

## Adaption and Environment in Aristotle's Biology

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**1. Adaption.** Animals are adapted to a *bios* characteristic of their kind, that is, to a certain way to live on certain resources. The animal body is instrumental to that *bios*. To "have life" is, for the animal body, to serve as an instrument the *bios* characteristic of the animal species (T1, T2). Quoting Kosman's classic (1987, 377): "to be a horse's body is to be an organ which is *dynamēi* that which is specified in the Equine Logos, that is, it is to be an *instrument capable of being* (or doing) that, the *actual being* (or doing) of which is specified in the formal account of being a horse."

In order to serve that *bios* as an instrument, the animal body must have its parts appropriately adapted to certain functions. Birds with a marsh-dwelling *bios* are long-legged and long-toed (T3), camels living on thorny and woody food have divided ruminant stomachs and horny palates (T4). Adaption is a phenomenon fundamental to Aristotle's biology. "Nature adapts the instruments to the functions," that is, the specific nature of herons, of camels, etc., makes the parts of the heron, or camel (etc.) body in such a way as to be instrumental to their respective functions for the heron, or camel (etc.) *bios*.

Darwinism is usually understood as explaining adaption by natural selection. The interpretation is disputed: survival may count as brute fact; fitness may be just fitness for survival. I will argue that the survival of each (plant or animal) species that actually exists, and hence the way of adaption described, may count as principles in Aristotle's biology – which, however is just another way of saying that adaption and survival ultimately count as brute fact.

**2. Environment.** There is no living on resources which are unavailable. Animals are adapted to a certain *bios* the practicability of which depends upon certain environmental conditions and appropriate supply. So the question arises: How are the supply and the environmental conditions secured upon which the *bios* to which an animal species is adapted depends?

**2.1.** The question has a history in ancient Greek thought which can be traced back to **Hesiod** (Erge 42 ff., T5): "Gods", says Hesiod, "keep the *bios* concealed to humans". There are two ways in which his narrative can be understood.

- (a) Evidently, the human condition is at issue. It belongs to the human condition, and hence is characteristic of the human *bios*, that supply is only secured by labour.
- (b) But this is only part of the message. Hesiod describes the human condition as being subject to divine envy and caprice. The resources upon which the laborious *bios* of humans depends are available only through the theft of fire by Prometheus. In the order of things

established by the supreme god, the human *bios* is, as Hans Blumenberg once put it, something "illegal".<sup>1</sup>

A similar description of the human condition is offered in the treatise *On Ancient Medicine* (VM c. 3, T6). All animals except human beings are nourished from what they find in their habitat, e.g. what grows from the earth (*ta ek gês phyomena*, 121.9 J.). But human nature cannot easily process any of these. Such food as is "suited to (sc. human) nature" (*harmozousa tê physei* 122.7 J., cf. 14-6) is never found in the human habitat but must be invented by (the medical) art. – Again, there are two ways in which this can be understood.

- (a) On the one hand, the inventions described may be taken as an essential feature in the *bios* to which the human species is adapted.
- (b) But on the other hand, the availability of supply which is only secured by art (*technê*) is no feature in the general order of things. It is an addition to that order. Similarly, art is an addition to human nature, inventions are no features in the biological make-up of the human species. Without the addition, the *bios* to which the human species is adapted has no supply – which, of course, is just another way of saying that the human species is not biologically adapted to any practicable *bios* at all.

Still another variant of the same story is the so called myth related by **Protagoras** in Plato's dialogue (Prot. 320c ff., T7). Animal species are equipped by Epimetheus with faculties for "preservation",<sup>2</sup> so as to secure the joint survival of all species. By a mistake, the human species is left out. It takes the joint effort of Prometheus (with Athena and Hephaestus in the background) and Zeus to secure human survival by means of the demiourgic and political arts. Again, the message is ambiguous.

- (a) On the one hand, the arts mentioned may count as the peculiarly human faculties for preservation, on a par with or even superior to non-human faculties (as the gods involved are superior).<sup>3</sup>
- (b) But on the other hand, arts are additions to the biological faculties of the human species. Reduced to the latter, the human species cannot survive. Humans are not biologically adapted to any practicable *bios* at all.

