτε γίγνεσθαι τῶν ὄντων οὐδὲν οὔτε φθείρεσθαι διὰ τὸ ἀναγκαῖον μὲν εἶναι γίγνεσθαι

This sentence is horrible, and I will discuss it in detail for the next several pages. But first let me try to outline the forest from the somewhat minute focus on the branches of the trees. The Eleatic Challenge concerns being, non-being, and becoming. These obviously comprise a difficult and abstract subject matter. Unfortunately, the subject matter is obscured by Aristotle's Greek (see below). He doesn't try to make things easier for his reader. He doesn't, for instance, give some examples to illustrate and explain the different premises and inferences. So the details of the arguments are highly obscure to us. To make matters worse, the Greek really can be taken in different ways. These different ways lead to more or less powerful arguments for each horn of the Challenge. I will discuss some obvious translations of these two phrases. I think the obvious translations fail, and argue for what may seem a strained interpretation upon which 'what is' and 'what-is-not' are variables that take those opposites a change occurs between as their values. In order to make space for my alternative, it is important for me to explain why simpler and more intuitive interpretations fail.

First, let us discuss 'τὸ γιγνόμενον'. This is translated as 'what comes to be'. 'τὸ γιγνόμενον' is the present participle of the verb 'come to be' ('γίγνομαι'). This verb could be used either completely or incompletely. Used completely the particple phrase should be translated 'what comes into being'. Used incompletely, the phrase means 'what comes to be F"; where 'F" refers to some unstated complement.

To illustrate this difference, let us use 'X' as the grammatical subject of 'what comes to be'. The first reading of the participle results in this reading of the premise: if X comes into being, then X comes into being from what-is or what-is-not. The second reading of the participle results in this reading:

τὸ γιγνόμενον ἢ ἐξ ὄντος ἢ ἐκ μὴ ὄντος,

if X comes to be F, then X comes to be F from what-is or what-is-not.

Neither of these readings makes much sense as stated. Both speak about coming from what-is or what-is-not. And Aristotle just does not tell us what he means by 'what-is' and 'what-is-not', nor does he tell us what it is for things to come from what-is or what-is-not. For instance, does he mean that, if Socrates comes into existence, then Socrates must previously have existed or not existed? Or does he mean that if Socrates comes into existence, then Socrates must have come into existence from say some previously existing or non-existing matter? These are obviously very different claims which are themselves unclear and in need of explanation. Unfortunately, there are many others ways of reading the claim.

However, I assume that the participle is used completely. In the last section, I discussed how we must read the conclusion of the Challenge as a denial of all kinds of change. This reading of the conclusion requires taking the occurrence of 'come to be' ('γίγνομαι') and 'cease to be' ('φθείρω') in the conclusion completely. By itself, this does not require that we take the occurrence of each of these verbs in the rest of the argument completely. Nevertheless, I will take each occurrence completely as I can do so while still presenting the main reconstructions of the Challenge. So I take the participle 'what comes to be' ('τὸ γιγνόμενον') completely, i.e. as 'what comes into being'. Thus the first premise of the Eleatic argument reads:

- If anything whatsoever comes into being, irrespective of what ontological category that thing belongs to, then that being must come into being from what-is or from what-is-not.

I will focus my attention on the difficulties for interpreting the premise when read in this way. These difficulties arise because it is extremely difficult to

understand what it means for X to come into being from what-is or from what-is-not. Both 'what-is' 'ἐξ ὄντος' and 'what-is-not' 'ἐκ μὴ ὄντος' are participle phrases formed from the preposition 'from' 'ἐξ with the present participle of the verb 'being' ἔἶναι′ in the genitive case.[23] Translating and interpreting these participle phrases is difficult because interpreting how 'being' (ἔἶναι′) is used in these phrases and what it means is difficult. Ross, for instance, writes:

> It is not at first sight clear whether this means 'either from what is or from what is not' or 'either from what is it or from what is not it.[24]

Why does Ross say that we can read the passage in both ways and what exactly do these different readings amount to? We normally translate the Greek verb ἔἶναι′ with the English verb 'to be' or 'being'. The English verb 'to be' has two syntactic uses; a complete and an incomplete use. Lesley Brown explains the difference between these complete and incomplete uses by using these two examples:

1. Socrates is.
2. To be or not to be.[25]

If a speaker uses 'to be' completely when she says 1 and 2, she utters well formed sentences: we do not require her to supply anything further to understand what she says. However, if she uses 'to be' incompletely when she says 1 and 2, she says no well formed sentence. What she says could be equivalent to, 'Socrates is *a*' and 'To be *a* or not to be *a*'. If a speaker says

[23]We can translate the preposition 'ἐξ' as either 'from' or 'out of'. But I doubt that mere reflection on this preposition will help us interpret the puzzle. So I will remain silent about it.

[24]Ross {74, p. 494}. See also Kelsey {53, p. 333}.

[25]Brown {15, p. 212–213}.

these two phrases to you, you will not understand her and will need to ask her 'Socrates is a what'?

We can use the English verb 'to be' in these two syntactically different ways: completely and incompletely. These two syntactical uses correlate with different uses of the verb.

When we use the English verb 'to be' completely, we mean 'exists'. So if a speaker uses 'to be' completely when she says 1, she means that Socrates exists. If she uses the verb completely when she say 2, she means 'To exist or not to exist'.

However, when a speaker use the verb 'to be' incompletely, she uses it to mean one of two things: a) the copula, or b) 'identical to'. Brown describes the copula as: "The verb whose sole function is to join subject to predicate and which has no 'further meaning of its own'. So it lacks meaning."[26] So if our speaker uses 'to be' incompletely when she says 1 and means the copula, then we will expect her to supply some complement to complete what she says, e.g. 'Socrates is laughing.' Alternatively, when we use the verb 'to be' incompletely, we often can use it to mean 'is identical to'. For example, if we ask our speaker the question, 'Who is that snub nosed man laughing?', and she answers 'Socrates is', she likely means that Socrates *is identical to* the snub nosed man laughing.

Ross says that we can translate what Aristotle writes in Greek in two different ways. These two ways come from (i) taking the Greek verb ἐῖναι′ either completely or incompletely, and (ii) assuming that this syntactic distinction correlates with the same semantic distinction we encounter with the English verb 'to be'.[27] This leads to two different readings of the phrases

[26]Brown {15, p. 213}.

[27]It is unlikely that the Greek verb 'εἶναι' has exactly all and only the syntactic and semantic properties as the English verb 'to be'. For instance, Brown {15} believes a complete

'what-is' and 'what-is-not', and so to two different readings of the premises that contain these phrases. For instance, the first premise can be read as follows:

The Complete Reading (CR) If X comes into being, then X comes into being from what exists or from what does not exist.

The Incomplete Reading (IR) If X comes into being, then X comes into being (i) from what is predicatively X or from what is not predicatively X, or (ii) from what is identical to X or from what is not identical to X.

CR and IR offer radically different interpretations of the Eleatic Challenge. Subsequently, how they interpret Aristotle's response will differ radically. Let me illustrate the difference between CR and IR by using some concrete examples of both a quality and a substance coming into being:

1. If the hot comes into being, then the hot comes into being from what exists or from what does not exist.
2. If the hot comes into being, then the hot comes into being from what is hot or from what is not hot.

use of 'εἶναι' is closely related to an incomplete use. She asks us to compare the verb 'εἶναι' to the verbs 'teach' and 'eat'. A speaker can say 'Jane teaches' and 'Jane teaches French'. These two uses of 'teach' are closely related. 'Jane teaches French' entails 'Jane teaches'. 'Jane teaches' entails 'Jane teaches something'. So Brown says that 'Jane teaches' is syntactically complete but that it allows for further completion. If that's right, the presence of a completion does not make the verb incomplete (because we can complete already completed verbs). Similarly, Brown believes that 'εἶναι' is both used completely and that it can be completed further. The English verb 'to be' does not have this feature. The closest we could come to expressing the same phenomena in English is with the phrases 'a being' *vs.* 'an F-being' (where 'F' selects a particular kind that beings fall under). So the sentence 'Socrates is a being' is well-formed. Nevertheless, we can fill the sentence out further by saying that 'Socrates is an F-being'. This latter sentence entails the former while the former entails that Socrates is some kind of being or other. (See also the influential work of Kahn {52}.) Obviously, if'εἶναι' has a different set of syntactic and semantic properties from 'to be' then the difficulties for interpreting the Eleatic Challenge increase dramatically. But I am going to set aside this issue. My alternative reading below treats the participles as variables that have as their values the termini of a change. Such an interpretation need take no stand on what the participles mean.

