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Organismal Natures

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As other contributions to this volume show, biological substances are at the heart of Aristotle's ontology. Within this ontology the *natures* of organisms play the central explanatory role (cf. *Physics* II and, esp., *Parts of Animals*). In several places throughout the corpus Aristotle draws our attention to the fact organismal natures are complex things. The nature of a living thing is divided into its *material* nature and its *formal* nature. The formal nature is identified with the substantial being (*ousia*) of a thing, which Aristotle divides into nature understood *as mover* and nature understood *as end*. This complex structure (as well as its explanatory import) is set out explicitly in a key passage from *Parts of Animals* I 1:

> The natural scientist will state both what the soul or that very part of the soul is, and speak about the attributes it has in virtue of the sort of being it is, especially since the nature of something is spoken of and is in two ways: as matter and as substantial being (*ousia*). And nature as substantial being is both nature as mover (*hôs hê kinousa*) and nature as end (*hôs to telos*). And it is the soul — either the whole soul or some part of it — that is of this sort in the case of animals. So in this way

1 The original version of this paper was read at the *Boston Colloquium in the Philosophy of Science* (Boston University, January 22, 2007). Subsequent evolutions arose from discussions at the Second and Third Workshop on Aristotle's *Generation of Animals* (University of Pittsburgh, May 2007; November 2007). I am especially grateful to the participants of those workshops, especially Allan Gotthelf, Jim Lennox, and Jessica Gelber. I am also grateful to Peter Adamson, Ron Polansky, Jim Hankinson, Riin Sirkel, and Mariska Luenissen who commented on earlier drafts. Finally, I would like to thank John Mouracade and the participants at the Alaska Workshop (especially my commentator Margaret Scharle) for allowing me to present my ideas and challenging me to think harder about the issues involved.

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> it will be requisite for the person studying nature to speak about the soul more than the matter, inasmuch as it is more that the matter is nature because of soul than the reverse; for indeed the wood is a bed or a stool because it is potentially these things. (641a22-33 Lennox trans. with modifications)

In this paper I want to explore the concept of organismal natures as it is deployed in Aristotle's biological writings, in particular the role nature plays in the account of animal generation. For it is here that nature's teleological aspect is most on display.

Galen's Criticism

Historically, not everyone accepted the Aristotelian appeal to natures. Most famously among Aristotle's critics was Galen. In Chapter 6 of *On the Construction of the Embryo* Galen complains that to describe development as a process caused by 'nature' amounts to nothing more than a platitude: 'Surely everyone will recognize that there is such a thing as the cause of the formation of the embryo and that we all call this cause 'nature' but without knowing its substance' (§687).[2] For Galen, the only satisfying answer one could give to the question, What forms the organism?, would be one that takes the craftsman analogy literally and says that the entire process is under the guidance of some kind of intelligence that operates with a view to the end (§683, §701). In raising this objection Galen seems to have the Aristotelian and Stoic theories of biological generation squarely in mind.

Whatever the Stoics believe, Aristotle certainly agrees with the negative conclusion of Galen's overall project that the growth and development of living things cannot be due to material-forces operating according to chance (the key premise in Galen's Design Argument, e.g. *De usu partium* XI, §7-8). For Aristotle, the process of development is structured according to the form of the organism being generated by it. Development, he insists, 'follows upon' (*akolouthei*) the organism's substantial being and exists for the sake of it rather than vice versa (*GA* V 1, 778b5-7). This confers a certain order and direction on the process that cannot be accounted for in terms of the random motions of atoms (Dem-

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2 This paper has benefited greatly from Hankinson (unpublished draft).

ocritus) or the undirected actions of Love and Strife (Empedocles). Aristotle accepts that natural generation involves material-level forces of the sort Democritus proposed (*GA* V 8, 789b2-15; see below); however, he insists that when operating by themselves these undirected causes would only produce a living thing by chance. And generation is far too regular for that (*Physics* II 8). But Aristotle rejects the further inference — endorsed by Galen — that the teleological structure imposed on a developing organism must be traced to an intelligent agent that puts the organism together according to its end like some kind of internalized Demiurge. Nature, Aristotle says, does not deliberate (*Physics* II 8, 199b26-30). Galen's criticism is directed against just this sort of claim. By invoking 'natures' as the cause of development, Galen says, Aristotle offers an account which is entirely vacuous.

On the other hand, Denis Walsh has recently argued that the concept of Aristotelian natures plays the same role in development as the modern concept of phenotypic plasticity and that in this sense Aristotelian natures have an indispensable role to play contemporary evolutionary biology.[3] However, if Galen is right, then the Aristotelian approach to teleology is not possible within the context of modern biology. While grounding such an account in the concept of organismal natures might avoid the spectre of intelligent design, that concept (Galen charges) is itself non-explanatory. My aim in this paper is not to defend an Aristotelian approach to modern biology but rather to explore the concept of organismal natures in the context of Aristotle's teleology. Before doing so, however, I want to offer a brief response to Galen's charge to show that Aristotle's concept of nature is *not* vacuous and non-explanatory. This is important, since Aristotle's natural teleology is grounded in his concept of organismal natures.

Organismal natures

On closer inspection, Galen's criticism of Aristotle misses its mark. For it underestimates the explanatory resources available to him. What Galen had failed to grasp about Aristotle's developmental biology is that

3 Walsh 2006. See also Gutiérrez-Giraldo 2001. For a contemporary defense of natural teleology in contemporary biology see Mayr 1992 (who also defends a limited appeal to Aristotelian 'natures'), Lennox 1992, Ayala 1998, Vinci and Robert 2005, and the references in Bedau 1992.

there is an important sense in which references to a thing's 'nature' are not explanatorily basic. In a number of places Aristotle hints at the idea that organismal natures can be analyzed in terms of the more fundamental theory of *dunameis* or causal powers. For example, in *Metaphysics* Θ (where Aristotle sets out his theory of causal powers) we are told that nature is a kind of *dunamis* because it is a source of change, though not in another thing (as *dunamis* was originally defined in Θ 1), but in the thing itself *qua* itself (1049b9-11). Again, in *GA* II 4, Aristotle explicitly refers to a thing's nature as the '*poiousa dunamis*' that is responsible for constructing its parts in the very beginning (740b35). So it seems that talk of 'natures' can be translated into talk of *dunameis* or causal powers. In order to understand how nature can be an efficient cause of development, then, one must first understand something about Aristotle's theory of causal powers.

