

2105

# The Cosmological Significance of Animal Generation

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CHAPTER 6

*Aristotle on the cosmological significance of  
biological generation*

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**Introduction: two perspectives**

David Sedley is perhaps the most well-known defender of the view that attributes to Aristotle a thoroughgoing and comprehensive global teleology in which the entire contents of the natural world – from living things and their parts, to the elements, to the seasons themselves – are so arranged that their mutual interactions contribute to the overall good of the universe and ultimately (in the case of sublunary phenomena) to the good of man.<sup>1</sup> It follows from this that Aristotle's natural teleology cannot be fully grasped except from this comprehensive global teleological perspective.<sup>2</sup> In opposition to this, many modern scholars defend what I will call the 'organism-centred' view of Aristotle's natural teleology. This reading treats the individual organism as the final end for the sake of which all its features exist, so that all final causation in biology can be understood exclusively from the perspective of the individual organism itself. One of the fundamental suppositions of Aristotle's natural science, for example, is that nature does nothing in vain but always what is best given the range of

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<sup>1</sup> In this chapter I will be concerned only with the use of teleology as it applies to living nature. It is a matter of some controversy whether or not Aristotle thinks natural teleology applies to non-living nature in any robust sense. For example, one could accept that the motion of the elements towards their proper place is directional and yet deny that Aristotle thinks that motion is to be explained by reference to the contribution it makes to an element's good, which I take to be a central feature of Aristotle's teleology. For an alternative view see Johnson (2005, Ch. 5), Scharle (this volume), and Falcon and Leunissen (this volume). All translations are my own except where indicated.

<sup>2</sup> See Sedley (1991: e.g. 180; 2007, 167–204; 2010, 18–29). Sedley (2010, 24) argues that for Aristotle 'biological teleology is derivative from a prior cosmic teleology'. Like Plato, he held that 'the world's goodness is the primary *explanandum*, and that the same world's comprehensive stocking with organic species, each elaborately engineered to suit its specific function, is in turn explained by its contribution to that goal'. This view is also defended by Kahn (1985) and Furley (1985).

possibilities. And Aristotle is explicit that ‘what is best’ is understood in relation to the organism’s *own* survival and well-being (*IA* 11, 704b12–18).<sup>3</sup> This conforms to Aristotle’s practice in the biological works: there is no attempt on Aristotle’s part to show how any of the adaptations possessed by living things contribute to the good of the universe as a whole. Instead Aristotle assumes that each individual has the features it does because, and only because, those features are good for that individual.<sup>4</sup>

As a general interpretation of Aristotle’s natural teleology I think the organism-centred view has it right. For the most part Aristotle treats the survival and well-being of each individual organism as the final end for the sake of which its features ultimately exist. And while those features might also benefit things outside the individual organism, those benefits are not part of the causal story that explains why they are present in the first place. At the same time I think there is value in considering an interpretation like Sedley’s insofar as it forces us to take seriously the connections between Aristotle’s natural teleology and his broader cosmology. In my view the collective reaction to Sedley’s reading has had the effect of swinging the pendulum too far in the opposite direction. As a consequence, scholars have tended to ignore, or at least downplay, the cosmological features of Aristotle’s biology. To be sure I think Sedley overestimates his case by attributing to Aristotle a thoroughgoing global interactionist teleology. Indeed, as far as I can tell, there is only one exception to the organism-centred view (discussed below). But this is hardly enough to vindicate the Cosmic Teleology reading. For the explanation in question is not part of any systematic attempt by Aristotle to adopt a more global teleological perspective of the sort defended by Plato (e.g. *Phaedo* 98b1–4, *Laws* 903b5–d1). However, I think this one passage is enough to show that Aristotle held a

<sup>3</sup> I discuss this principle in Henry (2013).

<sup>4</sup> For a classic statement of this view see Balme (1972, 96–97). It is defended by Bodnar (2005), Lennox (2001a, e.g. 182–84; 2001b, 341), Judson (2005, 348, 359–60), Gotthelf (2012, e.g. 8–9 n. 13), and Leunissen (2010, e.g. 41: ‘cosmic teleology is ultimately grounded in natural teleology’ and ‘natural teleology in its primary form is limited to individual natures acting as efficient causes for the sake of something’). *Phys.* 11 7, 198b5–9 is among the main passages cited in defence of the view that, for Aristotle, each organism’s nature aims at its *own* good. Lennox (2001b, 341) calls this Aristotle’s ‘basic teleological axiom’. Not everyone who rejects cosmic teleology accepts the organism-centred view. Johnson (2005), for example, argues that each particular substance is the final end for the sake of which all its features exist, so that all final causation can be understood exclusively from the perspective of the particular substance itself (e.g. p. 278: ‘the good which teleological explanations make reference to is specific to the natural kind being explained’). It just turns out that, on his reading, organisms are not the only natural substances subject to teleological explanation. Aristotle extends his doctrine to the elements and their natural motions. See also Scharle (2008).

weaker version of the organism-centred view than has traditionally been ascribed to him by opponents of Sedley.<sup>5</sup>

The exception I have in mind comes at the beginning of *Generation of Animals* (GA) II where Aristotle is attempting to give an account of the final causes of sexual differentiation. I claim that Aristotle's argument here is a specific application of a more general argument he gives in *Generation and Corruption* (GC) II 10, which seeks to explain why coming to be and passing away occur continuously and without fail by placing them in the context of his broader cosmology. As we shall see, what is at stake with this passage is exactly how to understand the teleological significance of animal generation. If I am right, then what Aristotle is arguing in GA II 1 is that continuous animal generation exists, not (or not only) because of the contribution it makes to the individual's own good but because of the contribution it makes to the good of the universe as a whole. Before turning to that, let me begin by drawing attention to another passage to give a sense of what I mean by 'the cosmological aspects' of Aristotle's biology.