3. If Socrates comes into being, then Socrates comes into being from what exists or from what does not exist.
4. If Socrates comes into being, then Socrates comes to be from what is Socrates or from what is not Socrates.[28]

1 and 3 illustrate CR. 2 and 4 illustrate IR. IR and CR are radically different claims. IR is concerned with whether a being like Socrates can come into existence from some being which was or was not Socrates. So understood, the Eleatic Challenge denies that either is possible. What's key on this reading is that the arguments concern the relationship between the pre-existing entity and the product of the change, e.g. whether that pre-existing entity is or is not Socrates. CR is not obviously concerned with the relationship between the product and the entity it comes from. CR is concerned with whether the entity that the product comes from exists or does not exist. So understood, the Challenge argues that neither is possible.

I think that *neither* reading is correct. I explain why over the next few pages, but let me reiterate why I do so. CR and IR both offer different readings of the Challenge. On the one hand, both *are* intuitive ways of reading the premises of the argument. Indeed, they may seem the only intuitive ways. Nevertheless, I will argue that IR and CR leave us with very poor and weak arguments on different horns of the Challenge. I will then go on to argue that there is an alternative to both CR and IR. However, in order to make space for this alternative, it is important for me to explain why IR and CR fail.

Here's my general argument against both CR and IR: Aristotle thinks that an adequate rebuttal of the Eleatic Challenge requires that we bring

[28]We can read 'is' in 2 and 4 as either the copula or the 'is' or identity.

clearly into focus the correct view of the principles of nature. But, I argue, on CR and IR, we need no correct view of the principles. For, on both CR and IR, the Eleatic Challenge fails just because it is invalid and obviously invalid. In other words, I argue that, on either of these readings of the Eleatic Challenge, Aristotle is wrong to say that meeting that challenge requires any understanding of the principles of nature. I will discuss CR and IR in turn.

5.4.1 The complete reading

Recall that CR interprets the first premise as follows:

CR If X comes into being, then X comes into being from what exists or from what does not exist.

On this reading, we must identify the subjects of 'what exists' and 'what does not exist'. There are two distinct options, and so two distinct versions of CR. The first takes both to have an indefinite subject. Call this reading *CR1*.

CR1 If X comes into being, then X comes into being from something or other that exists or does not exist.

The second takes the subject to be X itself. Call this reading *CR2*

- If X comes into being, then X comes into being from X existing or X not existing.

I will clarify each reading and then argue against both.

CR1

On CR1, we must (i) take the participles 'what-is' 'ἐξ ὄντος' and 'what-is-not' 'ἐκ μὴ ὄντος' substantively, and (ii) assume that the omitted article is an

indefinite article. Let us use'Y' for this indefinite subject. So, on CR1, the first premise reads:

CR1 If X comes into being, then X comes into being from Y-existing or from Y-not-existing.

Notice that 'Y' does not refer to any specific being. It refers to anything whatsoever that can be truly described as existing or not existing.[29] Similarly, 'a whale' need not refer to any specific whale. It can refer to anything whatsoever that can be truly described as a whale.

Here is an example to illustrate CR1:

- If Socrates comes into being, then Socrates comes into being from some existing thing or from some non-existing thing.

What's important to note here is that there is no specific existing or non-existing thing being referred to. So understood, the claim is weak. However, we are meant to suppose that the Eleatic Challenge argues that neither option specified is possible.

On the one hand, CR1 can interpret the second horn of the dilemma in a way that leaves a plausible argument. On this horn, the Challenge argues:

- If X comes into being from anything whatsoever which can be truly described as not-existing, then there is no subject. But this is impossible.

We can justify this inference if we assume that X must come into being from a subject, and that this subject must exist. Both seem reasonable assumptions.

The problem, though, with CR1 is how it interprets the first horn of the dilemma. On CR1, the first horn argues the following:

[29] I set aside issues of how we may refer to non-existing entities.

- If X comes into being from some existing thing or other, then X exists before X comes into existence. But this is impossible.

The difficulty lies in why anyone would accept this inference. Sean Kelsey puts the point nicely:

> Why should it follow, just because Socrates comes to be from something that "is" (period), that he already was, before he came to be?[30]

Let us recall that Aristotle thinks that the Eleatic Challenge can be met, but he thinks that meeting the challenge require identifying and correcting a mistaken view of the principles that the Challenge assumes. But if we accept CR1, we can meet the Challenge without any deep understanding of the principles of nature. For on CR1, the Challenge assumes:

- If X comes into being from something or other existing, then X comes into being from X.

For instance, CR1 claims that if Socrates comes into being from something or other that exists, then Socrates comes into being from Socrates. But CR1 offers us no explanation as to why the Monist would endorse this inference. *And* the only way of supporting the inference is unavailable to the Monist. For the only way to support this inference is by further assuming:

- Only X exists.

Assuming this claim would allow the argument on the first horn to go through. If only X exists, and X comes into being from Y existing, then X is identical to Y and X comes into being from itself. For instance, if only Socrates exists and Socrates come into being from Y existing, then Socrates is identical to Y and Socrates comes into being from himself.

[30]Kelsey {53, p. 333}.

But the Eleatic Challenge just cannot assume that there is only one being X that exists. There are two stages to the Eleatic Challenge. In the first stage, the Monist argues that change is impossible. In the second stage, she *uses* the impossibility of change to argue that there is only one being. Aristotle does not provide the details of the second stage. Nevertheless, irrespective of the details, the Eleatic Challenge cannot both use an argument for the impossibility of change to establish monism *and* assume monism as a premise in the argument for the impossibility of change.

Again, Aristotle argues that the Eleatic Challenge fails. But Aristotle also says that we must understand the principles of nature to understand why the Challenge fails. But on CR1, we need no understanding of the principles to respond to the Challenge. All we need observe is that the Challenge assumes its conclusion as a premise. Seeing that such an argument fails requires no understanding of the principles of natures. It requires only a basic grasp of logic.

CR2

Unlike CR1, CR2 takes 'what comes into being' (' τὸ γιγνόμενον") as the subject of the participles 'what-is' 'ἐξ ὄντος' and 'what-is-not' 'ἐκ μὴ ὄντος'. On this reading, the first premise of the Eleatic Challenge reads:

- If X comes into being, then X comes into being either from X-existing or from X-not-existing.[31]

[31]See Waterlow {84, p. 9} for this reading. Note that 'τὸ γιγνόμενον' is in the accusative. So one might ask how 'τὸ γιγνόμενον' could be the subject of 'ἐξ ὄντος' and 'what-is-not' 'ἐκ μὴ ὄντος', which are in the genitive. But while the cases of these phrases do not agree with one another, the case of 'what-is' 'ἐξ ὄντος' and 'what-is-not' 'ἐκ μὴ ὄντος' is governed by the preposition 'ἐξ'. So syntax allows this reading. Let me add that Waterlow seems to think that the participle 'ὄντος' is used circumstantially with temporal force: X comes from it (X) previously existing or from it (X) previously not-existing.

There is some evidence for CR2. On the first horn, the Challenge argues that what is cannot come into being from what-is because what-is would already be. This assumes that if what comes into being (τὸ γιγνόμενον) comes from what-is (ἐξ ὄντος), then what-is (τὸ ὂν) would come into being. For example, it says that if Socrates comes into being from what-is, then what-is would come into being. This suggests that 'what comes into being' ('τὸ γιγνόμενον') is referring to whatever 'what-is' ('τὸ ὂν') is referring to.

So understood, CR2 offers a reasonable argument on the first horn of the dilemma. CR2 says, for instance, that if Socrates comes into being from himself previously existing, then Socrates would have existed before he came into existence. It is easy to see why this is a problem. If Socrates continually exists for some duration of time, this is not a time during which Socrates has come into or out of existence. This is precisely a time during which he has continued to exist. So Socrates cannot come into existence from previously existing for that would not be a change at all.