**2.2.** Aristotle's comment in *PA* (T8)<sup>4</sup> is a version of (a) which strongly denies (b). There is no deficiency in the biological faculties of humans. Rather humans are equipped with hands

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<sup>1</sup> To be sure, Blumenberg (1975, 20) attributed illegality to Prometheus and his peers only (Prometheus is "Mitglied einer 'illegalen' Göttergeneration"). But if this is true, illegality transfers inevitably from Prometheus to the human condition.

<sup>2</sup> "Faculties": *dynameis* (Prot. 320d5, 320e2, 321c1), "preservation": *sôtêria* (Prot. 320e3, 321b6, 321c8).

<sup>3</sup> Cf. Prot. 322a3: Humankind "has a share in divine faculties" ... θείας μετέσχε μοίρας.

<sup>4</sup> Note that the description on humans as "barefoot, naked, and without weapons ..." (*PA* IV 10, 687a25-6: *anhypodêton te ... kai gymnon kai ouk echonta hoplon*) quotes Prot. 321c5-6: *gymnon te kai anhypon*

which no other animal is intelligent enough to use. The hand is an universal instrument. The function to which its shape (*eidos*) is adapted by nature (*têi physei*) is this: to enable humans to use all kinds of instruments.<sup>5</sup> That's why humans don't need such instruments as Epimetheus apportioned to non-human animals: claws and horns etc. for defense, hoofs for walking on rugged ground, grown-on coats for protection. Humans are better off than non-humans who can never lay aside their Epimethean equipment but have to sleep with their shoes on and to walk around with their beds on the shoulders.

According to Aristotle, Promethean art (*technê*) is (or at least, is an essential feature in) the *bios* to which humans are biologically adapted. In addition art is adaptable to all kinds of environmental conditions (T9). That's why, on the one hand, supply for human needs is not usually ready-made found. The *automatos bios* is thus relegated to comedy.<sup>6</sup> But on the other hand, precisely this is peculiar to humans. The human *bios* is secured by *technê*, and may be even equated with living on *technê* – as the choice of a *bios* is the choice of a *technê* to live on (see T 10). Supply for human needs is supply for the relevant arts. In a sense, therefore, humans are no exceptional case at all.

"Nature", says Aristotle (T11) "seeks what is suitable" – that is, as Balme explains,<sup>7</sup> "nature has provided suitable organs and therefore the animal seeks [the habitat in which these organs can be set into action, and thus seeks] the food that these organs enable it to get". And so do the relevant arts. To be experienced in life-stock breeding pertains, says Aristotle, to the What, the Where and the How (T12: *poia ... pou kai pôs*). The scheme of questions seems to be derived from Sophistic teachings (cf. T13),<sup>8</sup> and is evidently meant to apply to the other branches of primary production described in the sequel as well.<sup>9</sup> None of the questions is just a matter of knowing: it is also a matter of seeking. It belongs to the relevant art both to know and to know how to seek the What, the Where and the How.

But what about the Nowhere? – On the one hand, it belongs to the art to know both what can, and what cannot, be achieved".<sup>10</sup> Yet on the other hand, there is no art if nothing can be

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*dêton ... kai aoplon*. Nature apportioning *organa* in *PA* (687a11: *dianemei*) is an echo of Epimetheus apportioning *dynameis* in *Prot.* (320d5 und passim: *neimai, nemei* etc.).

<sup>5</sup> 687b6-7: Ταύτη δὲ συμμεμηχανῆσθαι καὶ τὸ εἶδος τῆ φύσει τῆς χειρός.

<sup>6</sup> Aristophanes *Ach.* 977, Cratinus fr. 172, Pherecrates fr. 137.3, Teleclides fr. 1.3.

<sup>7</sup> Balme 1991, 95 – footnote on *HA* VIII 2, 591b27, but referring to *HA* VIII 6, 595a16 and *HA* IX 12, 615a25-6 (=T10). The insertion in brackets is mine.

<sup>8</sup> See Schütrumpf's commentary (1991, 356 f.). But see also the description of an island as a candidate for colonisation in the *Odyssee* (IX. 116-41, commented on by Austin and Vidal-Naquet 1972/84, 30 f. and 184).

<sup>9</sup> Agriculture, bee-keeping, fish and poultry farming (*Pol.* I 11, 1258b17-20); timber-cutting and mining (*ibid.* b31).