According to *Metaphysics* Θ 1, a *dunamis* is a power or capacity for acting or being acted upon. These correspond to active and passive *dunameis*, respectively. Active *dunameis* are the powers that causal agents have for effecting changes, while passive *dunameis* are the corresponding powers things have for being changed by those agents. To take a simple example, we would explain the process of fire melting iron by reference to two sets of powers: the passive power of the iron in virtue of which it is potentially molten, and the active power of the fire in virtue of which it is capable of melting iron (or anything with the corresponding passive power). When these two substances come into contact under the right causal conditions, their powers are immediately activated by one another resulting in the iron becoming molten.

Allan Gotthelf has argued that explanations in terms of *dunameis* are basic for Aristotle and play the same role in his system as explanations in terms of natural laws do in contemporary science.[4] For Aristotle, a change is explained when it is shown to be the result of the mutual activation of a pair of causal powers. What I am suggesting is that explanations in terms of causal powers are more fundamental than reference to organismal natures, since organismal natures are themselves a kind of *dunamis*. Once this is understood, it becomes clear that Aristotle's

4 Gotthelf 1987, 209-212. Gotthelf himself takes *phusis* and *dunamis* to be distinct concepts which are not reducible to one another (personal communication). But he accepts that *dunamis* can have a broad and narrow sense and that *phusis* is a *dunamis* in the broad sense of a 'source of change' (the narrow sense being 'source of change in another or in itself *qua* other').

talk of nature as the cause of development is not empty and vacuous. On the contrary, it gives way to a deeper explanation in terms of the more fundamental theory of causal powers. It is the theory of causal powers itself that provides the scientific account of how exactly an embryo is transformed into an organism one in form with its generating parents.[5]

At this point one might object that the theory of causal powers does not rescue Aristotle from Galen's objection. For one might complain here that there is little difference between the *virtus dormitiva* of opium (in Molière's famous example) and the *dunameis* to which Aristotle appeals in his explanation of biological development.[6] And it is typically believed that such *virtus dormitiva* explanations are not explanations at all.

It isn't at all clear what this objection amounts to. I can see at least five possible readings:

1. Appealing to causal powers or capacities is just not explanatory at all.
2. Appealing to causal powers or capacities is not a good explanation because it allows us to explain anything by simply identifying a power to cause that thing.[7]
3. The theory of causal powers invokes mysterious and occult entities.[8]
4. Saying that certain things cause certain effects because they have the power to cause those effects is vacuous because it is just a redescription of the explanandum.[9]
5. Explaining certain changes (e.g., my falling asleep) by referring to the capacity of certain things to cause those changes

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5 For the depth of the explanatory power of Aristotle's theory of causal powers see *Meteorologica* IV. See also Lennox (unpublished draft).

6 Morsink 1982, 155. This objection is also raised by Hankinson (npage) and Scharle (personal communication) and is freely admitted by Lear (1991, 23-4).

7 Morsink 1982, 155.

8 This objection seems to originate in Hume.

9 This is how Molière poses the objection in *Le Malade imaginaire*. Here the explanandum is the fact that opium causes sleep. This differs from the next reading where the explanadum is the fact that I fall asleep.

> (e.g., opium's capacity to induce sleep) is vacuous because the explananda includes reference to the explanandum.

If the charge is 2, then it has no force against Aristotle. In supporting the theory of causal powers Aristotle is not thereby committed to the view that all one needs to do in order to explain something is to invent a power to do whatever it is we want explained. Aristotle would surely agree that one must have good scientific evidence for claiming that a thing has a *dunamis* for producing whatever effect it is claimed to produce. Charge 3 also has little or no force. For such capacities need not be 'mysterious' or 'occult' entities. Whether or not something has a certain causal power is the sort of thing that can be measured and verified empirically.[10]

If 1 is the charge, then it is just false from the perspective of modern science. There is a line of thought in contemporary philosophy of science that says that a good causal explanation requires reference to the 'capacities' or 'powers' of things.[11] This is the main thesis of Nancy Cartwright's influential book *Nature's Capacities and their Measurements*. Cartwright holds: 'Science is measurement; capacities can be measured; and science cannot be understood without them.'[12] She rejects the Humean picture of causation as well as the covering-law models of Hempel and Nagel. Instead she holds that 'our typical methodologies and our typical applications, both in the natural sciences and the social sciences, belong to a world governed by capacities, and indeed cannot be made sense of without them.'[13] The general causal claims of science according to this view are not reports of mere regularities or constant conjunctions but ascriptions of *capacities*, capacities to make things happen. And these capacities constitute *the natures* of things.

This seems especially true in developmental biology. Developmental biologists often attempt to explain certain phenomena by finding 'mechanisms' — mechanisms for controlling gene expression, post-transcriptional mechanisms that play supporting roles in the control of gene expression, mechanisms for pattern formation, and so forth. These causal explanations do not collapse into talk of a mere constant

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10 See Cartwright 1989.

11 I am grateful to Jim Lennox for drawing my attention to this possibility.

12 Cartwright 1989, 1

13 Cartwright 1989, 1-2

conjunction of events but of *things* ('mechanisms') having the capacities to produce certain changes.

So causal explanations that appeal to capacities or powers are potentially explanatory from the perspective of modern science. This is precisely what makes Aristotle's developmental biology scientifically respectable, whereas it would not be if he were to simply talk of 'natures' without the theory of causal powers in the background. Of course modern biologists still look to discover the molecular structures that ground the developmental capacities of embryos. But causal statements that include reference to such capacities are nonetheless taken to be explanatory in themselves. In that case, we might say that Aristotle's account of generation in terms of the developmental capacities of organisms is explanatory; it is just not *fully* explanatory according to our modern standards. For *we* demand a further explanation about the molecular structures that ground those causal powers. But note that the appeal to causal powers is still explanatory nonetheless; it isn't vacuous. To see it as non-explanatory is to misunderstand what one demands of an explanation, especially what Aristotle demands.