In GC II 10 Aristotle describes how the sun's annual motion around the earth causes generation and destruction in the sublunary world as it approaches and retreats. Part of that story includes an account of how this motion influences the life-cycles of living things:

This explains why it is not the primary motion that causes generation and destruction, but the motion along the inclined circle [sc. the sun's annual motion in the ecliptic] . . . the approaching and retreating of the moving body are caused by the inclination. For the consequence of the inclination is that the body becomes alternately remote and near . . . Therefore, if it generates by approaching and by its proximity, it – the very same body – destroys by retreating and becoming remote . . . Hence, too, the times (i.e. life-cycles) of the several kinds of things have a number by which they are distinguished. For there is an order for all things, and every time (i.e. every life-cycle) is measured by a period. Not all of them, however, are measured by the same period, but some by a smaller and others by a greater one. For some of them the period that is their measure is a year, while for others it is longer and others shorter than this. (GC II 10, 336a33–b16 Joachim translation with modification; cf. GC II 11, 338b3–5)

In GA IV 10 Aristotle explains how this works in the case of animal generation (777b16–778a9). There he tells us how the lives of organisms 'strive

<sup>5</sup> To be clear, what I am advocating in this chapter is a weaker version of the organism-centred view *not* a more limited version of the Cosmic Teleology reading. I take this one very limited case of global teleology to be an exception to Aristotle's otherwise thoroughgoing organism-centred view where each species of living thing has the adaptations it does because *and only because* they contribute to *its own* survival and well-being.

*Cosmological significance of biological generation*

103

to be measured according to natural cycles' (i.e. days, months, and years), which are determined by the motions of the sun and moon:

For the month is a common cycle between these two [sc. the sun and moon], and the moon is a principle owing to its communal relationship with the sun and its participation in its light; for it becomes just like a lesser sun. For this reason the moon contributes to all processes of development and completion. For the heatings and coolings, in a certain proportion, produce generation followed by destruction. And the limits of these (both their starting-points and terminating-points) are contained by the motions of the stars. For just as we observe a sea and everything that has a fluid nature being stabilised and changed according to the motion and stillness of the winds, and the air and the winds according to the cycles of the sun and moon, so too both the things that grow from these and other sorts of things necessarily follow upon them. For it is rational for the cycles of the less important things to follow upon those of the more important things. For even wind has a kind of life, a generation and destruction. And there are probably certain other sources of the revolutions of these stars. Therefore, nature seeks to count out the processes of development and completion by the numbers of these. But it is not precise owing to the indeterminacy of the matter and because of the many principles that impede the natural processes of generation and destruction and frequently cause things that happen contrary to nature.

The explanation here has two parts. The *efficient causal* explanation attempts to identify the mechanism by which the stages of an animal's life-cycle are ultimately controlled by the motions of the sun and moon. Their motions cause changes of the seasons, bringing with them changes in temperature and light, which in turn trigger events within the organism associated with the phases of its life (e.g. as the days get shorter there is a decrease in light and temperature that triggers the hibernation instinct in certain animals). But Aristotle also thinks the phenomenon in question can be given a *teleological explanation*. Aristotle is not suggesting that the cosmic cycles occur for the sake of regulating the phases of an animal's life: they do not occur *in order that* animals should have something by which to measure their life-cycles. Instead he is saying that the formal natures of animals *use* the motions of the stars and the changes that follow upon them for that purpose. And being 'used for the sake of something' is a kind of teleological relation.<sup>6</sup>

I draw attention to this passage in order to illustrate how Aristotle thinks that the full significance of certain aspects of animal generation

<sup>6</sup> See Leunissen (2010, e.g. 81–99).

cannot be grasped without reference to cosmology. For the explanation on offer depends, at least in part, on understanding Aristotle's broader theory about the causal dependence of changes in the sublunary world on the eternal motions of the heavens that he articulates in *GC* II 10. Of course in this particular example the appeal to teleology does not involve relating the feature in question to some broader cosmic good, and so this observation is entirely compatible with the organism-centred interpretation. Thus, while the *GA* IV 10 passage illustrates *the cosmological significance* of animal generation, it does so without depending on *a global teleological perspective* of the sort we find in Plato. But the same cannot be said for the *GA* II 1 passage that forms the focus of this chapter. In that passage Aristotle adopts the global teleological perspective in order to explain the feature in question. Or so I shall argue.

It is worth stressing at the outset that the arguments in this chapter should in no way be taken as a defence of Cosmic Teleology. I think that reading fails as an overall interpretation of Aristotle. Instead my aim is to advocate for a slightly *weaker* version of the organism-centred view than opponents of Sedley have traditionally defended. While it is true that, for the most part, Aristotle treats the organism's own good as the final end for the sake of which its adaptations ultimately exist, I want to stop short of claiming that *all* final causation in Aristotle's biology can be understood *exclusively* from the organism's perspective. Instead I shall attempt to show that there is at least one feature – the process of biological generation itself – that cannot be understood from the perspective of the individual organism alone but must be explained (at least in part) by the contribution it makes to the good of the universe as a whole. Or so Aristotle seems to claim. At the same time, this is hardly enough to vindicate the Cosmic Teleology reading. For (as mentioned) it is not part of any systematic attempt on Aristotle's part to adopt a more global perspective of the sort we find in Plato.

### Why are there sexes? *Generation of Animals* II 1

One of the major puzzles driving Aristotle's *Generation of Animals* is why there are sexes. Of particular importance to the case of animal generation is why animal species are divided into separate sexes.<sup>7</sup> *GA* II 1 opens by introducing two modes of explanation for this, one that refers to the embryological mechanisms responsible for sexual differentiation (efficient

<sup>7</sup> Aristotle thinks that plants have male and female principles but that these are present together in the same individual. The *aporia* of *GA* II 1 is why they are separated in the case of animals.