However, CR2 offers a poor argument on the second horn of the dilemma:

- If X comes into being from X-not-existing, then there would be no subject. But this is impossible.

For instance, CR2 says that if Socrates comes into being from himself not-existing, there would be no subject. Before I explain why this is problematic, I first discuss the incomplete reading (IR). I then argue that CR2 and IR both fail as interpretations of the second horn of the dilemma.

5.4.2 The incomplete reading

IR says that 'what-is' 'ἐξ ὄντος' and 'what-is-not' 'ἐκ μὴ ὄντος' are used incompletely and says that we must supply a complement to complete both

phrases. This complement is 'what comes to be'. So IR reads the first premise as follows: X comes to be from what-is-X or from what-is-not-X. For instance, Socrates comes to be from what is Socrates or what is not Socrates. We can read 'is' here as either the copula or the 'is' of identity, but I will continue to speak of both together as the incomplete reading; my objection to IR applies irrespective of whether we read 'is' as the copula or the 'is' of identity.

CR2 and IR yield a poor argument on the second horn of the dilemma, poor for the same reason. On IR, the Monist would would argue that if X comes to be from what-is-not X, there is no subject. For example, if the hot comes to be from what-is-not hot, there would be no subject. On CR2, the Monist would argue that if the hot comes into being from it, the hot, not existing, there would be no subject. But these inferences are suspect. Kelsey puts the point as follows:

> Why should it follow, just because Socrates comes to be from something that is not Socrates, that he comes to be from nothing at all (or from nothing that "underlies")?[32]

Similarly, why should it follow, just because Socrates comes to be from himself not existing, that he comes to be from nothing at all (or from nothing that underlies)? On CR2 and IR, the Monist infers that, if Socrates comes to be from something that is not-Socrates or from himself not-existing, then there would be no subject. But why would she accept this inference? The obvious response is that Socrates comes to be from a subject which is not Socrates but is something else, say, menstrual blood. This response must be unavailable to the Monist. But it is only unavailable to him if he can show that, if Socrates comes to be from what-is-not Socrates or from himself not-existing, then Socrates comes to be from nothing at all.

[32]Kelsey {53, p. 334}.

The difficulty for IR is that the Monist cannot support her claim in this way. If she claims that, if Socrates comes to be from what is not Socrates, then Socrates comes to be from nothing at all, she would assume that the only being that exists or could exist is Socrates. But the Monist cannot assume that only Socrates exists. For the claim that only Socrates exists entails monism; that there exists only one being. However, Aristotle tells us that the Monist uses the impossibility of change to argue for monism. So the Monist cannot assume monism in an argument that is ultimately for monism. And, on CR2 and IR, assuming monism is the only way she could support his argument on the second horn of the dilemma.

Let me be clear. Aristotle thinks that the Monist's argument on the second horn fails. But Aristotle also says that we must understand the principles of nature in order to understand this failure. But on CR2 and IR, we need no deep understanding of the principles to meet the Eleatic Challenge. All we need observe is that the Monist assumes monism in an argument for monism.

Perhaps we might defend CR2 and IR by translating 'subject' (ὑποκείμενον) in different ways. For instance, Michael Loux writes:

> the remark in question has to be understood to have the neutral force "There must be something there beforehand." But, then, the remark does not provide a separate reason for endorsing the claim that "nothing comes to be from that which is not;" so understood, the remark merely reformulates that claim or restates it in other words.[33]

Aristotle reports earlier thinkers believing that there must be something which iὑποκεῖσθαι'. I translate this phrase 'to underlie', i.e. to be a subject. But Loux worries that this is a mistranslation. He claims that Aristotle

[33]Loux {63, p.285}.

discovered the need for a subject of change. Since the Monist was unaware of the need for a subject of change—according to Loux—, Aristotle should not say that she assumes that need as a premise. So Loux says that we must translate the term in some other way, and he suggests that we can translate it as 'something or other'. The Monist then argues that if Socrates comes to be from what-is-not-Socrates or from himself not existing, Socrates would come to be from what-is-nothing at all.

Below I discuss whether the Monist recognizes the need for a subject of change. Here I only say that translating 'ὑποκεῖσθαι' in this alternative way does not help. The Monist would assume that if Socrates comes to be from what-is not Socrates, Socrates would come to be from nothing at all. But this is no argument. The inference could only be supported by assuming that the only way for something to be is to be Socrates. This, of course, assumes the very thing that the Monist ultimately tries to argue for—monism.

Concluding: I have discussed and argued against some different ways of interpreting the first premise. Each way results in arguments for the impossibility of change that assumes monism. This would be surprising. According to Aristotle, the Eleatic Challenge constrained two centuries worth of scientific investigation into nature and change. Many philosophers tried to meet the challenge and so block the radical conclusion that being is one and unchanging. Aristotle too tries to meet the challenge. But he explicitly says that doing so requires that we get a clear view of the principles of nature. But if either IR or CR is correct, then no deep investigation of the principles is needed. So interpreted, this argument for monism assumes monism. Nobody should take such an argument seriously.

5.5 An Alternative Reading of 'what-is' and 'what-is-not'

There is an alternative to both IR and CR that leaves strong arguments on both horns of the Eleatic Challenge, and also explains why Aristotle says that we must understand the principles of nature to meet that challenge. This alternative relies on various claims about opposites, some of which we encountered earlier in *Phys.* I. I will argue that 'what-is' and 'what-is-not' are variables that take as their values those opposites that a change occurs between. Understood in this way, we can sidestep the difficulties that arise when translating these phrases. For if they function as variables, they can be replaced with any letters or words that we choose and define as variables. I will first discuss why I believe that 'what-is' and 'what-is-not' function as variables that take opposites as their values. I then discuss how this leads to a new and attractive reading of the Eleatic Challenge.

Recall that Aristotle begins *Phys.* I.5 as follows:

> (a) All thinkers agree in making the opposites principles, (b) both those who describe the All as one and unmoved, for even Parmenides treats hot and cold as principles under the names fire and earth, (c) and those too who use the rare and the dense. (d) The same is true of Democritus also, which his plenum and the void, both of which exists, he says, the one as being, the other as not-being. Again he speaks of differences in postion, shape, and order, and these are genera of which the species are opposites, namely, of position, above and below, before and behind; of shape, angular and angle-less, straight and round (188a19–26).[34]

In (1) Aristotle says that all his predecessors agree that some pair of opposites are principles. In (2) he speaks about Parmenides and says that Parmenides believes that earth and fire are principles; though Aristotle says

[34] Πάντες δὴ τἀναντία ἀρχὰς ποιοῦσιν οἵ τε λέγοντες ὅτι ἓν τὸ πᾶν καὶ μὴ κινούμενον (καὶ γὰρ Παρμενίδης θερμὸν καὶ ψυχρὸν ἀρχὰς ποιεῖ, ταῦτα δὲ προσαγορεύει πῦρ καὶ γῆν) καὶ οἱ μανὸν καὶ πυκνόν, καὶ Δημόκριτος τὸ πλῆρες καὶ κενόν, ὧν τὸ μὲν ὡς ὂν τὸ δὲ ὡς οὐκ ὂν εἶναί φησιν· ἔτι θέσει, σχήματι, τάξει. ταῦτα δὲ γένη ἐναντίων· θέσεως ἄνω κάτω, πρόσθεν ὄπισθεν, σχήματος γεγωνιωμένον ἀγώνιον, εὐθὺ περιφερές. ὅτι μὲν οὖν τἀναντία πως πάντες ποιοῦσι τὰς ἀρχάς, δῆλον.

that this is equivalent to making the opposites hot and cold principles. Perhaps it is confusing to find Aristotle saying that Parmenides believes that there are two principles of those beings which change given that Parmenides is supposed to believe that there is only one principle and that change is impossible. But Aristotle's point here is that Parmenides believes that, if change were possible, then the opposites hot and cold would be principles of those beings that change.