Some have defended Aristotle against this version of the vacuity charge by saying that in Aristotle's world there simply is no deeper level of facts to move to while the vacuuity charge presupposes that there is some further level to be reached.[14] So an appeal to causal powers is not only explanatory for Aristotle, it is fully explanatory. For an appeal to causal powers is explanatory bedrock for him. I don't think this is right. Aristotle agrees with modern science that the causal powers of organisms are realized in some kind of material structure. *PA* II 1 introduces us to a hierarchical picture where the increasingly complex capacities of animals are grounded in their lower-level material base. However, it is argued that, in living things at least, the lower-level material base is organized for the sake of the higher-level capacities it supports rather than vice versa. for example, in *Generation of Animals* Book V we are told that the capacity of the eye to detect small differences in colour is dependent on the clarity of the fluid it contains; the clearer the fluid, the sharper the animal's vision (779b13-81a12). The clarity of the fliud itself is in turn dependent on some combination of *pneuma* and water, both of which give rise to clarity. In this way, an investigation into the power of the eye to detect small differences in colour reveals certain lower-level

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14 See, e.g., Morsink 1982, 155-61; Lear 1991, 23-4.

material facts about the structure of the eye that support that capacity. However, Aristotle will insist that in the development of the eye that particular combination of *pneuma* and water was produced for the sake of vision and not vice versa. In Aristotle's language, that particular combination of *pneuma* and water is conditionally necessary for sharp vision. So capacities for Aristotle actually explain, in a teleological way, their lower-level material base, not the other way around. In this sense capacities are explanatory bedrock, but not because there is no further level of facts to be reached.

This leaves readings 4 and 5. If 4 is the charge, then it is clearly an objection, but it is not an objection against Aristotle. The explanadum of Aristotle's *Generation of Animals* is the transformation of an embryo into its adult form. And we explain that change, in part, by reference to the developmental capacities of organisms themselves. If we then ask what those developmental capacities consist in, we would expect Aristotle to point to certain lower-level structures that serve as the material base for those higher-level capacities (e.g., *Meteorologica* IV) just as modern biologists point to certain cellular and molecular structures. But, as we have just seen, that material base will itself be explained teleologically by reference to the higher-level capacities for whose sake they exist.

So if the vacuuity charge holds at all, it must be charge 5. Now to explain the development of an embryo into a living thing of such-and-such a kind by referring to the actualization of a capacity to develop into a living thing of that kind certainly does sound vacuous, since the explanada includes reference to the explanandum. But not all causal powers are basic for Aristotle in the sense of being unanalyzable into further capacities.[15] The capacity to develop into an organism of such-and-such a kind is not an unanalyzable capacity. Rather, the *Generation of Animals* invokes a whole range of causal powers, including the capacity to transform uterine blood into various grades of nutriment, the capacity to transform those nutrients into tissues, bone structures and other 'uniform' parts, the capacity of certain materials to become membranous when acted on by heat, and so forth. Aristotle's talk of 'nature' as a cause of development gives way to a deeper explanation in terms of *these* kinds of causal powers, which together comprise the developmental capacities of living things.

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15 Compare Lear (1991, 23-4), who sees the *dunamis* to produce the living thing as an unanalyzable power.

Material and Formal Natures

In accordance with the theory set out in *Physics* Book II, *Generation of Animals* articulates an account of development where the process that transforms the embryo into its adult state is portrayed as a complex dialectic between the organism's formal nature and its material nature. The material nature of an organism is often taken to play a merely negative (some might say, nefarious) role in this process. For example, in the closing lines of Book IV Aristotle explains how the 'indeterminacy' of matter often impedes to the teleological efforts of the formal nature in the construction of an embryo:

> Nature's aim, then, is to measure the generations and completions of things by the numbers of these [sc. the periods of the heavenly bodies], but it cannot do this accurately on account of the indeterminacy (*aoristian*) of the matter and the occurrence of many principles that impede natural generation and destruction and are so often the causes of things occurring contrary to nature. (*GA* IV 10, 778a5-9)

The most perceptible area where matter has this negative effect is in the occurrence of birth defects and other deformities. Thus, *GA* IV 4 tells us that monstrosities result when the formal nature (*hê kata to eidos phusis*) fails to control the material nature (*tên kata tên hulên*) (770b16-17). Of course even here the abnormality is, in a sense, in accordance with nature (*kata phusin*), since the explanation for the monstrous result will still make reference to the *nature* of the organism understood in the material sense. Nevertheless, Aristotle insists that the cause of monsters is to be traced to the matter and not the form (cf. 770a4-8). According to Lennox, the teleological activities of the formal nature are also constrained by the material nature even in the normal cases. For Lennox this 'gives material natures both a more independent and a more central role in Aristotelian science than is typically suggested.'[16]

However, material natures are not limited to this negative role in Aristotle's account of natural generation; they also make a positive contribution of their own.[17] Consider the way Aristotle explains the forma-

16 Lennox 2001b, 183, 196.

17 See Leunissen (unpublished draft), who argues that the independent positive contributions of the material nature have been generally neglected by commentators.

tion of basic tissues such as flesh and bone (the so-called uniform parts of animals) in *GA* II 6:

> The formation of the uniform parts is effected by cold and heat. … As the nourishment oozes through the blood vessels and the pores in each one of them (just like water in unbaked pottery) the flesh, or its analogue, is formed by being fused together by the cold, and for this reason it is dissolved by fire. But of those constituents floating to the surface which have an excessively earthy nature (having but little moisture and heat in them), when these are being dried as the moisture evaporates together with the heat, they are formed into parts that are hard and earthy in character (e.g., nails and horns and hooves and beaks). As such these can be softened by fire though none of them can be melted by it, while some of them (e.g., eggshells) can be melted by fluids. Both the sinews and the bones are formed by the internal heat as the fluid substance is solidified. For this reason, like earthenware, bones cannot be dissolved by fire. For it is as though they are being baked in an oven by the heat involved in their formation. (743a3-20)

Aristotle announces at the outset of this passage that the uniform parts of animals are generated 'by cold and heat'. What is distinctive about this section is that all of the explanations presented are couched exclusively in terms of these material necessities independently of any reference to natural goals. However, Aristotle immediately qualifies this (743a21-34) by claiming that reference to heat and cold alone cannot explain why *this* amount of heating and cooling occurs at precisely *this* time in precisely *this* way, which is necessary to ensure a normal pattern of development. This is then followed by an attempt to locate those material-level accounts from 743a3-20 within a broader teleological framework by suggesting that in the context of biological development heating and cooling are 'used' by the organism's formal nature for the sake of something:

> Now cold is a privation of heat. And both of these are used by the nature <of the embryo> insofar as they have a capacity for making one thing this way and another that way *from necessity*; so that in the context of development at any rate it is *for the sake of something* that the heating and cooling of these and the formation of each of the parts takes place, the flesh being made soft — heating and cooling making it such on the one hand from necessity and on the other hand for the sake of something — while sinew is made solid and elastic, and bone

> solid and brittle. … We must state then, as we have said, that all of these things come into being on the one hand by necessity and on the other hand not by [that kind of] necessity but for the sake of something. (743a36-b8; cf. *GA* V 8, 789b6-9, *PA* III 2, 663b22-4)

Teleological explanations in Aristotle's biology often have the pattern exhibited here, where some part *X* is said to come about both from necessity and for the sake of something. In such cases as these, the material and formal nature of the organism *interact* to produce a functioning structure.