*Cosmological significance of biological generation*

105

causation), and one that refers to the advantage that comes from having separate sexes (final causation).<sup>8</sup> The opening of Book II provides the teleological explanation, while the efficient cause explanation is postponed until Book IV.

The teleological explanation proceeds in two steps. First we get an argument for why the sexes exist at all (731b24–732a3). Aristotle then goes on to show why animals are separated into sexes, that is, why some individuals are male and others female (732a3–10). In what follows I shall focus exclusively on the first argument. The key text reads as follows:

[A] Of the things that are, some are eternal and divine, while others are capable of being and not-being, and the beautiful and divine is always a *per se* cause (*aition aei kata tēn hautou phusin*) of what is better in things that admit it. And what is not eternal is capable of being <and not being> and admits of the better and worse. And soul is better than body, and what is ensouled is better than what is not owing to the possession of soul, and being is better than not being, and living is better than non-living. These are the causes owing to which the generation of animals exists. [B] For, since it is not possible for the nature of this kind of thing to be eternal, what comes into being is eternal in the only way possible for it. While it is not possible to be eternal *in number* (for the substance of existing things is in the particular; if it was of this sort, then it would be eternal), it is possible to be so *in form*. For this reason there is always a continuous generation<sup>9</sup> of humans, animals, and plants. [C] Since the principle of these is the male and female, it is for the sake of generation that the sexes are present in those that possess them. (*GA* II 1, 731b24–732a3)

In [A] Aristotle divides existing things into those that are everlasting and enjoy eternal being (e.g. god and the heavenly bodies) and those that are only capable of temporary being (the elements, animals, and plants). The latter alone are subject to generation and destruction since they contain matter, which is the seat of a thing's capacity to be and not be (*GC* II 9, 335a33–34, *Metaph.* VII 7, 1032a20–22). Aristotle next invokes a series of axiological principles (e.g. being is better than non-being, living is better than non-living), which are said to provide 'the causes owing to which the generation of animals exists'. [B] then expands on this point. While no sublunary organisms are capable of existing indefinitely (each one is composed of matter and so eventually decays), they can become eternal in form by engaging in reproduction. The upshot of this, Aristotle says,

<sup>8</sup> The formal and material causes of the sexes themselves are found in *GA* I 2.

<sup>9</sup> I follow Lennox in taking *genos* here to have the sense given at *Metaph.* v 28, 1034a29–30: 'the continuous generation of things having the same form' (in modern biological terms, an ancestor–descendent lineage).



is that, while there cannot be eternal *organisms* in the sublunary realm, there can be eternal *lineages* ('For this reason there is always a continuous generation of humans, animals, and plants.'). [C] This, in turn, provides the final cause for the existence of males and females: male and female are 'principles' of generation (*GA* 1 2, 716a5–8) and so are conditionally necessary for reproduction.<sup>10</sup>

Traditionally, this passage has been read in the context of a similar argument from *DA* 11 4. There Aristotle argues that the capacity for reproduction exists for the sake of the individual organism insofar as it provides her with a means for partaking in the divine:

For this is the most natural among the functions for living things . . . namely, to produce another like itself, an animal producing an animal, and a plant producing a plant, in order that it may partake in the everlasting and divine insofar as it is possible. For every living thing desires this and performs all of its natural activities for the sake of it . . . Since, then, they cannot share in the immortal and divine by continuous existence, for no perishable thing can remain numerically one and the same, they share in these in the only way they can, some more and some less. What persists is not the individual itself but something like it, not numerically one but one in form. (*DA* 415a26–b7)

According to this passage, the significance of reproduction is that it grants the individual access to 'the immortal and divine', where what persists is not numerically the same individual but something that is similar to it in form. Most scholars take it for granted that our passage from *GA* 11 1 simply reiterates this point. When read in that context, *GA* 11 1 is understood, again, as arguing that reproduction exists for the sake of the individual insofar as it provides a means for achieving the only kind of immortality open to her.<sup>11</sup> On this reading the continuity of the species is not the end for the sake of which reproduction exists but a mere consequence of the fact that, when every individual strives after its own good, what you get is a continuous generation of things of the same form. We can call this the organism-centred reading of *GA* 11 1, since it treats the good of the individual as the final cause for the sake of which animal generation exists and eternal lineages as a mere by-product of this.

<sup>10</sup> This reading of *GA* 11 1 agrees closely with Lennox (1985, 71), though we disagree over the good for whose sake continuous generation takes place (see below).

<sup>11</sup> Kullman (1985, 172) writes of the *GA* 11 1 passage: 'The idea is, once again, that the circle of procreation is the way in which animals, inasmuch as they are sexual, partake of the everlasting and the divine, which in this respect functions as the final cause.' See also Balme (1972, 96; 1987, 279–80), Lennox (1985, e.g. 67, 73, 92 n. 9), Leunissen (2010, 41), Gottlieb (2012, 9 n. 13, 58, 71), and possibly Kahn (1983, 195).



*Cosmological significance of biological generation*

107

In contrast to this, I want to argue that *GA* II 1 is not just another version of the *DA* II 4 argument. Instead it should be read as a specific application of a more general argument that Aristotle makes in *GC* II 10, which seeks to explain why coming to be and passing away occur continuously and without fail. What is at stake between these two readings, we shall see, is exactly how to understand the teleological significance of generation according to the *Generation of Animals*. If I am right, then what Aristotle is arguing in *GA* II 1 is that continuous generation exists not (or not only) because of the contribution it makes to the individual's own good but because of the contribution it makes to the good of the universe as a whole.<sup>12</sup> In this way *GA* II 1 not only highlights the cosmological significance of animal generation; it also attempts to explain that phenomena from a global teleological perspective. To see this, we need to examine *GC* II 10 in more detail.