Now in (4) Aristotle says that Democritus believes that the opposites plenum and void are principles. He adds something striking: he tells us that Democritus says that the plenum exists as what-is, and that the void exists as what-is-not. So for Democritus what-is and what-is-not are opposites because they are the opposites plenum and void.

Before I discuss this point further, note that while Aristotle says that Democritus makes one of his opposites what-is and makes the other what-is-not, he does not say the same about Parmenides or the natural philosophers he refers to in (3). But he does make this point in other places. For instance, in *GC*. Aristotle says:

> (5) Thus Parmenides speaks of two, saying that that what-is is fire and what-is-not is earth. (6) Whether we postulate this particular pair or another of the same kind makes no difference: for we are seeking the character of the change, not its subject. (7) The way which leads to what-is-not unqualifiedly is unqualified perishing, and the way that leads to what-is unqualifiedly is unqualified generation. (8) In whatever way the distinction is made, whether in terms of earth and fire or of some other pair, one of the pair will be what-is, the other what-is-not (*GC* 318b5–12).[35]

In this passage, Aristotle is speaking about how to individuate unqualified

[35] ὥσπερ Παρμενίδης λέγει δύο, τὸ ὂν καὶ τὸ μὴ ὂν εἶναι φάσκων πῦρ καὶ γῆν. Τὸ δὴ ταῦτα ἢ τοιαῦθ' ἕτερα ὑποτίθεσθαι διαφέρει οὐδέν· τὸν γὰρ τρόπον ζητοῦμεν, ἀλλ' οὐ τὸ ὑποκείμενον. Ἡ μὲν οὖν εἰς τὸ μὴ ὂν ἁπλῶς ὁδὸς φθορὰ ἁπλῆ, ἡ δ' εἰς τὸ ἁπλῶς ὂν γένεσις ἁπλῆ. Οἵς οὖν διώρισται εἴτε πυρὶ καὶ γῇ εἴτε ἄλλοις τισί, τούτων ἔσται τὸ μὲν ὂν τὸ δὲ μὴ ὄν. See also *Met.* 986b33–987a1.

generation from unqualified perishing. In (7) he says that a process of coming to be begins with what-is-not and ends with what-is, and a process of perishing begins with what-is and ends with what-is-not. This is as we might expect. But what's important for our purposes is how Aristotle uses 'what-is' and 'what-is-not'. In (5) Aristotle explicitly says that Parmenides identifies what-is and what-is not with fire and earth, i.e. with the opposites hot and the cold.[36] And Aristotle in (6) and (8) says that we need pay no attention to this example of the hot and cold. There might be some other pair of opposites that unqualifed change occurs between, like rarity and density. Nevertheless, Aristotle stresses that unqualified change always occurs between a pair of opposites, whether those opposites be the hot and the cold, or the rare and the dense, etc.

What Aristotle says in the last two passages is striking and more than a little puzzling. One might, for instance, interpret him as saying that for Parmenides fire is the existing stuff and earth is the non-existing stuff. This is bizarre. Why would Parmenides say that all non-existing stuff is earth? Fire and earth differ not because one exists and the other does not exist. Rather, fire and earth differ because they are different kinds of existing stuffs.

So what does Aristotle mean when he says that philosophers like Parmenides and Democritus identify what-is and what-is-not with a pair of opposites if he does not mean that one opposite exists and the other does not?

I suggest that Aristotle uses 'what-is' and 'what-is-not' as variables that have as their values the opposites that a change occurs between. For example, warming takes place between the opposites cold and hot: a stone be-

[36]One might worry that Aristotle presents Parmenides as using premises from the Way of Opinion in an argument in the Way of Truth against the possibility of change. But I am not claiming that Aristotle presents Parmenides in this way. My point is about usage. This example is another instance where Aristotle uses 'what-is-not' and 'what-is' for those opposites that a change occurs between.

comes warm from being cold. So warming can be characterized as a change that occurs between what-is-not and what-is as long as we take 'the cold' as the value of 'what-is-not' and 'the hot' is the value of 'what-is'.

I suggest that we read the first premise of the Eleatic Challenge in a similar way:

- If X comes to be, then X comes to be from X or from the opposite of X.

For instance, if the hot comes to be, then the hot comes to be from the hot or from the cold.[37]

My argument for reading the phrases in this way is twofold. First, Aristotle uses 'what-is-not' and 'what-is' for a pair of opposites earlier in *Phys.* I.5 so there is no reason that he should not be doing so here. Second, reading the phrases in this way leads to an attractive and plausible reading of the Challenge that is immune to those difficulties that beset the alternatives.

5.6 A New Reconstruction

I will now turn to reconstruct the dilemma. I suggest that the Monist and Aristotle agree on three key assumptions. I use 'A' for 'assumptions', and these assumptions are what support the explicit premises of the Challenge.

A1: Change occurs between opposites.

A2: There is a subject of change.

A3: The subject of a change cannot be identical to either of the opposites that a change occurs between.

[37]Michael Loux has offered a similar reading of the first premises. Loux {63, p. 288} claims that (i) 'what is' and 'what is not' "provide fully significant and unambiguous characterizations of the terms of a coming to be." (ii) These phrases are "generalizations of more particular characterizations" (Loux {63, p. 290}). However, Loux and I differ in that he thinks 'what-is-not' stands for the mere absence of what-is, e.g. the mere absence of heat. In contrast, I think it stands for the opposite of what-is, e.g. the cold.

I discussed A1 in Ch.2: change must occur between opposites because processes of change are defined in terms of those opposites that they occur between. I think A2 is never defended. I discussed A3 in Ch.3: the subject of change cannot be identical to either of the opposites that a change occurs between because (i) the subject of change must persist as it is being acted upon by the actor which brings about a change in it, and (ii) the relevant opposite is destroyed and so cannot persist through the change.

I will first reconstruct the Eleatic Challenge by using A1–A3. I then explain why I think we can safely attribute A1–A3 to the Monists, Parmenides and Melissus. I use the letters 'F' and 'O' to stand for each of a pair of opposites.

P1: If F comes to be, F comes to be either from F or from O. (From A1)

P2: If F comes to be from F, F is already.

P3: It is not possible for F to come to be if F is already.

C1: F cannot come to be from F. (From P1–P3)

P4: If F comes to be from O, O is the subject of change.

P5: It is not possible for O to be the subject of change (From A3)

C2: F cannot come to be from O. (From P1; P4–P5)

C3: F cannot come to be. (From C1&C2)

Unlike IR and CR, this argument does not assume monism. Support for P1 comes from the claim that change occurs between opposites. Supporting P1 in this way does not depend upon monism, but on the assumption that the only principles of nature are opposites. Similarly, support for P2 comes from assuming that since the only principles of nature are opposites, then it must be an opposite that is the subject of change. Let me illustrate this with an example.

Let us assume that the hot (or the hot thing) comes to be. P1 says that when the hot comes to be, the hot can come to be from one of two things. First, it can come to be from the hot. Second, it can come to be from the cold. Neither option is possible. If there is heat where previously there was heat, there has been no change: something has just continued to be hot. But neither can the hot come to be from the cold. If the hot came to be from the cold, the cold must be that subject which warms up. But, as Aristotle discussed in *Phys.* I.6, the cold (or what is just cold) cannot be the subject of change. So if the hot comes to be from the cold, then the hot must come to be from nothing at all. And if the hot comes to be from nothing at all, there is no subject.

Read in this way, the Eleatic Challenge is deeply integrated with and builds upon the rest of *Phys.* I. The Challenge arises precisely from an inability to see how opposites and a subject of change could simultaneously be principles of nature. Aristotle accepts A1–A3; the assumptions the argument turns on and the assumptions he has discussed in length. So we find Aristotle discussing a puzzle based on assumptions that he accepts. Aristotle should then take the puzzle seriously. In particular, we expect Aristotle to show how he can accept A1–A3 and yet still meet the challenge. After all, the Monist also accepts A1–A3 but he believes that it is precisely because A1–A3 cannot be satisfied that change is impossible. In the second part of this chapter, I show how Aristotle deploys his own view of the principles to argue that we can hold on to both A1–A3 and still escape both horns of the dilemma. We will see that his response precisely turns on the claim that the privation and subject of change are one in number, two in form. So unlike the Monist, Aristotle has a view of the principles that allows him to argue that

changes occur between opposites even though opposites are not the subject of any change.