This general pattern is illustrated nicely at *GA* II 4, 739b26-32. Here Aristotle explains how protective membranes form around the outer surface of the embryo during the early stages of its development:

> When the more solid portion comes together, the fluid portion is separated off from it, and as the earthy constituents solidify membranes form all around it. This occurs both from necessity and for the sake of something: *from necessity*, because the surface of a fluid must solidify upon being heated as well as cooled; *for the sake of something*, because the embryo must not be in a liquid but must be separated from it.

The explanation works like this. On the one hand, the material nature of the embryo is such that, when exposed to heating and cooling, its surface must solidify resulting in membranes forming all around it. This is a case of straightforward material necessity. The *dunameis* of the factors involved (the active powers of hot and cold and the passive powers of fluid substances) are such that their mutual interaction produces that specific effect (cf. *Physics* 198b12-14). It is as close as we get in Aristotle to a law of chemistry. On the other hand, experimental biology shows us that developing embryos must be separated from their fluid environments, if they are to reach maturity. As such, the presence of extraembryonic membranes is necessary, not in the sense that it follows directly from the laws of chemistry; rather, they are necessary *if* the embryo is going to survive. In other words, membranes are *conditionally* necessary (or necessary *ex hupothesis*). It is important to stress that the former necessity — the fact that a fluid substance necessarily solidifies when exposed to heat and cold — is not an instance of conditional necessity. The mechanical interactions between the materials involved are necessary independently of any developmental goals. (For example, this same 'law of chemistry' is invoked in the formation of the omentum at *PA* IV 3, 677b21-8, where it is not couched in terms of

conditional necessity.) ~~What is conditionally necessary here is simply the presence of the membranes themselves.~~ In the context of development material necessity is often *subordinated*, but not always *reducible*, to conditional necessity.[18]

The dual-pattern of explanation in *GA* II 4, 739b26-32 is not a disjunctive appeal to two alternative ways of accounting for the same phenomenon, one that invokes the necessity rooted in the organism's material nature versus one that invokes final causation rooted in its formal nature. Rather, 'necessity' and 'for the sake of something' form two parts of a single, unified explanation. The teleological principle invoked at *GA* II 6, 743a36-b8 adds an important element to the story because it tells us how the two parts of such explanations are tied together. Material forces, such as heat and cold, have the capacity to necessitate certain changes in virtue their own natures. In the context of development, these necessities are exploited by the embryo's formal nature in order to bring about certain teleological goals ('it is for the sake of something that the heating and cooling *of these and the formation of each of the parts* takes place'). Applied to our example, the embryo's formal nature uses the necessity associated with its material nature (the fact that the outer surface of a fluid substance must solidify and become membranous when exposed to heating and cooling) in order to secure the goal of separating it from its fluid environment, which it must be if it is to survive to maturity.

So rather than merely hindering development or constraining the actions of the formal nature in some way, the capacity of an organism's material nature to necessitate certain changes can be *co-opted* by the activities of its formal nature to secure developmental goals. As Aristotle puts it, the material nature supplies both the matter and the 'tools' for the formation of essential parts (*GA* V 8, 789b6-9). This helps to improve our understanding of the role that material natures play in Aristotle's biology. It also helps to bolster the case against so-called heuristic (or Kantian) readings of Aristotelian teleology by putting us in a better position to see exactly why Aristotle thinks teleology is an ineliminable feature of the living world. In the context of natural generation, at least, since the changes arising from the embryo's material nature are, to a large extent, regulated and structured by its formal nature for the sake of an end, we cannot eliminate final causation from the world without

18 For a good discussion of the difference between material and conditional necessity, see Leunissen (unpublished).

fundamentally changing the way things turn out. There would not be a world populated by complex organisms whose parts are adapted for specific ways of life.

It is not the case, however, that *all* of the motions and changes arising from the material nature are subordinated to teleology in this way. In the development of living things, the material nature makes a positive contribution of its own that can be understood entirely independently of the teleological actions of formal natures. This is the main thrust of Leunissen's paper. As Leunissen shows, in many cases both the raw materials and the parts formed out of those materials come to be through non-teleological necessity. In many cases parts will be made from raw materials that result from certain other material constituents behaving according to their own natures (e.g., horns, *PA* III 2, 663b25-35; eye-brows, *PA* II 15, 658b14-25).[19] And in the *Parts of Animals* Aristotle speaks of a number of parts (e.g., the omentum) that are completely formed as a result of material necessity alone. Once formed, these part are used by the organism's formal nature for a good end. But they did not *come to be* for that end, since the formal nature is not involved in their construction (*PA* IV 3, 677b21-8).

The analysis of Aristotelian natures offered in this paper plays an important role in understanding Aristotle's account of variation. As we shall see, by analyzing forms in terms of formal natures and formal natures in terms of causal powers we are in a better position to ask whether variations among species members are ultimately due to the form or the matter of the individual. This sheds important light on the issue of whether or not Aristotle believed in so-called individual forms.

Are Formal Natures species- or individual-specific?

Commentators on Aristotle have typically held that the form transmitted to the offspring in the act of reproduction includes only those features that are common to the species. Those features that distinguish one species member from another are accidental and result either from the species-form being embodied in different quantities of matter or from certain environmental influences impeding the perfect replication of that form. In the 1980s a series of papers came out that challenged

19 This is what Lennox (2001b, 187) calls 'pre-conditional necessity', which is entirely dependent on the animal's material nature.

this traditional view of Aristotelian form by showing that the form at work in natural generation (according to the *Generation of Animals*) is not a generic species form but a sub-specific form that incorporates features peculiar to the organism whose forms it is.[20] On this reading, living forms are individual in the sense that they contain within themselves variations below the level of species.