<sup>10</sup> [Hippocrates], *De arte*, c. 3 (Jones II 192.6 ff.). See my comments in Heinemann 2011, 70 f.

achieved at all. It belongs to the art not just to seek but also to find. So there is no art if there is nothing to find. And still, it is just a truism that to seek is not to find. There is no Where to know when there is nothing to find.

That truism, however, tells only part of the truth. In a sense, there is no seeking if there was never anything to find at all. To seek "what is suitable" belongs to the animal *bios*, and is an activity which presupposes that the animal is alive. The animal is only alive when it has found "what is suitable" often enough. As a "steady-state theorist" (Sedley 1991, 186.), Aristotle cannot allow that any animal species is extinguished by a permanent lack of supply. But my question was: how is that secured according to Aristotle? So far, I have presented some evidence indicating that Aristotle should have been well aware of that question (at least insofar as humankind is concerned).

**3. Inter-species teleology?** Aristotle's answer is found in the *Politics* (T14).<sup>11</sup> Supply is provided by nature for all animals including humans. As new-born animals are supplied with yolk or milk, so after their development (*tois genomenois*, 1256b15): "it must be evidently assumed that plants are there for the sake of animals, and the other animals for the sake of humans. ... Assuming that nature makes nothing uncompleted or in vain, it is necessary that nature has made all this for the sake of humans" (b15-7, 20-2).

**3.1.** The passage is disputed. It seems to promote an anthropocentric world-view inherited from such authors as Xenophon (*Mem.* I 4 and IV 3), but explicitly repudiated by Plato (*Lg.* 903c), which may be considered unworthy of Aristotle. More importantly, Aristotle's talk about "nature" as the maker of plants and animals sounds highly metaphorical – to say the least. In Aristotle's biology, phrases like "nature makes nothing in vain" usually indicate biological functions.<sup>12</sup> But if so, the "nature" mentioned is the nature of the plant or animal species in question. To claim that "nature makes nothing in vain" is another way of claiming that every animal part has a function for the sake of which it exists. Given the role played by specific nature in the scheme of teleological explanation, the metaphor is innocuous. But no specific nature seems to be referred to in the passage quoted from the *Politics* (T14, see above). So there is no analogy with the usage in Aristotle's biological writings; the passage cannot be understood on that model. Nature is always the nature of something, and is in the thing of which it is the nature according to Aristotle (T15). As no such thing is indicated in that passage, it is hard to see how Aristotle's definition of "Nature" is meant to apply.

It comes as no surprise that many interpreters, including Wieland and Judson,<sup>13</sup> have denied the claim that "nature made" plants and animals "for the sake of man" to belong to science or

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<sup>11</sup> Just after the passage mentioned earlier (T10).

<sup>12</sup> Lennox 1997/2001

<sup>13</sup> Wieland <sup>2</sup>1970, 275; Judson 2005, 356 f. – For more references see Johnson 2005, 231.

theoretical philosophy. Wieland suggests that appealing to "popular views" is sufficient when questions of practical philosophy are at issue. According to Judson, the claim quoted is made "from the point of view of household managers and statesmen": the claim may "be true from their standpoint",<sup>14</sup> but "nothing follows about the status of these things [i.e. of the human resources mentioned in *Pol.* I 8] from the standpoint of biology – or of Aristotle's first philosophy."

3.2. David Sedley (1991), followed by Johnson (2005, 231 ff.) and others, has rightly rejected this view. The claim that "nature made" plants and animals "for the sake of man" answers a question which does belong to science: How is the survival of an animal species secured? Similarly, the issue thus raised belongs to theoretical philosophy: By what principles can the existence of animal species be explained? I also agree with Sedley that, on the one hand, the teleological character of Aristotle's explanation in *Politics* passage (T14) must be taken seriously but, on the other hand, a distinction must be observed which is only adumbrated in the *Corpus*.

We use things, says Aristotle (T9a), "on the ground (or: assumption) that everything exists for our sake".<sup>15</sup> He adds (T9b): "For in a sense, we are also an end – taking into account that the term 'for a purpose' (*hou heneka*) is ambiguous, as was said in my *Peri philosophias*." The distinction thus alluded to is the distinction between "purpose of" (*hou heneka tinos*) and "purpose for" (*hou heneka tini*),<sup>16</sup> and may be also described in terms of function and benefit, respectively. The things we use, says Aristotle in the passage quoted, are there to our benefit which, however, is not to say that this is the function for the sake of which they exist. The translation quoted above is therefore misleading: the final clause in T9a should be rather rendered "... on the ground that everything exists to our benefit."