5.7 Objections and Responses

Let me clarify my reading by responding to two potential objections. First, on my reading, one might worry that Aristotle could only be speaking about qualified change and not also about unqualified change, i.e. coming into and going out of existence. For instance, in respect to sculpting, I take 'shapelessness' as the value of 'what-is-not' and 'shaped' as the value for 'what-is'. But both shapelessness and shaped exist. And so we might wonder whether unqualified changes like sculpting really are changes that occur between what exists and what does not exit (or *vice versa*). In other words, we may worry that, on my reading, unqualified changes are changes from what exists to what exists. This is a reasonable concern. Let me say three things to try ease it.

First, in *Phys.* I.5 and elsewhere, Aristotle clearly calls certain pairs of existing opposites 'what-is' and 'what-is-not'. This might be counter-intuitive, but Aristotle says it nonetheless.

Second, we can explain why Aristotle believes that unqualified change occurs between opposites if we focus on the processes of unqualified changes. When something comes into being, there is some change that occurs. Let us suppose that a special form of heating (concoction) occurs whenever something new comes into being. And let us suppose that a special form of cooling occurs whenever something ceases to be (altogether). These processes of heating and cooling occur between the hot and the cold. For warming and cooling are precisely the processes they are because they occur between

these opposites. And Aristotle does believe that unqualified changes are always some kind of process of change, e.g. heating, concocting, combination, separation, etc. Since these processes are always some kind of change, and since changes are individuated in part by the opposites they occur between, it is reasonable for him to believe that unqualified changes must occur between pairs of opposites.

Third, if unqualified changes occur between opposites, this does not entail that new objects do not come in or out of existence during these changes. For instance, we might accept that Socrates comes into being during a process of heating and that this process occurs between the cold and hot. For we might think that some initially cold thing undergoes a process of being warmed up and that the result of it becoming warm is that Socrates comes into existence. For instance, Thales might argue that the end result of some rarefied water becoming dense is that Socrates exists. Nevertheless, this process of unqualified change—compression—occurs between the opposites rarity and density.

A second potential objection lies in my claim that Aristotle believes that the Monist accepts A1–A3. This is striking because we may worry that Parmenides cannot accept each. After all, if Aristotle was the one to discover and argue for A1–A3, he should not present the Monist arguing for the impossibility of change on these assumptions. Why think Aristotle attributes A1–A3 to his predecessors?

First, showing that Aristotle says that his predecessors believe that change must be between opposites (A1) is simple. In the last section, I discussed how Aristotle explicitly says that Parmenides believes that the opposites are principles. Parmenides denies that change exists. So, obviously,

Parmenides does not believe that the opposites are principles of beings that really do change. Rather, Parmenides believes that if change were possible, change would occur between opposites.

So Aristotle says that Parmenides accepts A1. Nevertheless understanding how Aristotle attributes this belief to Parmenides requires care. For example, he says:

> As I have already said, in this much most of the others who write on nature agree. (1) For all of them suppose that the elements, called principles by them, are opposites, although (2) they suppose this without explaining why they are elements as if they were constrained by the truth itself (189b26–30).[38]

Aristotle in (1) says that his predecessors agree that the opposites are principles. But Aristotle in (2) qualifies what beliefs he attributes to his predecessors. He thinks that they fail to understand why the opposites are principles. Nonetheless, Aristotle still attributes to them this belief.

Showing that Aristotle attributes A2 to his predecessors is harder. Aristotle uses 'ὑποκεῖσθαι' when reporting the second horn of the Eleatic Challenge. I translate the term as 'subject' and I assume that the Monist argues: if X comes to be from what-is-not, there would be no subject. For if X comes to be from its opposite, its opposite would then be the subject. Since the opposite cannot be the subject, X would come to be from nothing at all. Hence, there would be no subject.

However, we may worry whether Aristotle can attribute A2 to his predecessors. If Aristotle discovered the need for a subject of a change while his predecessors failed to recognize that need, Aristotle should not report them

[38]μέχρι μὲν οὖν ἐπὶ τοσοῦτον σχεδὸν συνηκολουθήκασι καὶ τῶν ἄλλων οἱ πλεῖστοι, καθάπερ εἴπομεν πρότερον· πάντες γὰρ τὰ στοιχεῖα καὶ τὰς ὑπ' αὐτῶν καλουμένας ἀρχάς, καίπερ ἄνευ λόγου τιθέντες, ὅμως τἀναντία λέγουσιν, ὥσπερ ὑπ' αὐτῆς τῆς ἀληθείας ἀναγκασθέντες.

as saying that change requires a persisting subject in a premise of their argument for the claim that change is impossible.

But I see no evidence that Aristotle thinks his predecessors were unaware of the need for a subject of change. He explicitly characterizes his predecessors believing in a subject earlier in the work. Here are two examples:

> On the other hand, the physicists speak in two ways. Some physicists making the body that is subject one, either one of the three or something else which is denser than fire and rarer than air, then generate everything else from this, and obtain multiplicity by condensation and rarefaction (187a12–17).[39]

Again:

> There is, therefore, much to be said for those who make the subject different from these four [fire, air, earth, and water]; of the rest, the next best choice is air, as presenting sensible differences in a less degree than the others; and after air, water (189b5–8).[40]

In both these quotations, Aristotle says that some of his predecessors agree that there is a subject, but they disagree about which being or beings is/are these subjects. Thales may believe this subject is water. Parmenides believes that if change were to exist, then fire or earth would have to be this subject.

So Aristotle says that his predecessors believe in a subject of change. Again, we must take care in how we understand Aristotle's ascription of this belief. For we just saw that Aristotle characterizes his predecessors' beliefs about opposites in a way that is likely alien to them. Likewise Aristotle can characterize his predecessors' beliefs about the subject of change in ways

[39]Ὡς δ' οἱ φυσικοὶ λέγουσι, δύο τρόποι εἰσίν. οἱ μὲν γὰρ ἓν ποιήσαντες τὸ [ὂν] σῶμα τὸ ὑποκείμενον, ἢ τῶν τριῶν τι ἢ ἄλλο ὅ ἐστι πυρὸς μὲν πυκνότερον ἀέρος δὲ λεπτότερον, τἆλλα γεννῶσι πυκνότητι καὶ μανότητι πολλὰ ποιρον, τἆλλα γεννῶσι πυκνότητι καὶ μανότητι πολλὰ ποιοῦντες (ταῦτα δ' ἐστὶν ἐναντία, καθόλου δ' ὑπεροχὴ καὶ ἔλλειψις.

[40]διὸ καὶ οὐκ ἀλόγως ποιοῦσιν οἱ τὸ ὑποκείμενον ἕτερον τούτων ποιοῦντες, τῶν δ' ἄλλων οἱ ἀέρα· καὶ γὰρ ὁ ἀὴρ ἥκιστα ἔχει τῶν ἄλλων διαφορὰς αἰσθητάς· ἐχόμενον δὲ τὸ ὕδωρ.

that are alien to them: they may not possess the terms and concepts to characterize this belief in the way that Aristotle characterizes it. Sarah Waterlow puts the point nicely:

> Yet the phrase [subject] is not entirely out of place in this brief account of the paradox, because it reflects a conceptual requirement to which the earlier thinkers were no less sensitive than Aristotle himself, although unlike him they could not see how it was to be reconciled with the fact of *change*.[41]

Aristotle's predecessors believe that change requires a subject of change. They were unable to articulate this belief in precisely these terms and they may have been unaware about why they believed change requires a subject of change. But believe in the need for a subject of change they did.

So we can understand Aristotle's characterization of the Monist as follows: the Monist argues that, if change were to exist, change must occur between opposites and there must be a persisting subject of change. But the Monist believes that, if there were a subject of change, the only candidate for that subject was an opposite. In other words, the Monist believes that a subject must undergo each change and was unable to clearly distinguish any other candidate for this subject than the *termini* of a change. However, the Monist argued that an opposite could never undergo a change, could never be a subject of change.