Despite marshalling in an impressive body of textual evidence, neither paper managed to convince the general populace that, for Aristotle, living forms include more than what is common to the members of a species. The view that forms are species-specific remains the dominant interpretation in contemporary Aristotelian scholarship. For example, Sharples (2005) argues:

> Nevertheless, it seems that both for Aristotle and for Alexander there is in principle a distinction between what is essential to every member of a species and what is not, the latter being accidents due to the matter of each individual. … A species is the group of individuals…each of which is defined by, and indeed given being by, the presence in it of the form of that type of thing. Aristotle can certainly use εἶδος extensionally of a collection of individuals, but this use may be derivative, in the sense that it is the εἶδος in the sense of form that makes the individuals a group in the first place. Conversely, the features that distinguish one member of a species from another are accidents due to the matter and therefore in principle irrelevant to Aristotelian science. There is no knowledge, in the sense of scientific knowledge and understanding, of what is accidental; knowledge is related to essence and purpose.[21]

The implication of this view, Sharples adds, is that 'many of the features of individuals will be outside the scope of biology as a formal science.'[22]

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20 See especially Balme 1987 and Cooper 1988. This view, which claims that biological forms include features below the level of species (e.g., differences in eye colour), should be distinguished from the position, defended by Frede and Patzig (1988), that forms of particular organisms are themselves particular (numerically distinct, non-repeatable instances) rather than universals. The idea that Aristotelian forms are particulars is compatible with the traditional view that such forms are generic species forms. Paul Studtmann (this volume) discusses 'particular forms' in this sense.

21 Sharples 2005, 104-5

22 Sharples 2005, 106

Sharples argues that the view that Aristotelian forms are universal — in the sense that they exclude 'all peculiarities below the level of species' — reflects a deeper continuity between Aristotle and Plato, where the notion of form is much better suited to the precision of mathematics than the complexities of biology.[23]

The tendency of scholars to ignore the evidence of *GA* is puzzling. Aristotle's remarks on inheritance really do seem to support the more radical notion of individual forms. Part of the problem I think is that defenders of this view tended to emphasize the wrong portions of text. For example, the passage that most took to support individual forms reads as follows:

> What is distinctive (*idion*) and individual (*kath hekeston*) always exerts a stronger influence relative to generation. For Coriscus is both a human being and an animal; but human is closer to what is distinctive of him than is animal. And both the individual and the kind generate, but more so the individual; for this is the substance (*hê ousia*). For while the offspring also comes to be a certain quality, at the same time it comes to be a *this something*, and this is the substance. (*GA* IV 3, 767b29-35)

Many took this passage to be saying that what is distinctive and particular about the individual generator always exerts the strongest influence over the process of generation, which accounts for the fact that offspring tend to resemble their parents more than other members of the same species. Yet all this passage need be asserting — one might object — is that particular substances like Socrates and Coriscus are the things that engage in reproduction not universals like human and animal, which *Metaphysics* Z 15 denies are substances at all. On this reading the passage does not commit Aristotle to the notion of *individual* forms.[24]

Whatever we make of this text, I believe the more compelling evidence comes from the surrounding passage, which has gone virtually unnoticed in the debate over individual forms:

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23 Sharples 2005, 107

24 This reading was suggested to me by Chris Shields and Meg Scharle at the Alaska workshop. However, notice that this passage says that *both* the individual *and* the kind (= universals, cf. 768a13) exert a generative influence. The point is simply that the individual exerts *more* influence (*alla mallon to kath' hekaston*).

> I speak of each *dunamis* in the following sense. The generator [*to gennôn*] is not only a male but also a particular sort of male, e.g., a Coriscus or a Socrates, and it is not only a Coriscus but also a human being. And it is in this sense that, of the characteristics that belong to the generator insofar as it is capable of generating [*katho gennêtikon*] and not incidentally [*kata sumbebêkos*] (e.g. if it is a scholar or someone's neighbour), some belong to it more closely while others more remotely. … So, there are *kinêseis* present in the seeds of animals derived from the *dunameis* of all of these sorts of things [sc. 'male', 'Socrates', 'human'], and in potentiality even those of its ancestors, although those of the individual are always closer. (*GA* IV 3, 767b23-768a2)

This passage tells us two important things about the metaphysics of generation. First, it draws a distinction between the *heritable* properties of an individual (those that belong to the generator *katho gennêtikon*) and what we might call its *genetically incidental* properties (those that are *kata sumbebêkos*). The examples of genetically incidental properties are being a good scholar and being someone's neighbour. These properties are incidental to the generator *qua* generator, not because they fail to be universal, but because they are not passed on in the act of reproduction (they are not heritable). What this passage makes clear is that some variation within a species *is* heritable. As Aristotle puts it, some individual differences are among the properties that belong to the generator 'insofar as it is capable of generation' (*katho gennêtikon*).

Aristotle never says exactly which individual differences he has in mind here. He only mentions properties that make the generator 'a Coriscus or a Socrates' as opposed to simply 'a human being'). For the sake of argument I will treat their particular shade of eye colour and particular nose shapes as features that belong to each of them *katho gennêtikon* (as heritable differences). Whatever features Aristotle ultimately has in mind is irrelevant, though, since he is clear that some sub-specific differences are among those that belong to the generator *katho gennêtikon*.

The other thing of interest in this passage is the use of the concept *dunamis*.[25] Aristotle tells us that there are *kinêseis*, or 'movements', in the reproductive materials of organisms whose function is to transmit their heritable (*gennêtikon*) traits. These movements are said to be derived from (*apo*) a corresponding series of *dunameis* for just those traits. Now

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25 The following is based on ideas developed in Henry 2006.

it is reasonable to suppose that these *dunameis* refer to particular developmental capacities. On this reading, these *dunameis* constitute that inner source of change (or 'nature') that controls the embryo's development into its adult form.

This hereditary concept of a *dunamis* is meant to provide the ontological basis for the distinction Aristotle draws in our passage between features that belong to an organism *katho gennêtikon* and those that are *kata sumbebêkos*. Unlike genetically incidental traits, each heritable feature of an organism can be traced to a corresponding *dunamis* in its generative nature, which is a capacity for the formation of just that trait. In this way *GA* 767b23-8a2 can be seen as an attempt to isolate the more precise (efficient) causes of reproduction: the *dunameis* are the causal entities behind the heritable features enumerated in that passage.[26]

Putting these two ideas together, what the offspring receives from its parents in the act of reproduction is a series of *dunameis*, or developmental capacities, for different parts of its body. These *dunameis* are transmitted directly from parent to child via a series of *kinêseis*, or 'movements', carried in its spermatic material. Contrary to the traditional view, our passage extends this mechanism to include, not only the transmission of those *dunameis* that belong to Socrates as a human being, but those that are distinctive of him as a particular human being (e.g. his snub-nose and blue eyes). If this is right, then the generative natures of organisms must include *dunameis* for both individual- and species-level properties.

