Philosophic Exchange

Volume 46 | Number 1 Article 3

2017

Aristotle and Darwin: Antagonists or Kindred Spirits?

James G. Lennox
University of Pittsburgh, jglennox@pitt.edu

Aristotle and Darwin: Antagonists or Kindred Spirits?

James G. Lennox
University of Pittsburgh

1. Introduction

In January of 1882 William Ogle, a physician and classicist, sent Charles Darwin his recently published English translation of Aristotle's *On the Parts of Animals*, which contained a long and detailed introduction and extensive notes, philological and scientific. Darwin sent a brief note upon receiving the gift. But after reading Ogle's Introduction and book I and beginning of book II of the translation, Darwin sent him a more detailed note in which he expresses his amazement at what he had been reading:

> Feb. 22, 1882
>
> My dear Dr Ogle
>
> You must let me thank you for the pleasure which the Introduction to the Aristotle book has given me. I have rarely read anything which has interested me more; though I have not read as yet more than a quarter of the book proper. From quotations which I had seen I had a high notion of Aristotle's merits, but I had not the most remote notion what a wonderful man he was. Linnaeus and Cuvier have been my two gods, though in very different ways, but they were mere school-boys to old Aristotle.

We don't know how much more of Aristotle he read. Darwin was ill and bed-ridden at this point in time, and on April 19 he passed away. As someone who has devoted much of his research for the past four decades to Aristotle and his influence and Darwin and his influence, it gives me great pleasure to imagine Darwin, during his last days of life, sitting reading Aristotle's *Parts of Animals* with a smile of recognition of a kindred spirit living 2300 years earlier.[1]

---

[1] For a detailed study of this correspondence in its historical context, see Gotthelf, 1999, 3-30 (reprinted in Gotthelf 2012).

But how could that be? For at the hands of both philosophical and biological followers of Darwin, a narrative has emerged to the effect that it was Aristotle's influence on the history of biology that made it nigh on impossible to imagine a living world undergoing constant evolutionary change. According to this narrative, not only would Darwin not have seen a kindred spirit in Aristotle; he would have seen his principal antagonist in the history of biology.

The purpose of this paper is to establish that this narrative is a myth created by neo-Darwinians and their philosophical defenders. I am not the first to make this claim[2], but I will go about my task informed both by four decades of study of Aristotle's zoological inquiries and the philosophy that made those inquiries possible, and by an almost equally lengthy study of the history of Darwinism.[3]

2. The Creation of a Myth

Certainly Charles Darwin and Aristotle can *sound* like kindred spirits; take the following two quotes, one from *On the Origin of Species* characterizing natural selection, the other from Aristotle's study of *Animal Locomotion*, identifying a presupposition of zoological investigation.

> Although Natural Selection can act only *through and for the good of each being*, yet characters and structures, which we are apt to consider as of very trifling importance, may thus be acted on. (Darwin 1859, 83)

> Nature makes nothing in vain, but always makes, from among the possibilities, *that which is best for the being of each kind of animal.* (Aristotle, *De incessu animalium* 2, 704b15-17)

And yet according to legions of evolutionary biologists and philosophers, such appearances are completely misleading. In this sec-

---

[2] Amundson1998, 153-177; Winsor, 2001, 239-254; Wilkins 2009.

[3] Cf. entry in the *Stanford Encyclopedia of Philosophy* on Aristotle's Biology (https://plato.stanford.edu/entries/aristotle-biology/) and on Darwinism (https://plato.stanford.edu/entries/darwinism/).

tion we will look at the creation of the Antagonism Myth and at its central themes and variations.

A convenient place to begin is with that venerable defector from the Vienna Circle, Sir Karl Popper. Written during World War II and the horrors of Nazism, the first volume of Popper's *The Open Society and Its Enemies* traced the horrors of twentieth century totalitarianism back to Plato and Aristotle. About Aristotle's influence on the history of science he had this to say:

> Every discipline, so long as it used the Aristotelian method of definition has remained arrested in a state of empty verbiage and barren scholasticism, and the degree to which the various sciences have been able to make any progress depended on the degree to which they have been able to get rid of the essentialist method. (Popper 1945, vol. I, 206)

Popper identifies two features of Aristotle's philosophical method as roadblocks to scientific progress: a method of definition and an essentialist method. No doubt Popper saw these as closely related, for he correctly sees that in Aristotle and the Aristotelian tradition, the proper object of a definition is the essence of the definiendum, and an important part of scientific inquiry is aimed at discovering essences. But Popper's conclusion, that this was an impediment to scientific progress, was not based on a detailed study of the history of science, but rather on deeply held skeptical views about induction and the nature of rationality. After all, scientific textbooks continue to be full of definitions of key terms that purport to identify what is essential to the objects and processes being defined.

Admittedly under Popper's influence, a young David Hull, prior to his becoming a leader in the resurgence of philosophy of biology in the 1970s, penned the following words.