**The continuity of generation: *Generation of Animals* II 10**

In *GC* II 10 Aristotle asks, what is the cause responsible for the fact that generation and corruption go on continuously and never fail? He has already provided the material cause of the phenomenon back in *GC* I 3.<sup>13</sup> *GC* II 10 offers the efficient and final causes.

**Efficient causal explanation (336a15–336a7).** In the *Physics* Aristotle established that locomotion is the primary form of change and that this is what causes generation and destruction. In *GC* II 10 he argues, more specifically, that this is the sun's annual movement in the ecliptic as it approaches and retreats from the earth's surface (cf. *Meteor.* 346b20–22). This, Aristotle says, can be supported by appealing to the observable facts: 'for we see (*horômen*) that generation occurs as the sun approaches and things decay as it retreats' (336b16–24). Since the sun's motion is eternal, it follows that generation and destruction must themselves occur continuously and without fail.

<sup>12</sup> For a similar reading see Kahn (1985, 194–96) and Cooper (1982). Cooper recognises that *GA* II 1 treats the continued existence of living things itself as an important good and not just the existence of the individual organism, but he does not trace the argument to *GC* II 10. By contrast, while Gotthelf (2012, 58) sees the connection between *GA* II 1 and *GC* II 10, he continues to treat the former as if it were simply a version of the *DA* II 4 argument. On his reading, the lesson of *GA* II 1 is that reproduction is aimed at *self*-preservation, while the existence of eternal lineages is merely a consequence of that. Finally, Kahn's interpretation, though similar to mine, embraces a cosmic teleology of far greater magnitude than anything I am willing to endorse.

<sup>13</sup> See 319a18–22.

**Teleological explanation (336b25–337a7).** Aristotle next gives us a teleological explanation for the continuity of generation and destruction in the sublunary realm, which appeals to the notion of what is best. The main text of the argument runs as follows:

As we have said, coming to be and passing away will be everlasting and continuous and will never fail owing to the reason stated. This conclusion also follows rationally (*eulogôs*). For, since we say that nature always strives after what is better, and that being is better than not being . . . but not all things can possess <eternal existence><sup>14</sup> because they are too far removed from the first principle, it follows that the god adopted the remaining alternative and filled up (*suneplêrôse*) the universe by making generation perpetual. For that way existence would be most connected (*malista suneiroito*) because the fact that coming to be should itself come to be perpetually is the closest approximation it has to eternal being. (*GC* II 10, 336b25–35 translated after Joachim)

I'll set to one side the fact that this passage seems to rely on the unAristotelian idea that the universe was created by a providential god who deliberated about what is best for the world. It is almost certainly metaphorical.<sup>15</sup> One suggestion is that Aristotle is simply invoking the popular idea of a creator god as a heuristic device. Reasoning *as if* the universe were designed by a providential god aiming at some optimal state of affairs is a useful heuristic device because it helps us identify the final cause of continuous generation. Aristotle, like Plato, takes it as a basic fact, not explicable in terms of anything more fundamental, that the universe is an ordered system and that this order is good. It follows that everything that contributes to this order is itself good. But that does not commit Aristotle to the further claim that there must have been some Divine Craftsman who organised the parts of the universe in order to make it so.<sup>16</sup>

The conclusion of the above argument is fairly clear. Continuous generation exists in the sublunary world because it is the best possible way to maximise the level of being in the universe as a whole given the constraints on sublunary being. Aristotle deduces this conclusion from two universal principles, both of which are taken as basic:

<sup>14</sup> The point of the argument seems to be, not that some things are incapable of existing at all (e.g. square triangles), but that some things are not capable of *eternal* existence. This is shared premise of both the *GA* II 1 and *DA* II 4 arguments.

<sup>15</sup> Even Sedley (2007: 168 n. 4) dismisses the language of god creating the world as figurative.

<sup>16</sup> I owe this suggestion to Sean Coughlin. On the use of teleological principles as heuristic devices see Leunissen (2010, 119–35).

- (i) Nature always strives after what is better.
- (ii) Being is better than non-being.

The first of these is explicitly identified as a first principle of natural science in *IA* 11, which states that ‘nature does nothing in vain but always what is best for the substance from among the possibilities concerning each kind of animal’ (704b14–15).<sup>17</sup> This assumption is supposed to license a certain pattern of explanation that appeals to the concept of what is best (what we call ‘optimality’ reasoning). According to this pattern of reasoning, we explain why something is the way it is by showing how being in that state is *the best possible* way for it to be. As Aristotle puts it, ‘if it is better this way, then it is that way and being in that state is in accordance with nature’ (*IA* 704b17–18).<sup>18</sup>

The teleological argument in *GC* 11 10 exhibits this pattern of reasoning. Since being is better than non-being, the ideal universe would be one that contained only eternal substances that never passed out of existence. That way the universe would be completely filled up with being with no traces of non-being. But since the actual universe contains a sublunary realm of material composites, and since all material composites must come to be and pass away (*GC* 11 9, 335a32–b5), this state of affairs is not possible. The alternative, Aristotle reasons, is to have an everlasting cycle of generation that guarantees an endless supply of generated beings: ‘That way’, he says, ‘existence would be most connected, because the fact that coming to be should itself come to be perpetually is the closest approximation it has to eternal being’. If the generation of sublunary beings were intermittent rather than continuous, so that there were periods in the earth’s history when no sublunary beings existed, that would decrease the overall amount of being in the world. The world would contain existential gaps, as it were.<sup>19</sup> Perpetual generation avoids this by linking individuals together in a continuous (gap-less) chain, so that, although each individual must pass out of existence, there will always be some sublunary beings in existence.<sup>20</sup>

<sup>17</sup> Aristotle treats this as an empirical truth based on observations about the way living things behave (e.g. *de Juv.* 469a28–30).