It is a short step from this to the notion of individual forms. For these *dunameis* are surely part of Socrates' *formal* nature: they are capacities of his generative soul.[27] It follows from this that Socrates' form will be different from Callias' form insofar as his generative soul includes capacities for developing particularly Socratic (as opposed to Calliastic) features, such as a snub nose and bulging blue eyes. It is in this sense that Socrates form is individual: Socrates' generative soul does not just

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26 This reading of *dunamis* is also defended in Morsink 1982. For the idea that a science must attempt to identify the 'more precise' causes of a phenomenon see *Physics* II 3, 195b21-5.

27 In *de Anima* II 4 Aristotle says that generative soul is essentially the capacity to reproduce the form and *ousia* of the individual in a different material body (415a26-8), while nutritive soul is the capacity to maintain that form and *ousia* in the same body (416b3-24). While both capacities belong to the same part of the soul, the reproductive capacity is primary (416b24-6).

include *dunameis* for parts of a human being but more specific *dunameis* for parts of a particular kind of human being, namely, a Socrates. These more specific *dunameis* (*dunameis* for resemblances that are peculiar to Socrates) are not found in Callias' generative soul.[28]

Before moving on I want to say a word about Aristotle's use of the plural *dunameis* (and the corresponding *kinêseis*) in our passage. The plural raises important questions about the modularity of development. Certainly, the fact that organisms are not simply collections of parts but unified wholes suggests that their generative natures must also be unities of some kind and not merely a collection of independent developmental capacities for independent parts. At the same time, it is unclear from the text of the *GA* just how far Aristotle is willing to accept this non-modular conception of development. But however Aristotle ultimately answers this question (Do generative natures have 'parts'?), it is at least clear that for the purposes of discussing inheritance he thinks it is useful to talk about *distinct capacities* for the development of different traits. For among the phenomena he thinks his account must be able to explain is the fact that offspring can resemble different family members in respect to different parts (767b1-2). To explain this Aristotle posits different *dunameis* for different parts of the parent, which can be inherited more or less independently of the others. For example, after describing how resemblance to the whole is accomplished Aristotle says:

> The same course of events also applies in the case of the parts. For often some of the parts resemble the father, some the mother, and some one of the ancestors. For the movements of the parts are also present in <the sperma> in activity and in potentiality, as has often been said. (768b1-4)

Given the suggestion at 767b23-8a2, presumably these 'movements of the parts' will also be drawn from *dunameis* corresponding to those parts. So while the formal nature of an organism will constitute a unity

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28 Aristotle does say on many occasions (in both the *Metaphysics* and the biology) that Socrates and Callias are 'one in form'. And *Generation of Animals* V 1 is clear that 'the account of the substantial being' (*logos tês ousias*) of an organism does not include features that are peculiar to it as an individual (e.g., eye colour in humans). For a way to read this idea that is consistent with my interpretation see Lennox 2001b, 174-7.

of some kind (that *phusis* is itself a single, unified *dunamis* for the formation of a single organism), it can be understood as a unified complex of various developmental capacities.[29]

Heritable variations like eye colour and nose shape occupy an interesting place in Aristotle's ontology. First of all, they are not material accidents or incidental by-products of changes aimed at other ends. What allows us to say that some developmental process *P* is internally directed towards its outcome *X* (according to Aristotle) is the fact that *P* is the actualization of a *dunamis* for *X*, where *X* is the *per se* object of that *dunamis*. Some other outcome *Y* might also result from the actualization that same *dunamis*, but *Y* is considered incidental to *P* (since *P* is the actualization of a *dunamis* for *X* not *Y*). I will not attempt a full defense of this here. The point is that we can identify which outcomes are developmental goals and which are incidental by-products of the changes leading up to them by identifying which *dunameis* are at work in the process.[30]

There is good reason to think that all the *dunameis* mentioned in *GA* 767b23-8a2 are *per se* efficient causes of the traits associated with them. On this reading, all of those individual differences that belong to Socrates *katho gennêtikon* (those corresponding to the *dunamis* for 'Socrates') will come to be as part of a continuous actualization of a single *dunamis* for a human being with just those features. If this is right, then those individual differences will not count as material accidents; for there is nothing accidental about them. Like Socrates' species-level properties, the presence of his individual features can be traced to a set of *dunameis* for just those ends.[31]

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29 The modularity question arose at the Second Workshop on the *Generation of Animals* (Pittsburgh 2006). There was no consensus about the import of the plural *dunameis* (and *kinêseis*) in *GA* IV 3; however, there was a strong feeling among the participants that they must constitute a unity of some kind. I am convinced by Lennox's 1982 view (reprinted in 2001b, 248n41) that development involves an 'integrated *series* of potentials [*dunameis*]' rather than '*an* irreducible potential for form'. (Lennox has since denounced that view on several occasions [personal correspondence].) This does not mean that the product of development must be a mere aggregrate of features. As I see it, modularity comes in degrees, and the text of the *GA* does not give us any indication as to how non-modular Aristotle thinks development is.

30 Gotthelf 1989, 115-16

31 Being 'accidental' (*kata sumbebêkos*) has two senses in Aristotle. Something can be accidental in a causal sense of being the incidental by-product of a series of chang-

Yet, the fact that heritable variations are the intrinsic or *per se* objects of a set of developmental capacities does not mean that those features are present in the organism for the sake of anything. For Aristotle is equally clear in Book V that *no* variations below the level of species are subject to teleological explanations. (The reasons for this are complex and outside the limits of this paper.) At the outset of Book V Aristotle tells us that those features which are neither common products of animal natures nor distinctive of some particular kind of animal neither are nor come to be for the sake of anything (778a30-3). Eyes are common products of animal natures, while wings and feathers are features that are distinctive of some particular kind of animal. Eye colour in humans, on the other hand, would be an example of a heritable difference that satisfies neither of these two conditions. For not all humans have eyes that are the same colour. Thus, while the eyes might be present for the sake of something, their particular colouring is not.