So while the Monist agrees that A1–A3 are individually necessary conditions for a change to occur, he was unable to see how any being could satisfy A1–A3.[42] If A1 is satisfied, X must come to be from its opposite. But since the Monist understood this to mean that X must come to be *only* from its opposite, he thought A2 could not also be satisfied. In contrast, if A2 is satisfied, A1 cannot be satisfied. If X comes to be from some subject of change,

[41] Waterlow {84, p. 9}.

[42] They are unlikely sufficient as we also need an efficient cause.

then this subject cannot be the opposite of X. Since the Monist thinks that X can only come to be from one thing, if X comes to be from subject of change and this subject is distinct from the opposite of X, then A1 cannot also be satisfied.

This concludes how I interpret the argument. On this reading, it is plain that a certain view about the principles lies behind the Eleatic Challenge. In effect, the Monist assumes that, if X comes to be, X cannot come to be from both a subject of change and X's opposite, e.g. the sculpted cannot come to be from both the unsculpted and some subject of change. Aristotle's solution, we will see, is to show that the product of a change can come to be from both the opposite and the subject of change.

There is a deep and interesting question as to why the Monist thinks that X cannot come to be from the unsculpted and some subject of change. The issue is at the heart of *Phys.* I.2–3. Discussing those chapters would take a dissertation in its own right. But let me here observe that Aristotle in those chapters attributes to the Parmenides and Melissus the view that for each being, there is one predicate that it possesses. So certain things are hot and only hot. Other things are horses and only horses, but nothing is both a horse and hot. Unfortunately, Aristotle never tells us why the Monists accept this claim. He merely observes that these predecessors believe it impossible for something to be both one and many, a belief that he rejects. (See 185b25ff)

5.8 Aristotle's Solution: Tools

There are two key elements to Aristotle's response. First, unlike the Monist, on Aristotle's view of the principles, the subject and privation are one in

number and two in form, e.g. one entity can be both shapeless and bronze. Second, this view of the principles allows Aristotle to distinguish different ways for the product of a change to come into being from the privation and the subject. This distinction in turn allows Aristotle to distinguish two different ways of reading the first premise of the Eleatic Challenge. Read in one way, he believes that the argument is valid but unsound. Read in another, distinct way, he thinks that the argument is invalid. I discuss both these elements in turn:

First, in *Phys.* I.7 Aristotle claims:

> In every case, there must be something which underlies [is the subject for] what comes to be; even if the subject is one in number, the subject is not one in form, since being a man is not the same as being an unmusical thing. (By 'in form' I mean the same as 'in account')(189b13–16).[43]

Here Aristotle says the subject and privation are one in number but two in form. By this, Aristotle means first that, say, being a man and being musical coincide in one substance. Second, he means that what it is to be a man differs from what it is to be unmusical. Similarly, what it is to be unsculpted differs from what it is to be bronze. This difference is important. I will explain why from the perspective of a music teacher.[44]

[43] διωρισμένων δὲ τούτων, ἐξ ἁπάντων τῶν γιγνομένων τοῦτο ἔστι λαβεῖν, ἐάν τις ἐπιβλέψῃ ὥσπερ λέγομεν, ὅτι δεῖ τι ἀεὶ ὑποκεῖσθαι τὸ γιγνόμενον, καὶ τοῦτο εἰ καὶ ἀριθμῷ ἐστιν ἕν, ἀλλ' εἴδει γε οὐχ ἕν· τὸ γὰρ εἴδει λέγω καὶ λόγῳ ταὐτόν·

[44] I here follow Irwin's reading of 'one in number, two in form'. According to Irwin, we use concrete phrases like 'the unmusical' to refer to both property instances *and* the subjects these property instances are in. Since there is only one subject that possesses this property instance of unmusicality, Irwin claims we can also use 'unmusical' to refer to that subject (Irwin {48, p. 515}) Subsequently, Irwin {48, p. 85} says "[t]he subject has different property instances that are one in number, since they belong to the same particular subject but different in 'being' (191a1–3) or 'form' (190a13–17), allowing us to refer to that subject in different ways." The instance of man and the instance of unmusicality are one in number because there is one subject that has both property instances. For alternative readings, see Code {24, 25}, Matthews {68, 67}.

Let us suppose that the famous Terpander decides to teach Arion how to play the lyre. If he is to make a musician out of Arion, he will expect two things of his prospective student. First, he will expect that Arion can complete the intensive music lessons. Arion won't complete the lessons if he is weak willed, sickly, distractable, and so on. Even if he were able to begin the lessons, he would quit halfway due to illness or some other difficulty. Second, he will expect that Arion is ready and able to start learning how to play the lyre. After all, Arion won't be able to start learning if he is still a child, so young he has yet to sufficiently develop cognitively and physically to begin learning anything at all. Similarly, if Arion has suffered some catastrophic injury in his life, there is little that Terpander can do to teach him music. So Terpander needs Arion to be able to both begin and complete a music education. If Terpander believes Aristotle, he will think that it is only unmusical men who are able to do both, i.e. that he can only make a musician out of unmusical men. Not every man can learn music. It is only those who are in the appropriate state that can do so.[45]

We may agree that Arion must be both unmsuical and a man to be a suitable musical student. But this agreement assumes that Arion can be two things, both unmusical and a man. This is one of Aristotle's key responses to the Eleatic. For the Eleatic believes that Arion could only be one thing, only a man, or only unmusical, and so on.[46]

The second element of Aristotle's response utilizes this difference between the subject and privation to claim that the first premise of the Eleatic Challenge can be read in two different ways. Recall the first premise as I construe it:

[45]Recall that the unmusical is not the mere absence of musicality. See Ch.2

[46]Kelsey {53} also argues that Aristotle's claim that the subject and privation are one in number, two in form is central to his solution.

P1. If F comes into being, then F comes into being either from F or from O.

Aristotle's crucial claim is that there are two different ways for one thing to come into being from another (191b13–16). Thus he thinks that P1 admits of two distinct readings:

P1*. If F comes into being, then F comes into being either unqualifiedly from F or unqualifiedly from O.

P1**. If F comes into being, then F comes into being either coincidentally from F or coincidentally from O.

So Aristotle thinks that one thing can come into being unqualifiedly or coincidentally from another. What are these two different ways and how do they differ from one another? Aristotle clarifies this distinction with an example:

> Now a doctor builds a house, not insofar as he is a doctor, but insofar as he is a housebuilder; and he becomes pale, not insofar as he is a doctor, but insofar as he is dark. But he practices medicine, or loses his medical knowledge, insofar as he is a doctor. We speak in the fullest sense of a doctor acting on something or being acted on, or coming to be something, from being a doctor, if it is insofar as he is a doctor that he is acted on in this way or produces these things or comes to be these things (191b4–8).[47]

Suppose that Galen cures a patient. We can describe Galen's curing a patient in different ways. We could say that the house-builder cures a patient, the violin player cures a patient, the tired parent cures a patient. These sentences are all true—assuming that Galen also builds houses, plays the violin and has just had a child. But none of these descriptions picks Galen out in a way that describes his ability to build houses. In contrast, 'doctor'

[47] οἰκοδομεῖ μὲν οὖν ὁ ἰατρὸς οὐχ ᾗ ἰατρὸς ἀλλ' ᾗ οἰκοδόμος, καὶ λευκὸς γίγνεται οὐχ ᾗ ἰατρὸς ἀλλ' ᾗ μέλας· ἰατρεύει δὲ καὶ ἀνίατρος γίγνεται ᾗ ἰατρός. ἐπεὶ δὲ μάλιστα λέγομεν κυρίως τὸν ἰατρὸν ποιεῖν τι ἢ πάσχειν ἢ γίγνεσθαι ἐξ ἰατροῦ, ἐὰν ᾗ ἰατρὸς ταῦτα πάσχῃ ἢ ποιῇ ἢ γίγνηται,

both refers to Galen and refers to the ground of his ability to cure patients, i.e. his being a doctor.

Here is a general formulation of the distinctions that Aristotle draws in this passage:

1. X does F from being P only if (i) X does F insofar as X is P, or (ii) X does F not insofar as X is P
2. X suffers F from being P only if (i) X does F not insofar as X is P, or (ii) X does F not insofar as X is P.
3. X comes to be F from being P only if (i) X comes to be F insofar as X is P, or (ii) X comes to be F not insofar as X is P.