<sup>18</sup> I see this kind of optimality reasoning, which explains why *S* is *P* by showing that *P* is ‘the best way’ for *S* to be, as a sub-species of teleological explanation even though it does not typically involve the same ‘for the sake of’ language characteristic of more familiar kinds of teleological explanation. Compare *Phaedo* 97b8–98a2 where Socrates appeals to what is best as a cause (*aitia*) of things in nature. For a discussion of this type of explanation in Plato and Aristotle see Henry (2013). For another example of where Aristotle takes the appeal to what is best as explanatory (i.e. as part of the *aitia* of a thing) see *IA* 708a9–20.

<sup>19</sup> I owe this way of expressing the point to Chris Frey.

<sup>20</sup> This way of reading the argument does not commit Aristotle to the claim that the universe must somehow be benefited by continuous generation (cf. Johansen, this volume, pp. 000). All it commits

What I want to suggest is that the *GA* argument means to apply this general argument to the specific case of biological generation in order to explain why the sexes exist. Read in this context, the *GA* argument can be reconstructed as follows:

- (1) Nature always strives after what is better given the range of possibilities.
- (2) Being is better than non-being, living (which is being for an organism) is better than not living, and so forth.
- (3) No sublunary organism is capable of eternal life; since they contain matter, such organisms must come to be and pass away.
- (4) Therefore, the god adopted the only remaining alternative and filled up the living world completely by making biological generation perpetual.
- (5) This is why there a continuous generation of humans, animals, and plants.

The core idea in this argument is that, since there cannot be any eternal organisms in the sublunary world insofar as they contain matter, the next best thing is to make their generation continuous. For having eternal lineages is the best possible way to maximise the amount of life in the world given the constraints imposed on living things by their material natures. Eternal lineages would ensure that biological existence is ‘most connected’ (*malista suneiroito*) by leaving no existential gaps in the living world. This, in turn, provides the final cause for the existence of sexes: males and females are present for the sake of this end, insofar as they constitute the first principles of generation.<sup>21</sup>

To close this section, let me offer two reasons for thinking the *GA* passage is an extension of the *GC* II 10 argument and not a version of the argument from *DA* II 4. First, the *GA* II 1 argument resembles the *GC* II 10 passage more than it does *DA* II 4. The main reason scholars have tended to read the *GA* and *DA* passages together is that text [B] is a shared premise between the two arguments. But we can now see that [B] is also a premise in the *GC* II 10 argument. And so this by itself cannot help to decide between the two readings. By contrast, the *GC* and *GA* arguments both draw on the same axiological principles expressed in [A], which do not figure into the *DA* argument. While it may be conceded that these same principles are in

Aristotle to is the claim that (a) there is some best way for the universe to be and (b) continuous generation exists *because* it contributes to that good state.

<sup>21</sup> See Lennox (1985, 72–73). Because Lennox reads *GA* II 1 in the context of *DA* II 4, however, he thinks continuous generation occurs because it procures the best possible state of affairs for the individual organism (1985, 72).

*Cosmological significance of biological generation*

III

the background of the *DA* argument, the fact that Aristotle makes explicit use of them in the *GA* passage creates a strong presumption in favour of my reading. For it suggests that Aristotle had *GC* II 10 in mind when he composed that passage (cf. *GC* 336b28–9).

Second, and more importantly, the *DA* and *GA* arguments are not focused on the same aspects of generation. The *DA* argument is concerned with the individual's need to reproduce, which Aristotle thinks is an expression of its desire for immortality. The *GA* argument, by contrast, makes no mention of this. There is no reference anywhere in the text to the idea that individuals engage in reproduction in order that they may 'partake in the everlasting and divine insofar as it is possible' (the key premise of the *DA* argument). Instead, the *GA* passage is focused squarely on the continuity of generation itself and, ultimately, on why sexes exist.<sup>22</sup> Neither of these is at issue in *DA* II 4. It is true that the *DA* argument presupposes the continuity of generation. The fact that Aristotle thinks individuals are members of eternal species is what grounds his claim that formal replication provides a means for individuals to partake in the immortal and divine. If he thought it were possible that species might go extinct, then reproduction could hardly be said to offer a way for individuals to share in everlasting existence. But the point of the *DA* argument is not to explain why species continue indefinitely into the future but why individual organisms engage in reproduction. And the answer to that question is, so that they can partake in the immortal and divine. As I read the *GA* passage, texts [A] and [B] constitute a single argument whose conclusion is given at 731b35–6: 'This is why (*dio*) there is always a *genos* of humans, animals, and plants.' This way of understanding the passage makes it clear that the *explanandum* of the argument all along was the fact that generation continues eternally and without fail. And that is exactly what the *GC* II 10 argument was meant to explain at a more general level.

In this chapter I have offered two interpretations of the *GA* II 1 argument, which have quite different implications for how he understood the teleological significance of biological generation. According to the organism-centred interpretation, the *GA* passage is merely echoing the point of the *DA* argument: males and females exist for the sake of reproduction, and reproduction exists for the sake of the individual. On this reading, generation is explained by the contribution it makes to the *individual's own* good

<sup>22</sup> See below. It is fairly standard to read the *GA* II 1 argument as focused on the continuity of generation itself (e.g. Cooper 1982). Even Gotthelf, who defends the organism-centred reading, takes the passage to be 'explaining the unendingness of sexual generation' (2012, 58). This is especially true if Lennox is right that *genos* at 732a1 has the sense given at *Metaph.* V 28, 1024a29–30, which refers to 'a continuous generation of things having the same form' (i.e. a reproductive lineage).