The distinction between the purpose something serves and the purpose it has applies to the *Politics* passage as well. Plants are there to the benefit of animals, non-human animals are there to the benefit of humans. But this is not to say that animal benefit is the function for the sake of which plants exist. Nor is human benefit claimed to be the function for the sake of which the other animals exist. Rather, it is suggested that (i) animals survive upon the benefit they derive from plants, and (ii) human survival gains additional support by the benefit derived from non-human animals. No explanation is given by (i) to the existence of plants, nor by (ii) to existence of non-human animals. Rather, (i) and (ii) contribute to explaining why the animal species benefitted, including humans, exist.

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<sup>14</sup> Cf. *Pol.* I 8, 1252b37-8: ἔστι τις κτητικὴ κατὰ φύσιν τοῖς οἰκονόμοις καὶ τοῖς πολιτικοῖς.

<sup>15</sup> "On the assumption / ground: *hōs* (194a34). See Wardy 1993, 27.

<sup>16</sup> Kullmann 1979, 25-37; Johnson 2005, sect. 3.1

3.3. But still, Aristotle's reference to nature troubles: "Nature", says Aristotle in the *Politics* passage, provides all animals with supply and, making nothing in vain, has made plants to the benefit of animals and non-human animals to the benefit of humans. I disagree with Sedley's claim that rather than specific natures, "global nature - the nature of the entire ecosystem, so to speak" is referred to.<sup>17</sup> On the assumption that Aristotle means to explain why plants and non-human animals that benefit humans exists, Sedley's claim may be justified. But no such explanation can be given in terms of benefit (*hou heneka tini*), as opposed to function (*hou heneka tinos*). So the assumption is refuted by Sedley's own argument mentioned earlier.

As "human being begets human being and plant begets plant" according to Aristotle,<sup>18</sup> the question

(1) Whose nature makes plants and animals?

is easily answered. Plants and animals are made by their respective plant or animal natures: wheat by the nature of wheat, chicken by the nature of chicken, etc. Still, Sedley may insist that Aristotle's claim is made in the past tense, and so the relevant question must be also put in the past tense:

(2) Whose nature made plants and animals?

But this is misleading. Strictly speaking, the answer to (2) is either the same as the answer to (1), or the answer is: None. Plant and animal species never change according to Aristotle. Hence on the one hand, the generation of individuals is always the same, the past tense makes no difference at all. On the other hand, there is no question of an origin of species. The question

(3) Whose nature made plant and animal species?

is pointless since plant and animal species existed forever and hence were never made according to Aristotle.

Taken in this way, the existence of species is left unexplained. Sure, the fact that certain plant species exist explains why there is a possibility for certain animal species to exist. Similarly, the fact that certain plant and animal species exist explains why there is a possibility for humankind to exist (and live the way which is found appropriate by most). But the explanation never leads to more than possibility. To infer actual existence from that, an appropriate

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<sup>17</sup> Sedley 1991, 192 – primarily referring to the teleological explanation of regular rainfall (*Phys.* II 8, 198b16-199a8); but the *Politics* passage is just another example equally quoted by Sedley (*ibid.* 180)

<sup>18</sup> *PA* II 1,646a33-4: ἄνθρωπος γὰρ ἄνθρωπον καὶ φυτὸν γεννᾷ φυτὸν. Cf. *GC* II 6, 333b7-9: ... Τί οὖν τὸ αἷτιον τοῦ ἐξ ἀνθρώπου ἀνθρώπων ἢ αἰεὶ ἢ ὡς ἐπὶ τὸ πολὺ, καὶ ἐκ τοῦ πυροῦ πυρὸν ἀλλὰ μὴ ἐλαίαν; *EE* II 6, 1222b15-8: εἰσὶ δὴ πᾶσαι μὲν αἰ οὐσίαι κατὰ φύσιν τινὲς ἀρχαί, διὸ καὶ ἐκάστη πολλὰ δύναται τοιαῦτα γεννᾶν, οἷον ἄνθρωπος ἀνθρώπους καὶ ζῶον ὃν ὄλωσεν ζῶα καὶ φυτὸν φυτά. See also Bonitz, *Index* 59b40-5