Each of 1-3 states two different sufficient conditions for each analysandum to hold. I take it that the anslysandum is the relation referred to by the left hand side of each 1–3. Aristotle claim is that for each 1–3, (i) and (ii) specify two sufficient conditions for the same relation to hold.[48]

We are now in a position to explain the difference between P1* and P1**. Consider a statue. We can say that the statue came into being from some bronze thing. We can also say that the statue came into being from some shapeless thing. If the statue comes into being unqualifiedly from the shapeless thing, then 'shapeless' must both refer to some entity that was turned into a statue and refer to what grounds the ability of that entity to be turned into a a statue. Similarly, if the statue comes into being unqualifiedly from the bronze, then 'bronze' must both pick out an entity that was turned into the statue and refer to what grounds the ability of that entity to be turned into a statue. In contrast, if the statue comes into being coincidentally from

[48]It is possible that the analysandum is the sense of 'from being'. Taken this way, (i) and (ii) disambiguate two senses of 'from being'. Since nothing is lost, and clarity gained, in what follows, I assume that 'being from' has the same sense throughout, and that Aristotle's solution relies on distinguishing two distinct ways that the one relation can hold.

the shapeless thing, then 'shapeless' refers to the entity that was turned into the statue but does not refer to what grounds the ability of that entity to be turned into a statue.

5.9 The Structure of Aristotle's Solution

Aristotle thinks that the Monist reads P1 as P1* (191b9–10). Read in this way, he thinks that the first stage of the Challenge presents a valid argument, but an unsound one. The argument is unsound because P1* is false. P1* assumes that there is only one way for F to come into being from F and/or O, i.e. unqualifiedly. But this is false. A major and important upshot of Aristotle's own view of the principles is that there is another way for F to come into being from F and/or O, i.e. coincidentally.

However, Aristotle is not merely content to show that the first stage of the Challenge is unsound when P1 is read as P1*. He argues that even if we read P1 as P1**, the first stage fails. He thinks it fails because he believes that the arguments on each horn of the dilemma contain an invalid inference. In other words, he thinks that the argument that F cannot come into being coincidentally from what-is is invalid. And he thinks that the argument that F cannot come into being coincidentally from what-is-not is also invalid.

5.9.1 Second horn: from what-is-not

Aristotle discusses the second horn first:

> (i) We agree with them in saying that nothing comes to be without qualification from what-is-not, (ii) but we say that things come to be in a way—for instance, coincidentally from what-is-not. (iii)

> For something comes to be from the privation, which in itself is not and which is not present to the thing <when it has come to be> (191b13–16). [49]

In (i), Aristotle agrees that the argument on the second horn of the dilemma show us that F cannot come into being unqualifiedly from what-is-not. However, he thinks that the argument does not show us that F cannot come into being coincidentally from what-is-not. (iii) contains an argument that F comes into being coincidentally from what-is not. This argument relies on issues of persistence, and I will set discussion of it aside until the next section. Here let me identify the structure of Aristotle's response. Let us read P1 as P1** and use an example:

1. If the hot comes into being coincidentally from the cold, then the cold is the subject of change.
2. It is not possible for the cold to be the subject of change.
3. It is not possible for the hot to come into being coincidentally from the cold. (From 1–2)

Aristotle accepts 2. He agrees that opposites cannot serve as the subject of change. But Aristotle rejects 1. On Aristotle's view the subject and privation are one in number, two in form. So, for instance, there is one entity that is both a man and cold. So Aristotle rejects the inference in 1. Even if the hot comes into being coincidentally from the cold, it does not follow that the cold

[49] ἡμεῖς δὲ καὶ αὐτοί φαμεν γίγνεσθαι μὲν μηθὲν ἁπλῶς ἐκ μὴ ὄντος πὼς μέντοι γίγνεσθαι ἐκ μὴ ὄντος, οἷον κατὰ συμβεβηκός ἐκ γὰρ τῆς στερήσεως, ὅ ἐστι καθ' αὐτὸ μὴ ὄν, οὐκ ἐνυπάρχοντος γίγνεταί τι· Both 'unqualifiedly' ('ἁπλῶς') and 'coincidentally' ('κατὰ συμβεβηκός') are adverbial phrases, phrases that could modify two different verbs: 1) 'come to be' ('γίγνεται') and 2) 'being' ('εἶναι'). I presume it modifies the former. I also assume that Aristotle does not use 'unqualifiedly' (ἁπλῶς') to restrict his attention to unqualified becoming. Rather, the phrase qualifies Aristotle's acceptance of the Eleatic's claim that something cannot come to be from what-is-not. Aristotle accepts this claim when it is not qualified. He then turns to defend a qualified way (πὼς) for something to come into being from what-is-not.

is the subject of change, i.e. it does not follow that anything is a subject in virtue of being cold.

5.9.2 First horn: from what-is

Aristotle's solution to the first horn is harder. He claims:

> Similarly, there is no coming to be, except coincidentally, from what-is, or of what-is. But coincidentally what-is also comes to be, in the same way as if animal comes to be from animal and a certain animal from a certain animal. (Suppose, for instance, that a dog comes to be from a horse. For the dog would come to be not only from a certain animal, but also from animal, though not insofar as it is animal or that is already present (191b17–23).[50]

This bit of text is difficult. Aristotle's example is of animal coming from animal and a certain animal coming from a certain animal. This is meant to be a case where what-is comes to be coincidentally from what-is. However, it is not entirely clear how exactly this is such a case. Let us first outline the inferences in the passage:

[50] ὡσαύτως δὲ οὐδ' ἐξ ὄντος οὐδὲ τὸ ὂν γίγνεσθαι, πλὴν κατὰ συμβεβηκός· οὕτω δὲ καὶ τοῦτο γίγνεσθαι, τὸν αὐτὸν τρόπον οἷον εἰ ἐκ ζῴου ζῷον γίγνοιτο καὶ ἐκ τινὸς ζῴου τι ζῷον· οἷον εἰ κύων ἐξ ἵππου γίγνοιτο. γίγνοιτο μὲν γὰρ ἂν οὐ μόνον ἐκ τινὸς ζῴου ὁ κύων, ἀλλὰ καὶ ἐκ ζῴου, ἀλλ' οὐχ ᾗ ζῷον· ὑπάρχει γὰρ ἤδη τοῦτο· Some have found the speculative biology unacceptable. Ross {74, p. 495} suggests that we read the text as: κύων ἐκ κυνὸς ἢ ἵππος ἐξ ἵππου γίγνοιτο. Aristotle would then be speaking of a dog coming from a dog, and a horse coming from a horse. While this does not strike the ear as unusual, the example is of no use to Aristotle. Aristotle is clearly trying to speak of the subject of change. Ross's emendation requires a) taking Aristotle as speaking of efficient causation, or b) taking Aristotle as still talking about the subject of change. Neither is helpful. If Aristotle is speaking of efficient causation, then we are left wondering how this example is meant to illustrate what is involved in, if you like, material causation. But if we read it as b), then we are in no better position than the text as we have it. We are then to imagine that Aristotle believes that the matter in the generation of a dog is a dog. So I leave the text as we have it. Of course, it would be useful if we had some explanation for why Aristotle thinks he needs to make his case in a speculative way. In comments, Terence Irwin suggests that, for this change, it's clear that what comes to be isn't the same as what it came to be from. Nevertheless, Aristotle points out that we can still use the bland formula 'animal from animal' to describe the change. This seems right to me. Aristotle wants to emphasise that while we can describe a change as what-is comes into being from what-is, this does not mean that the product is the same as what it came into being from. This animal from animal case is a perfect illustration of this point.