(it provides the best possible means for individuals to achieve a share in the immortal and divine). The fact that there is a continuous succession of living things is simply a consequence of individuals trying to maximise their good in the only way they can but is not the end for the sake of which reproduction exists. By contrast, I take the argument in *GA* II 1 to be focused on the existence of eternal lineages themselves. On this reading, eternal lineages are treated, not as a mere side-effect of individuals striving after their own personal good, but as the best possible means of ‘filling up’ the universe with being, given what is possible in the realm of living things. In this context, continuous generation is explained by the contribution it makes to the good of the universe as a whole (following the *GC* II 10 argument). The sexes exist because they are necessary for this. This gives the sexes a more cosmological significance.<sup>23</sup> Does this mean that Aristotle endorsed a version of Cosmic Teleology as Sedley claims? In the next section I would like to offer some reasons why we should resist this move.

### Cosmic teleology revisited

As noted *GA* II 1 begins by introducing two modes of explanation for sexual difference, an efficient-causal story that gives the embryological mechanisms responsible for differentiating individuals into males and females, and a teleological account that refers sexual difference to ‘a higher principle’ (*anôthen*). On the reading defended here *anôthen* is meant to connect the cause of sexual difference to Aristotle’s broader cosmology.<sup>24</sup> As we have seen, one of the central puzzles of Aristotle’s cosmology is why there is continuous generation in the sublunary world. He answers this question in *GC* II 10 partly by appealing to the causal influence of the sun’s eternal rotation along the ecliptic and partly by invoking principles of optimisation that show how continuous generation is the best possible way of maximising the amount of being in the sublunary world. I have argued that *GA* II 1 is an attempt to apply this same pattern of reasoning to

<sup>23</sup> There is at least one other place where this is suggested. In *GA* IV 3 Aristotle tells us that females exist, in part, because they are necessary to preserve the continuity of each sexually differentiated animal species (767b8–10: *sôzesthai to genos tôn kechôrismenôn kata to thêlu kai to arren*). However we translate *genos* here, Aristotle is clearly saying that sexes exist for the sake of preserving something more inclusive than the individual.

<sup>24</sup> Compare *GA* I 2, 716a13–16. Balme’s epistemological reading of *anôthen* as a reference to a ‘more universal’ principle cannot be ruled out (cf. *APo.* 97a33). The more universal principles in question, I take it, would be the various axiological claims that Aristotle makes about the relative value of soul, life, and being. But this is consistent with my broader reading of the passage insofar as the cosmological argument in *GC* II 10 also derives its conclusion from universal principles of the same sort.



explain why there is a continuous generation of living things. Since no individual organism is capable of eternal existence, the closest approximation to eternal being in the living world is to make generation perpetual. That way life would be ‘most connected’ (*malista suneiroito*), as Aristotle puts it in *GC* II 10. This, in turn, provides the final cause for the existence of the sexes insofar as males and females are first principles of generation. On this reading, continuous biological generation exists, not (or not only) because it contributes to the good of the individual, but because it contributes to the good of the cosmos as a whole.<sup>25</sup>

Having said that, I think it would go too far to treat this as evidence for Sedley’s Cosmic Teleology reading.<sup>26</sup> On Sedley’s reading, Aristotle thinks the universe is an organised whole endowed with a nature of its own. This ‘cosmic nature’, Sedley argues, is something over-and-above the natures of its individual parts (animals, plants, etc.). Sedley’s main evidence for this reading comes from the controversial passage at the start of *Metaph.* XII 10. There Aristotle considers the way in which ‘the nature of the whole (ἡ τοῦ ὅλου φύσις) contains the good and the best, whether as something separated and by itself, or as its arrangement’ (see *Metaph.* XII 10, 1075a11–25). Sedley takes the reference to ‘the nature of the whole’ to pick out a cosmic nature that belongs to the universe *as a whole* and embodies its good. This cosmic nature, Sedley argues, is prior (and thus irreducible) to the natures of the individual organisms, since the latter are parts of the former.

I am not unsympathetic to Sedley’s claim that Aristotle recognised more inclusive individuals above the level of particular organisms and that these more inclusive individuals might have natures of their own. In the *Politics* Aristotle has no trouble seeing the *polis* as a natural whole that is ontologically prior to the citizens, which are its parts. So it may not be much of a stretch to imagine him treating the cosmos itself as a complex individual endowed with its own nature. However, we must be careful how we understand ‘nature’ in this context. When Aristotle refers to ‘the

<sup>25</sup> This way of reading *GA* II 1 raises a question about how to reconcile Aristotle’s two perspectives on generation, since *DA* II 4 clearly refers it to the individual’s own good. One answer is to point to Aristotle’s distinction between things that exist both for their own sake and for the sake of something else, and those that are present purely for their own sake (e.g. *NE* I 7, 1097a23–34). In *Laws* X Plato uses this distinction and says that each part of the universe is present *both* for its own sake *and* for the sake of the universe as a whole (903b5–d1). Likewise, Aristotle may be saying that biological generation exists *both* for the sake of the individual (*DA* II 4) *and* for the sake of the universe as a whole (*GC* II 10). An alternative answer is to take the two passages to be focused on biological generation, not from two different perspectives, but at two separate levels: *DA* II 4 is concerned with why any particular organism engages in reproduction, while *GA* II 1 is concerned with why biological generation occurs eternally. And there is no reason to think he gives the same answer to both questions.

<sup>26</sup> The argument that follows comes from Henry (2013).



nature of the whole' in the *Metaphysics* passage, there can be no doubt that he is referring to the order and structure displayed by the universe (cf. *Metaph.* v 4, 1015a10–11; *GC* II 9, 335b4–7) and not to some cosmic agent that imposes that order on it like Plato's Demiurge. What I find objectionable about Sedley's interpretation is the idea that Aristotle thinks of the parts of the universe as somehow being adjusted to one another in such a way that their mutual interactions contribute to the cosmic good and, ultimately, the good of man. There is so little evidence for this interactive dimension in Aristotle's natural teleology that I find it hard to believe this was a core feature of his theory. If it were, then we should have expected Aristotle's biology to be driven by a deep interest in ecology and ecological relations. Yet, we find no traces of the concept of an ecosystem, no sign of the idea of 'the web of life', and very little attention to the ubiquitous co-adaptations that exist between living things. (This lies in stark contrast to the ecologically rich perspective of Darwin's *The Origin of Species*.)