– that is, a synchronic rather than diachronic – version of the principle of plenitude would be required. But there is no such principle in Aristotle.<sup>19</sup>

Aristotle's claim that "nature makes nothing in vain" is not meant to suggest that plants would be made in vain if no benefit for animals would result from their existence, etc. Rather, as new-born birds and mammals would be made in vain by the relevant natures without the provision of yolk or milk, so animals would be made in vain by their natures without there being plants, human beings would be made in vain by human nature without there being plants and non-human animals to feed of. The claim that "nature makes nothing in vain" is thereby turned into a tautology. There is no animal species without supply and appropriate environmental conditions being regularly secured. In addition, there is no nature of an animal species that does not exist. Hence, whenever there is an animal nature the animal species of which it is the nature exists, with supply and appropriate environmental conditions being regularly secured. In short: whenever there is an animal nature the animals it makes are not made in vain.

**4. Order in pluralist ontologies.** There is a sense in which my topic – adaption and environment – transcends biology: it also belongs to metaphysics. Natures of animal species – i.e. their essences (which count as natures, *Met.* V 4, 1014b36) – are fundamental entities in Aristotle's ontology. So the issue so far unsettled, is: how do fundamental entities interact so as to coexist according to Aristotle? How is order to be conceived in a pluralistic ontology?

**4.1.** Ontology is the study of being. There are two senses of ontology, dealing with the intension or with the extension of its the key concept, respectively. **Intension** is at issue, when the question is asked:

(1) What is it to be?

Taken in this sense, it belongs to ontology to

- to explain "what people want to signify when using the word 'is'," (T16)
- to study "being *qua* being and the properties it has as such," (T17)
- to ask the question, of fundamental ontology, "nach dem Sinn von Sein" (Heidegger, *SuZ* §1)

**Extension** is at issue, when the question is asked:

(2) What are the things-that-are?

Taken in this sense, ontology may be claimed to amount to cosmology (Whitehead, *PR* xi f.).

Its business is

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<sup>19</sup> Insofar as a version of the principle of plenitude may be attributed to Aristotle (for discussion, see Lovejoy 1936, 55-58, Hintikka 1973, 95-113, Jansen 2002, 162-170), the principle is diachronic: what is possible will eventually obtain. This is just "a claim concerning the relation between modal and temporal concepts" (Jansen 2002, 166 [my tr.]; cf. Hintikka 1973, 102 f.), and does in no way concern the existence of species.

- "to determine how many and what kinds of things there are" (T18)
- to deal with "the question that was, is, and always will be asked, and always will cause difficulty: what is the thing-that-is? – that is: what is substance (*ousia*)? This it is that some say is one, some more than one; that some say is finite in number, some infinite." (T19)
- to give an answer to the question "what are the fundamental entities of which the universe is composed?" (Kuhn 1970, 4 f.)

**4.2.** Pluralistic ontologies are ontologies in the extensional sense, and hence cosmologies, that assume diverse kinds of **fundamental entities**. Generally speaking, an entity is fundamental if it provides a principle of explanation. Relevant doctrines may take different forms.

- Presocratic approaches are described as reductionistic in the treatise *On Ancient Medicine*. If *F* [e.g. human being] is the subject to investigate, typical questions concerning *F* are: "from the beginning, what is *F*, how did *F* come to being in the first place, and of what things was *F* composed?" (T20) The entities are fundamental to which any *F* is thereby reduced, and which hence are claimed to be the nature of *F*.
- In Aristotle, fundamental entities have (or are) essences which (i) are irreducible in definition and, insofar as physics is concerned, (ii) are natures providing first principles of explanation.

According to Whitehead, "[Fundamental] entities are the only reasons, so that to search for a reason is to search for one or more a [fundamental] entity".<sup>20</sup> But this is not to say that all explanatory principles exhibited by a cosmology must be derived from an account of its fundamental entities. If ontology amounts to cosmology, the latter may be nevertheless irreducible to the former.

**Monism** recognizes just one (kind of) fundamental entity. **Pluralism** assumes that fundamental entities are diverse in kind (or in nature according to Aristotle).