The existence of heritable variations (individual differences that can be traced to a *dunamis* in the organism's formal nature) thus suggests that being the intrinsic object of a *dunamis* is not sufficient for teleology.[32] If this is right, then heritable variations occupy an interesting place

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es aimed at some other end. Or it can can be accidental in the logical sense that is opposed to being essential. Those individual features that belong to Socrates *katho gennêtikon* are accidental in the logical sense (though *qua* human not *qua* generator!) but not in the former sense (since each one is the *per se* object of a corresponding *dunamis*).

32 This is at least a necessary condition. For example, if eyes were the incidental by-product of a series of changes aimed at other ends, then there would be no sense in which eyes are present for the sake of seeing. Sight would not be part of the causal story that explains why animals come to have eyes. And I have argued that being the *per se* object of a corresponding *dunamis* is what distinguishes the 'intended' result of a process from those results that are incidental by-products of the changes leading up to them. Gotthelf argues that teleological explanations are sanctioned *only* when what is being actualized is a *dunamis* for a complex outcome that is not ontologically reducible to a sum of actualizations of a series of *dunameis* traceable to the organism's material ('elemental') nature (e.g., 1989, 113). Gotthelf could hold that the *dunamis* for 'human' (and 'male'?) in our focal passage is an *irreducible* potential for form in this sense, while the *dunamis* for 'Socrates' is reducible to a series of elemental *dunameis*. Although I remain attracted to Gotthelf's interpretation of teleology, the text at *GA* 767b23-8a2 does not invite this distinction. On my reading, all the individual differences that belong to Socrates *katho gennêtikon* (those corresponding to the *dunamis* for 'Socrates') come to be as part of a continuous actualization of a single *dunamis* for a human being with just those Socratic features. But those individual differences will not be present for the sake of anything.

in Aristotle's ontology: family resemblances are neither accidental by-products (since they are heritable) nor are they present for the sake of anything (since they are sub-specific).

Species natures

In addition to organismal natures, there is some evidence in the biology that Aristotle might also have a concept of *species* natures. In *GA* V 6 Aristotle introduces a series of distinctions in order to explain changes of colouring among animals. First, a given species of animals can be monochromatic or polychromatic.[33] It is monochromatic if all the members naturally have the same colouring (e.g., all lions are naturally tawny, all ravens black, all polar bears white),[34] while it is polychromatic if its members do not all have the same colouring (e.g., some pigeons are naturally grey, while others are naturally white). In addition, Aristotle distinguishes between being totichromatic (or whole-coloured, *holokhroma*) and being variegated (*poikila*). Being totichromatic means that the body of the animal is all one colour (e.g., a panther is entirely black), while an individual is variegated if its body is not all the same colour (e.g., leopards are spotted).

Part of the work being done by these distinctions is that it allows Aristotle to talk about the way the colouring of a species can change over time. Aristotle is not interested in changes in an individual's colouring over its life-span but changes in the colour of the population itself:

> Change of colour is much more common among totichromatic animals than among monochromatic ones, both in cases where a simple colour changes into another simple colour (e.g. ,white animals produce black

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33 Each of these is said to be a feature of the *genos*; however, in the present context *genos* should be taken to refer to a continuous ancestor-descendent line (see *Metaphysics* Δ 28; compare De Queiroz 2007), i.e. a reproducing species. For an explicit use of *genos* as species see *GA* IV 3, 767b9-10.

34 Aristotle does recognize that a species that is naturally monochromatic might contain individuals that are not the same colour as the rest of the population; for example, there may be white ravens. However, as he goes on to explain (see below), in these rare cases the colour of the individual is an unnatural 'affection' caused by some sort of disorder (e.g., albinism). So being monochromatic does not require that every single individual is the same colour only that the members are the same colour 'by nature'.

> ones and black ones produce white ones) and in cases where mixtures are produced from both of them. The reason for this is that not having a single colour is present in the nature of the whole kind (*en tê*$_i$ *phusei to holô*$_i$ *tô*$_i$ *genei*). For being easily changed (*eukinêton*) in both directions belongs to the kind, so that there are more instances of changing into one another and of being variegated. Monochromatic kinds are the opposite of this. For they do not change except owing to some affection, and this is rare (instances of a white partridge, raven, sparrow, and bear have been observed). These happen when there is some disturbance in the process of development. For what is small is easily destroyed and easily changed, and what is coming to be is of this sort. For the origin is located in something small in things that come into being. (*GA* V 6, 785b27-6a2)

Natural changes in the colouring of a population are said to occur more frequently among the totiochromatic-polychromatic kinds, those whose members have single-coloured bodies though not all members have the same colour of body (e.g., humans, oxen, pigeons). The reason, Aristotle says, is that it is in the nature of these kinds not to have a single colour. This makes the population susceptible to change (*eukinêton*), so that we tend to find more varieties of colour and more instances of colour change from one generation to the next.

What is striking about this passage is that it invokes 'the *phusis* of the *genos*' to explain why the colouring of some species is 'easily changed (*eukinêton*) in both directions'. This is striking because Aristotle seems to be ascribing a single nature to the species itself, which is the source of its tendency to change colour. There are two ways to read this remark, depending on how one views the ontological status of Aristotelian species.

One might argue that Aristotelian kinds are just not the sorts of things that can have natures in the strict sense. Natures are internal principles of movement and change belonging to primary substances. And only organisms are substances in this sense; the kinds to which they belong (species and genera) are either not substances at all (*Metaphysics* Z 15) or secondary substances that are ontologically parasitic on individuals (*Categories* 5). This suggests a deflationary reading of the text. Talk of a species nature here is simply a generalization over the particular natures of the members of that species. Drawing on the discussion in *GA* IV 3, what Aristotle seems to be saying is that the generative natures of different individuals within the kind contain *dunameis* for different colours. This is why the colour of the population is easily changed: there

is an abundance of heritable variation. By contrast, the natures of individuals in monochromatic species (e.g., ravens, panthers) all contain *dunameis* for the same colour. As such, any change in the population must arise from an unnatural affection of some kind owing to a disturbance in the process of generation.[35]

This may be the way Aristotle intends us to read this passage. However, there is a more interesting reading that takes Aristotle's talk of *species* natures seriously. First of all, Aristotle says that it is the nature of the species *not* to have a single colour. One might argue that the property Aristotle ascribes to the species here cannot be reduced to the properties of the organisms that comprise the species. For each particular organism is 'totichromatic', which means it naturally develops and maintains only one colour (e.g., a ox born grey remains grey for its life). In the same way being *eukinêton*, of which this *phusis* is the source, is not reducible to the natures of individual organisms.[36]

Now, since Aristotelian 'natures' are internal principles of change belonging to individual substances, if species really do have natures of their own, then Aristotle must be thinking of them as individuals rather than classes.[37] While I am not sure this is the case for Aristotle, let me offer some textual evidence to motivate this reading. In *Parts of Animals* I 2-4, for example, Aristotle appears to treat *infima species* as particular individuals: they are the *kath' hekesta* that we are attempting to grasp through definition.[38] On this view of species, individuals like Socrates and Callias are *parts* of a more inclusive individual (the human species) rather than *members* of a wider class (the class of all humans). Now one of the marks of being individual substance is possessing unity through time, or diachronic unity. What unifies a species individual in this way?