Sedley's main response to this objection is to say that, while Aristotle's biology is 'squarely focused on individual bodily functioning' the global teleology is supplied by metaphysics. I have two replies to this. First, it is not that the biological works lack examples of such 'coordination' between species (see, e.g., *PA* IV 13, 696b24–35, *GA* III 760a31–b1, *GA* IV 10, 777b16–778a9). The problem is that there are so few of them. If Aristotle really did view nature through the lens of Sedley's interactive teleology, then we would expect his biological works to be full of such examples. Second, it is not clear to me why a study of the coordination and interactions between the parts of nature should belong to metaphysics and not to the science of nature itself. For that is essentially the science of ecology. The absence of anything like an ecological perspective from Aristotle's science of nature and the fact that his biology is so squarely focused on individual bodily functioning makes much better sense if we assume that he rejected Plato's cosmic teleology.

### Necessity and eternity

To close this chapter, I want to turn to *GC* II 11 and consider the relation between necessity and the continuity of biological generation. Aristotle's discussion in this chapter is extremely challenging, and its arguments are not easy to decipher. My aim here is not to provide a decisive reading but simply to motivate a particular interpretation.<sup>27</sup>

<sup>27</sup> For a similar reading see Lennox (1985, 73–76).

*Cosmological significance of biological generation*

115

At the outset of the chapter Aristotle says that every continuous process of change involves consecutiveness where one thing comes to be after another with no interval between them (337a35–b2). The aim of the chapter is to investigate, in the case of coming to be, whether any members of the series are absolutely necessary or whether they are all merely contingent in the sense that they could fail to come into being:

The question is whether all <generated> things are of this sort or whether for some of them it is necessary in the strict sense (*anankaion haplôs*) that they come into being. In other words, is it the case that, just as in the sphere of being some things cannot possibly fail to exist, so too concerning generation [sc. some things cannot possibly fail to come into being]? For example, is it necessary that the solstices will occur in the sense that it is not possible for them to be incapable of occurring? (337b10–13)

Joachim calls *GC II II* an ‘appendix’ because he thinks the main task of *GC* is completed in *GC II IO* and that the discussion of necessity in the final chapter adds nothing to this. I think this is a mistake. The discussion of necessity is clearly connected to *GC II IO* and the theme of continuous generation. As I read the chapter, Aristotle is ultimately worried about the possibility that biological generation may not continue eternally but could cease at some point. Aristotle will go on to argue that in every process of generation it is never necessary in the strict sense that the end product will come to be; its generation is always contingent. This is especially true in the case of living things, where the generation of each individual is dependent on a number of complex factors that are themselves contingent (e.g. one or both of its parents might have been infertile, or they might have failed to conceive, or its development might have been derailed due to some accident in the process, and so forth). But if it is possible that each individual might fail to come into being, then what is the source of that necessity that is supposed to make biological generation itself eternal? What ensures that there will always be a *genos* of humans, animals, and plants?<sup>28</sup>

The argument of *GC II II* proceeds in three parts. (1) Aristotle first presents a series of arguments to show that it is not necessary in the strict sense for any generated substance to come into being; each one is such that it could have failed to come to be (337b14–33). Its coming to be is only ‘conditionally’ necessary, as Aristotle puts it.<sup>29</sup> From this he concludes that

<sup>28</sup> Although *GC II II* starts off as a general worry about the necessity of all generated substances, by the end of the chapter it becomes apparent that Aristotle’s main concern is the eternity of biological generation (338b6–12, translated below). See also Lennox (1985, 76–7) and note 00 below.

<sup>29</sup> To say that something is ‘conditionally’ necessary is to say that it must come to be *if* such-and-such is to be or come to be (e.g. the foundation must come to be *if* a house is to be; for it is presupposed by

what is necessary in the strict sense must occur eternally and vice versa (337b33–338a3; cf. *NE* VI 3, 1139b20–4).<sup>30</sup> (2) Next Aristotle argues that it is in circular motion, and in cyclical generation in particular, that such absolute (*haplôs*) necessity is to be found (338a3–18).<sup>31</sup> (3) Finally, he raises a worry about the generation of living things:

But then why do some things obviously come to be in this way (as, for instance, rain and air come to be cyclically so that it must rain if there is a cloud and, conversely there must be a cloud if it is to rain), while humans and animals do not return upon themselves so that the same individual comes to be for a second time (for although your coming to be presupposes your father's, his coming to be does not presuppose yours)? Why, on the contrary, does this sort of generation seem to proceed in a straight line? (338b6–11 translated after Joachim)

Back in *GC* II 10 Aristotle had argued that only continuous motion is properly eternal and that circular motion is the only kind of motion that is genuinely continuous. However, a rectilinear process, like natural generation, can 'imitate' circular motion by reverting back on itself thereby forming a cycle (think of the rain cycle where the elements are reciprocally transformed into one another). Here Aristotle is worried that the generation of living things is not cyclical in the right way. This is a problem because he has just argued that what is necessary *haplôs* is eternal and that it is only in cyclical generation that this sort of necessity is to be found. What Aristotle needs to show, then, is that the generation of living things is necessary in the strict sense while respecting the fact that each individual organism is only conditionally necessary and could fail to come into being (cf. 337b26–7). In a word, he needs to show how eternal lineages can be composed of a series of contingent beings.<sup>32</sup> Let me flesh this out a bit, since this is not the traditional way of reading the chapter.

the existence of a house). See Cooper (1982). *GC* 337b14–33 provides a set of complicated arguments to show that, in any causal sequence where some prior member *A* is the cause of some subsequent member *B*, both *A* and *B* will always only be conditionally necessary. Joachim (1926, 272–4) offers a good exposition of those arguments.