- Ancient monists include Anaximenes, Heraclitus, Parmenides (*alêtheia*), and Diogenes of Apollonia etc. A modern monist is Spinoza.
- Ancient dualists/pluralists include Parmenides (*doxa*), Anaxagoras, Empedocles, the atomists, Philolaos, Plato, and Aristotle.<sup>21</sup> Leibniz is a modern pluralist,<sup>22</sup> modern dualists are Descartes and Kant.<sup>23</sup>

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<sup>20</sup> Whitehead, *PR* 24 (category of explanation xviii) – but I have replaced Whitehead's "actual" with Kuhn's "fundamental"

<sup>21</sup> Parmenides (light/night), Philolaos (limiters/unlimited things), the atomists (full/void), and Plato (*Phd.*, *Rep.* etc.) are dualists, the others are pluralists (including Plato, *Tim.*: by reason, by necessity, by both reason and necessity).

<sup>22</sup> Individual substances, as described by complete concepts, see *Disc. de Metaph.* §8 ff.



**4.3. Order** (*kosmos*) is unity in diversity, i.e. a well-formed whole, composed of (typically heterogeneous) parts. Paradigm cases taken from Homer include an arrow fitted to a bow, a lady's make up (in view of which, beauty counts a mark of *kosmos*), three tribes coexisting in Rhodos (T21, cf. Kahn 1960, 220 f.). Two requirements are met in each of the cases mentioned: (i) fittingness of the parts, (ii) proper arrangement (*taxis, eutaxia*). Both requirements are indispensable: for the necessity of (ii), in addition to (i), jigsaw puzzles are an example.

In the Presocratics and in Plato, the totality of all things is usually described as a *kosmos*.<sup>24</sup> In sum, three distinct ways are exhibited to meet the requirements mentioned. Order may be imposed upon the world by

**a)** the permanent operation of some ordering agency or principle which governs both the generation and the arrangement of things, thus securing both requirements (i) und (ii). Examples include

- divine steering: *kybernaô* in Anaximandros, Heraclitus, Parmenides and Diogenes of Apollonia; divine *epimeleia* in Plato;<sup>25</sup>
- principles of order: *dike* in Anaximadros and Heraclitus, assisted by time or Erinyes; *harmonia* in Philolaus.<sup>26</sup>
- forces: necessity (*chreôn, anagkê*) in Anaximandros, Heraclitus, Parmenides, Leucippus; love and strive in Empedocles.<sup>27</sup>

**b)** design. Examples include<sup>28</sup>

- Anaxagoras (DK 59 B 12 etc.). There is no mention of (i): all kinds of things, with given causal properties (i.e. natures ???), pre-exist. Ad. (ii): by initiating an ever-increasing rotation, *nous* arranges things in such a way that the pre-existent forces are set in action and all subsequent development is thereby predetermined.

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<sup>23</sup> Descartes: *res extensa / res cogitans*. Kant: *sinnliche / übersinnliche Natur*, cf. *KpV A74 (Akad. Ausg. 5, 43)*: *Natur = "Existenz ... unter Gesetzen"*; *"sinnliche Natur" = Existenz unter empirisch bedingten Gesetzen*; *"übersinnliche Natur" = "Existenz nach [sc. "praktischen"] Gesetzen"*, d.h. *"eine Natur unter der Autonomie der reinen praktischen Vernunft. Das Gesetz dieser Autonomie aber ist das moralische Gesetz."* – Note that in both Descartes and Kant, natural science is given a monist foundation.

<sup>24</sup> In the 4th century, both *kosmos* and *to holon* are also used in a narrower sense referring to the heaven and to the order of heavenly motions only (cf. Aristotle, *Cael.* I 9, 278b20-1). As far as I can see, Aristotle use of *kosmos* is restricted to this.

<sup>25</sup> DK 12 A 15 (= Aristoteles, *Phys.* 203b11), DK 22 B 41 (cf. B 64), DK 28 B 12.3, DK 64 B 5; Plato, *Lg.* 896e-897a.

<sup>26</sup> DK 12 B 1, 22 B 80 (cf. B 94), DK 44 B 6.

<sup>27</sup> DK12 B 1, 22 B 80, 28 B 10.6, 67 B 2, DK 31 *passim*.

<sup>28</sup> See also Theseus in Euripides, *Suppl.* 195 ff. [Hippokrates], *De victu* 11; Socrates in Xenophon, *Mem.* I 4 and *passim*.