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35 This argument follows the lead of Lennox 2001b, 184.

36 The reading of species natures developed here might also be extended to Aristotle's discussion of bees in *GA* III 10. For example, at 760a12-14 Aristotle attributes the fact that the generation of bees is 'arranged in a sort of proportionate series', which ensures that the three varieties (*genê*) of bee (king, worker, drone) 'continue forever in existence and none of them fails', to the activity of *hê phusis*. This orderly arrangement of generation seems to be a species-level property that cannot be traced to the *phusis* of any particular bee in the species.

37 This view would have real contemporary relevance (Hull 1976, Ghiselin 1997).

38 See Lennox 2001a, 153: "The particular' (*kath' hekaston*) is used by Aristotle to refer both to individuals [sc. organisms] and to the most determinate forms of a kind; here [sc. 642b6-7] the latter use is to the fore.'

Reproductive continuity. The primary definition of a *genos* in *Metaphysics* Δ 28 is 'a continuous generation of organisms of the same form'. On this model species turn out to be individuals whose parts are unified through formal replication.

Individuals also have functional unity; they are integrated wholes. And there is some suggestion that Aristotelian species do possess this kind of unity. The parts of an Aristotelian species (the individual organisms) constitute a single, unified whole if and only if they all contribute to a common function (see *Metaphysics* Δ ##, ## **[REFERENCE NEEDED]**). What is this common function? There is at least one place where Aristotle seems to suggest that the different parts of a species — specifically, its males and females — exist for the sake of its preservation. In *GA* IV 3 Aristotle explicitly says that males and females are necessary because 'the species must be kept in being' (767b8-10). On this reading, then, the parts of a species are tied together through reproduction (diachronic unity) and by this one common function (functional unity).

Summary Conclusion

In this paper I set out to explore Aristotle's concept of organismal natures as it is deployed in his biological writings by focusing on the role of nature understood 'as mover' in Aristotle's account of animal generation. We can gather the arguments of the paper into five main claims:

> 1) Aristotle's concept of organismal nature picks out something complex: it is a complex of a *material* nature and a *formal* nature. The generation of an organism arises from the interaction between these two natures, where necessities arising from the material nature are often used by the formal nature as 'tools' for bringing about certain teleological goals (*GA* II 6, 743a36-b8; V 8, 789b2-15).
>
> 2) Reference to a thing's nature is not explanatorily basic; talk of nature can be understood in terms of Aristotle's more fundamental theory of *dunameis* or causal powers (*Metaphysics* Θ 8, 1049b9-11). This makes Aristotle's developmental biology scientifically respectable from a modern perspective, whereas it would not be if he invoked the concept of organismal natures without the theory of causal powers in the background.

3) The formal nature at work in generation is a unified complex of independently heritable *dunameis*, which include capacities to develop both species- and individual-level properties (*GA* IV 3, 767b23-8a2). Thus formal natures are in a sense 'personalized'. For example, Socrates' generative nature includes a set of capacities for developing particularly Socratic (as opposed to Calliastic) features, such as a snub nose and bulging blue eyes.[39]

4) Heritable variations, such as eye colour and nose shape, occupy an interesting place in Aristotle's ontology: they are not accidental by-products of development, since each one is the *per se* object of a corresponding *dunamis* (*GA* IV 3); yet they not present for the sake of anything, since they are sub-specific (*GA* V 1). The existence of heritable variations thus shows that being the intrinsic object of a *dunamis* is not sufficient for teleology.

5) There is some evidence that Aristotle invokes the concept of a *species nature* to explain certain species-level properties, such as the tendency of a species to change its colour over successive generations (*GA* IV 6, 785b27-6a2).

Claims 3 and 5 are likely to be the most controversial. I have tried to show how claim 3 (specifically the commitment to individual formal natures) follows directly from Aristotle's hereditary use of the concept of *dunamis* in *Generation of Animals* IV 3. This concept is meant to provide the ontological basis for the distinction he draws between features that belong to an organism '*katho gennêtikon*' (which includes individual features) and those that are '*kata sumbebêkos*'. Claim 5 is more tentative, and I am not aware of anyone who has suggested this radical interpretation. Admittedly, the evidence for this is weak; I know of no any other texts that support it. And so in the end the deflationary reading of '*en tê*$_i$ *phusei to holô*$_i$ *tô*$_i$ *genei*' may be preferable. On this reading, Aristotle's reference to species-level natures is reducible to the natures of the organisms that comprise a species.

I myself have been attracted to the view (defended by Lennox) that Aristotle does not extend teleology beyond the actions of individual

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39 This is not to suggest that *the products* of these capacities (e.g. eye colour) are part of an organism's substantial being (cf. *GA* V 1, 778a32-b1) but only the *dunameis* themselves, which I take to be capacities of generative soul.

natures, even to the point where I doubt Aristotle would accept cases of what modern biology calls 'co-adaptions' (e.g., the co-adaption between insects and flowering plants). Nevertheless, the possibility that Aristotle invokes a concept of species-level natures over and above organismal-level natures remains an interesting idea and deserves to be taken seriously. The price to be paid for this reading is that one must show that Aristotelian species are individuals in the way that organisms are individuals, since only individuals can have natures (understood as an inner source of change). Yet in the *Politics* Aristotle has no trouble seeing the *polis* as an individual with human beings as its parts. The *polis*, Aristotle says, is a product of nature and prior to the individual citizen; for the latter, when isolated from the *polis*, is not self-sufficient and is therefore like a part in relation to the whole body (*Politics* I 2; compare *Metaphysics* Z 16). So it may not be much of a stretch for Aristotle to treat certain biological groups as individuals with natures of their own and organisms as their parts.[40]

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40 It should be stressed here that the idea of species natures need not commit Aristotle to 'global teleology' any more than the idea of group selection commits one to Intelligent Design.

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