1. A dog comes into being from a horse.
2. A horse is an animal.
3. A dog comes into being from animal-horse. (From 1–3)
4. A dog is an animal.
5. Animal-dog comes into being from animal-horse. (From 3–4)
6. Animal comes into being from animal. (From 5)
7. Animal is already present in animal.
8. Animal comes into being coincidentally from animal. (From 7)

1 is clearly stated. 2 is required to infer 3 from 1. 4 is not clearly stated but Aristotle wishes to show that when a certain animal (a dog) comes to be from a certain animal (horse) this is also a case where animal comes to be from animal. While 5 is not stated, Aristotle needs it if he wishes to infer from the fact that when dog comes from animal, so also does animal come from animal. 6 is clear. 7 is trickier. The point seems to be that if a horse becomes a dog, we can describe this as a change in which an animal becomes an animal. By saying that animal is already present, Aristotle tells us that the description 'an animal becomes an animal' is uninformative. Even though it is true, it does not tell us just how the subject of change changed (for the horse was already an animal). In order for Aristotle to infer 8 from 6 and 7, he assumes:

- If X comes into being from Y, and X was present in Y, then X comes into being coincidentally from Y.

Since the animal comes into being from the animal, and the animal was already present in the animal (the horse), then the animal comes into being coincidentally from the animal. What allows Aristotle make this claim is that he thinks that one enity can be both an animal and a horse.

How exactly does this example allow Aristotle respond to the Eleatic Challenge? Let us again read P1 as P1**. Here is the argument on the first horn of the dilemma:

P1: If F comes into being coincidentally from F, then F is already.

P2: It is not possible for F to come into being if F is already.

C1: F cannot come into being from F. (From P1–P3)

Aristotle's example shows that there is a way of describing the *terimini* of a change that allow us reject P2. Allow 'animal' as the value of 'F'. Aristotle claims that it is possible for animal to come into being even though animal is already. In his example, a dog comes into being from a horse. This is also a case where animal comes into being from animal. So animal comes into being even though animal is already. Key to this solution is that the change is one only where F comes into being coincidentally from F. If animal were to come into being unqualifiedly from animal, then animal would have to become an animal insofar as it is animal. But this would be no change at all.

5.10 The Role of Persistence in Aristotle's Solution

It may appear that persistence has little if any role to play in Aristotle's response to the Eleatic Challenge. His response turns on showing that P1 can be read in two distinct ways, as either P1* or P**. By itself, this distinction does not rely on the persistence of the subject of change.

However, persistence does play a key role in Aristotle's solution, though in an indirect way. Aristotle owes us a way of distinguishing what F comes into being unqualifiedly from as opposed to what it comes into being coincidentally from. Why claim that the statue comes into being coincidentally

and not unqualifiedly from shapelessness? Similarly, why claim that the statue comes into being unqualifiedly from bronze and not coincidentally from bronze? He owes us some clear criterion to distinguish what the product of a change comes into being unqualifiedly from as opposed to what it comes into being coincidentally from.

Aristotle does offer us such a criterion, a criterion that relies on the persistence of the subject. Recall his solution to the second horn:

> (i) We agree with them in saying that nothing comes to be without qualification from what-is-not, (ii) but we say that things come to be in a way—for instance, coincidentally from what-is-not. (iii) For something comes to be from the privation, which in itself is not and which is not present to the thing <when it has come to be> (191b13–16).

I discussed (i) and (ii) in the previous section. Here note that (iii) offers us the criterion I asked for:

CRITERION 1: If Y is not present in X after X comes into being, and X comes into being from Y, then X comes into being coincidentally from Y.

Privations satisfy this criterion. A statue comes into being from shapelessness. Since shapelessness is not present in a statue once it is created, then a statue comes into being only coincidentally from shapelessness. Similarly, hot cocoa comes from cold chocolate. Since the cold is not present in that fresh cocoa we make, the cocoa comes into being only coincidentally from the cold.

CRITERION 1 speaks of what the products comes into being coincidentally from. It also entails a claim about what the statue comes into being unqualifiedly from:

CRITERION 2 If Y is present in X after X comes into being, and X comes into being from Y, then X comes into being unqualifiedly from Y.

I here assume that there are only two ways for X to come into being from Y. So if X comes from Y but does not do so coincidentally, then X comes unqualifiedly from Y. Thus CRITERION 2 states a criterion for what it takes for X to come into being unqualifiedly from Y.

Let me illustrate CRITERION 1 and 2 with an example: suppose that we melt an ice sculpture of Arion into a pool of chilled water. We would like to know what the pool unqualifiedly comes into being from. There are two candidates. 1) The ice-sculpture of Arion. 2) The portion of water that composes that ice-sculpture. We speak truly when we say that the pool comes into being from both. However, according to Aristotle, one of these entities has by its nature the properties that allow it be turned into a pool. How do we decide whether it is the ice-sculpture or the portion of water that can be so turned? Aristotle provides a decision mechanism: he tells us to look at what synchronically composes the pool of water. Does the portion of water or the ice sculpture synchronically compose that pool? It's the former. Thus it is the portion of water that has the properties to be turned into the pool of water. Hence, the pool of water comes into being unqualifiedly from that portion of water. However, the pool still comes into being from the ice-sculpture. But this is explained by a deeper fact. Namely, the ice-sculpture stands in the appropriate relation to the portion of water, a portion the pool unqualifiedly comes into being from. Hence, the pool only comes into being coincidentally from the ice-sculpture.

Now CRITERION 2 does speak to issues of persistence: if X comes into being from Y, and Y is present in X after X comes into being, then Y persists

through this process. For instance, if our pool of water comes into being from a portion of water, and that portion of water is present in the pool once the pool has come into being, then that portion of water must have persisted through this process. Similarly, if our cup of hot chocolate is made from some chocolate, and that chocolate is present in our cup of hot chocolate, then that chocolate must have persisted through this making.

So in order to distinguish P1* from P1** Aristotle clearly assumes that the subject of change must persist through whatever change it is subject for. How are we to understand the significance of this assumption? It is striking that Aristotle offers no defence of it. He just doesn't see it as requiring a defence. Both he and the Monist accept that the subject must persist if change is to exist. The Eleatic could identify no suitable persisting subject, so concludes change does not exist. Aristotle responds by arguing that if we recognize that subject and privation are one in number, two in form, then we can identify a suitable persisting subject. But this offers us no reason to accept the initial assumption that change requires persistence. Anyone who denies this initial assumption will find no argument here that they should accept it.

Of course, we may like Aristotle to defend his claim that the subject persists. But we can at least explain why he focuses so little on the claim. His main response to the Eleatic Challenge requires that he distinguish P1* from P1**. He uses his own view of the principles to do that, i.e. his claim that (1) the subject is one in number two in form, and (2) the subject persists and is present in the product of the change. His main focus is the distinction between P1* and P1**. In *Phys.* I.8, he takes (1) and (2) as given and so sees no need to defend either there.

5.11 Conclusion

Aristotle claims that a correct understanding of the principles is required to respond to the Eleatic Challenge. We saw that several interpretations of the Challenge leave an argument that is obviously invalid. On my interpretation, the Monist presents a valid argument when P1 is read as P1*. This explains why Aristotle takes the argument so seriously. Aristotle uses his own view of the principles to do two distinct things. First, he shows that P1* is false. Second, he shows that his particular use of the principles is immune to a version of the Challenge that directly attacks the innovation he introduces. This provides a comprehensive defense of his own view of the principles.

I have also shown that both the Challenge and Aristotle's solution assumes that the subject of change must persist through whatever change it is subject for. But Aristotle's solution does not make any theoretical commitments about persistence. He does not claim that there is a diachronic criterion of identity for each persisting subject. Perhaps Aristotle does believe this. But his solution does not turn on this claim, and reading the solution has being particularly focused on such criteria is not helpful for properly understanding it.

So persistence does play a key role in *Phys.* I. We have seen that Aristotle uses it to advance his search in several ways. For instance, we saw in Ch.3 that he uses persistence in *Phys.* I.6 to argue that opposites cannot be the only principles of nature. Here in *Phys.* I.8 he uses persistence to distinguish two different ways for a product to come into being from something else. Perhaps it is striking that Aristotle treats persistence in what may appear a naive way. He just doesn't see any need to argue that change requires a

persisting subject nor does it occur to him, at least for the purposes of *Phys.* I, that the persistence of the subject requires any explanation. Nevertheless, persistence does play a key role in Aristotle's search for the principles of nature.

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