- Protagoras in Plato, *Prot.* 320c ff. There is no mention of (ii). Ad (i), animals are equipped by gods with faculties for "preservation",<sup>29</sup> so as to secure the joint survival of all species.
- Plato's *Timaeus*. Natures of abstract structures (*tauton, thateron* etc.), of the elements, and of receptivity for structure preexist; natures of complex things are, ad (i), formed thereof and, ad (ii), set into action at their proper places by the Demiourge.

c) selection. On the assumption that there are both states of order and of disorder, it is pointed out that only states of order give rise to an inhabited world by, e.g.

- Empedocles. Ad (i): elements are eternal. Ad. (ii), diverse states of order and of disorder succeed one another. Two states of trivial order: complete separation and complete mixture of the elements; two intermediate states of complex order (one of which is the inhabited world).
- the atomists: Ad (i): atoms are eternal. Ad. (ii) infinite (space and) time allows for all kinds of states, among which are states of (local) order – which, in addition, may be even relatively stable (see Hume).
- contemporary defenders of a weak anthropic principle. Given (i) the most general laws of nature, (ii) the structure of the universe depends on the values of a set of physical constants; complex order allowing the universe to be inhabited by observers requires particular values.

According to the doctrines thus mentioned, selection is due to the requirement of observation. Differently in Darwinism: for both (i) species and (ii) ecosystems, to exist is to survive – and therefore, to be fit for (jointly) surviving.

**4.4.** Aristotle is an ontological pluralist with (at least) so many fundamental entities as there are natural kinds. As a "steady-state theorist", he must do "without any genetic account of the natural order" (Sedley 1991, 186). Hence, order cannot be imposed upon the world by design according to Aristotle. There is also no ordering agency or principle which governs both the generation and the arrangement of things; no divine steering or caring (*epimeleia*); no global nature to serve as a substitute for Plato's demiourge or world-soul.

Sure, the heavenly motions exert a certain influence on the sublunar world. Sedley adduces the relevant passage in *Met.* XII to illustrate the maintenance of order by global nature.<sup>30</sup> But on closer inspection, the ordering described is restricted to a temporal adjustment – to which the sublunar world<sup>31</sup> is not even firmly bound. The passage adduced is merely about (ii) the

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<sup>29</sup> "Faculties": *dynameis* (*Prot.* 320d5, 320e2, 321c1), "preservation": *sôtêria* (320e3, 321b6, 321c8).

<sup>30</sup> *Met.* XII 10, 1075a11-25. See Sedley 2000, 328-336. Differently Scharle 2008, 157-161; Kahn 1985 is still indispensable.

<sup>31</sup> That is, Aristotle's slaves and beasts, 1075a21.

arrangement (*taxis*) of things. Nothing is said concerning (i) the existence of species.<sup>32</sup> In addition, it is far from evident, that Sedley's "global nature" is referred to in that passage. Rather, the phrase "the nature of the whole" (1075a11 *hê tou holou physis*) refers to the cumulative natures of things (which are directly referred to in the sequel, a23).

Aristotle's account of global order turns out to be selectionist in a sense: There are no collections of co-existent species which cannot jointly survive. But evidently, this is just a necessary condition. There may be many collections of species such that,

- on the one hand, the species in each each collection are so adapted to each other as to be able to jointly survive but,
- on the other hand, the total of the species in two or more of the collections cannot jointly survive.

One of the collections is the collection of all existent species, the other collections are not. But Aristotle has nothing to say concerning the way the collection realized is selected (and the others are excluded from realization). Rather, this seems to be a matter of brute fact – just as the existence of a nature, and hence of the animal species of which it is the nature, counts as brute fact according to Aristotle (T22):

"To try to show that the nature exists would be foolish. For evidently many things of the sort described [i.e. having natures] exist. To show what is evident by what is not evident is a sign of inability to distinguish between what is, and what is not, known by itself (*di' hautô gnôrimon*, 193a5-6)."

Natures are principles. The claim that natures are known by themselves to exist is just another way of saying that the natures in question are first principles according to Aristotle.<sup>33</sup> – Hence, my concluding question which I am leaving to you for discussion is this. What is the difference between brute fact and first principle in Aristotle?

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<sup>32</sup> The Unmoved Mover may not account for order but just for the qualification of uninterrupted existence as good (see Kahn 1985).

<sup>33</sup> Irwin 1988, 132.

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