<sup>30</sup> Cf. Charles (1988, 14–17).

<sup>31</sup> Joachim (1926, 273) summarises the doctrine thusly: 'No member of a rectilinear succession of *gignomena* . . . can exhibit "absolutely necessity of occurrence". If a thing is to come-to-be with "absolutely necessity", it must come-to-be always and invariably: and that is possible only if it is a member of an eternally-repeated cycle of *gignomena* (337b33–338a5). Hence "absolutely necessity of occurrence" and "reciprocal necessary nexus" (which depends on it) are to be found only in cyclical *kinêsis* and cyclical *genesis* (338a5–17).

<sup>32</sup> My interpretation, which takes Aristotle to be worried primarily about the fate of biological generation, is suggested by the puzzle at 338b6–12 (towards which the entire chapter appears to have been building) where the relevant contrast is between meteorological phenomena and heavenly motions, on the one hand, and biological generation, on the other. There are two reasons for thinking Aristotle is not concerned with the continuity (and therefore eternity) of elemental motion in *GC* II 11. First, Aristotle has already laid it down in *GC* II 10 that elemental transformation is

*Cosmological significance of biological generation*

117

It is often supposed that Aristotle thinks biological generation is *only* necessary in the conditional sense. Leunissen, for example, argues that absolute necessity holds for eternal things such as the movement of the heavens while ‘conditional necessity holds for the generation of animals, which is a sublunary natural process that is rectilinear and that concerns beings whose substance is perishable’.<sup>33</sup> Obviously Leunissen takes Aristotle’s statement about biological generation at 338b6–11 to express his settled position in *GC* II 11. But, first, we should note that Aristotle only says the process seems to be (*eoiken*) rectilinear (338b11). I take this to be a tentative statement that is part of the set up for the problem in question. Second, it is important to distinguish between the claim that the generation of some particular organism (e.g. Socrates) is only conditionally necessary from the claim that the phenomenon of biological generation itself is only conditionally necessary. Now Leunissen is right that Aristotle thinks absolute necessity holds only for eternal things, while the generation of *each particular* organism is a rectilinear process that involves only conditional necessity. Aristotle seems to say as much at 338b9–11 (cf. 337a25–29). But what Aristotle wants to say (and, in fact, goes on to say, if I am reading the text properly) is that *biological generation itself* is a cyclical process and therefore necessary in the strict sense. As we have seen, the *GA* II 1 passage contains an argument for why the generation of living things will continue forever so that there will always (*aet*) be a *genos* of humans, animals, and plants (731b35–36). And, according to *GC* II 11, what occurs always is necessary in the unqualified sense. Herein lies the paradox. Aristotle thinks that generation of every particular organism is not absolutely but only conditionally necessary so that each one could have failed to come into being. But if so, then it should be the case that biological generation itself could cease at some point.

Now we have seen that Aristotle thinks only continuous motion is properly eternal and that only circular motion is genuinely continuous. But he also holds that rectilinear motion can ‘imitate’ circular motion by being cyclical (i.e. reverting back on itself). And it is in cyclical generation, he says, that absolute necessity is to be found. He says that, at first glance, it seems as though (*eoiken*) biological generation is not cyclical in the right

a continuous process of generation in which the elements ‘return upon’ themselves and thereby ‘imitate’ circular motion (337a1–7). Second, the *GC* II 10 passage appears to have the rain cycle in mind, which is one of those processes of generation that 338b6–12 takes to be ‘obviously’ continuous/cyclical. For this reason I take *GC* II 11 to be raising a new worry about the continuity (and thus eternity) of biological generation. While it is true that Aristotle mentions the elements in the final paragraph of the chapter, he does so only to illustrate the kind of solution he wants to apply to the case of living things. The point is to extend what he said about the elements in *GC* II 10 to this central case (living things must, like the elements, return upon themselves, not numerically, but formally).

<sup>33</sup> Leunissen (2010, 105).

way; for ‘animals do not return upon themselves so that *the same individual* comes to be a second time’ (338b8–9). Once a particular animal passes out of existence, it is gone forever. By contrast, it is numerically the same sun that returns again and again to the same position every time it revolves around the earth. This is where I think many commentators leave the argument. But Aristotle continues by distinguishing between two different ways in which a rectilinear causal process might be cyclical and so imitate circular motion:

In discussing this, we must begin by inquiring into whether all things return upon themselves in the same way or whether, though in some sequences what recurs is *numerically* the same, in others it is only *the same in form*. Of those moving substances that are imperishable, it is clear that <what returns upon itself> will be numerically the same (for the motion is consequent upon that which is being moved). But those things that are perishable must return upon themselves formally but not numerically. This is why, when water comes to be from air and air from water, the air <that returns> is the same in form not the same in number. And even if these are numerically the same, this, at any rate, is not the case with those things whose substance comes into being, being the sort of thing that is capable of being otherwise. (338b6–19 translated after Joachim)

Aristotle obviously thinks biological generation is an instance of this kind of formal replication where what returns is not numerically the same individual but something that is the same in form. In this way biological generation itself takes on the character of a cyclical process. And since all cyclical processes are necessary in the strict sense, and since what is absolutely necessary is eternal, it follows that the change must be eternal and continue without fail. Admittedly Aristotle’s conclusion is ultimately disappointing because he does not make clear why cyclical processes are necessary in the unqualified sense. As far as I can see he still owes an account that connects the idea of being cyclical to the sort of necessity that guarantees the process will continue eternally without fail. More work needs to be done on this point. But I leave that for sharper minds than mine.