> Aristotelian definition had to be abandoned both for species names and for 'species' [i.e. the species concept]. Typologists could ignore the actual untidy distribution of properties among living organisms and the variety of methods of reproduction used to perpetuate species. Evolutionists could not. (Hull 1965, 314-326)

Like Popper, one message here is that scientific progress, at least in biology, required abandoning something called 'Aristotelian definition' and essentialism. But he has added a twist—a distinction between 'typologists' and 'evolutionists'. That twist is likely due to the influence of ornithologist and systematist Ernst Mayr. Mayr left Berlin to take a post at the American Museum of Natural History in January of 1931. He was the author of one of the foundational documents of the so-called 'Neo-Darwinian Synthesis', *Systematics and the Origin of Species*, first published by Columbia University Press in 1942. Aristotle and Plato are not mentioned in it; but in his 1963 *Animal Species and Evolution* and its abridged edition, *Populations, Species and Evolution* (1970), he echoes the sentiments of Popper:

> Owing to its belief in essences this philosophy [Typology] is also referred to as essentialism and its representatives as essentialists (typologists). [They] were influenced by the idealist philosophy of Plato and the modifications of it by Aristotle. … The concept of unchanging essences and of complete discontinuities between every eidos (type) and all others make genuine evolutionary thinking well-nigh impossible. (Mayr 1970, 4; cf. 11)

Two years before Hull's paper appears, then, Mayr identifies 'essentialism' with 'typology', and a bit later treats 'type' as a translation of the Greek *eidos* (normally translated 'form' or 'species'—more on that later). The essences in question are said to be unchanging and they are also said to be 'discontinuous'. And finally, Aristotle's understanding of these concepts is referred to as a 'modification' of the 'idealist philosophy of Plato'. This last step is critical; for as we will see all of the above claims are far more reasonably applied to Plato than to Aristotle. It was not unusual for those teaching Greek Philosophy in the Germany in which Ernst Mayr was educated to view Aristotle as a slightly unorthodox follower of Plato. But the Aristotle I will be discussing in the remaining sections of this essay is, on every basic philosophical principle, diametrically opposed to Plato.

From this point on this myth gets promulgated with virtually no reference to Aristotle's actual biology or philosophy of biology. Take this comment from Michael Ghiselin, who along with David Hull defended the idea that the lineages of populations known as

'species' should not be thought of as classes or kinds made up of individual organisms—rather the lineages themselves were individuals, and names such as *Canis lupus* name individuals.

> [Aristotelian essences] remained, however, the basic object of theoretical, or we might even say scientific, knowledge. To understand a thing was to know its essence. The essences, however, retained their timeless and unchanging character. Individual men might change, but for the class "man" to change would not even have made any sense. Species could not originate. (Ghiselin 1997, 7.)

You can see from this quote why the idea of species being individuals would appeal to Ghiselin—individuals originate and change, classes defined in terms of timeless and unchanging essences cannot.

For good measure, allow me to add one more twist to the tale, due to another philosophical defender of the neo-Darwinian worldview, Elliott Sober.

> Aristotle is typical of exponents of the Natural State Model in holding that variation is introduced into a population by virtue of interference with normal sexual reproduction. … The essentialist attempts to understand variation within a species as arising through a process of deviation from type. ...evolutionary theory undermined the essentialist's model of variability [and] removed the need for discovering species essences." (Sober 1994, 224, 226.)

The new twist here is the contrast between how the essentialist and the 'population thinker' view variation within a population. For the population thinker there is no essence or type, there are just populations of statistically varying individuals. Variation is the norm, so to speak. For the essentialist, however, there is a type that serves as the standard; variations are seen as *deviations* from the norm due to interferences in the natural process of development.[4]

---

[4] It is a topic for another time, but an underexplored question is exactly what "population thinking" is and how much of biology outside of population genetics ever adopted this kind of "thinking". With the advent of evolutionary

Let us sum up and move on—key to the Antagonist Myth are (at least) the following ideas:

- Aristotle should be considered a reformed Platonist
- According to Plato's Theory of Form: knowledge is of eternal and changeless types of which the things of this world are imperfect images
- Aristotle's forms are Platonic forms embedded in matter
- All perfect members of a species have an identical essence or specific form
- All other properties are 'accidental' or deviations from type
- Knowledge, in the form of a definition, is of the essence
- The essence is unchanging and eternal
- Definition thus provides necessary and sufficient conditions for species membership
- Reproduction maintains the species essence.
- This was the 'paradigm' that Darwin needed to overturn

3. Rejecting the Myth

The rejection of this myth will involve two distinct, though related steps. The first step will be to provide an account of Aristotle's Essentialism as it is actually displayed in his philosophy of biology and biological practice. We will see that it has nothing to do with the 'mythic' version. The second step will be to look at a common, explicitly anti-evolutionary way of defining the species concept in Darwin's time, and his attempts to reorient thinking about it. The paper will conclude with a Coda. I will return to the question with which I began—could Aristotle and Darwin be kindred spirits. By that point we will know what Aristotle's philosophy of biology actually looks like and what Darwin was really up against. We will be in a position to reconsider the question of how much common ground Aristotle and Darwin share.

---

developmental biology, it is worth reconsidering the claim that such thinking is a necessary condition for *evolutionary* thinking, as the Antagonist Myth asserts.

3.1. Aristotle's Three-Step Program of Biological Inquiry

I will here provide a somewhat simplified version of Aristotle's views about how biological research ought to be carried out.[5]

The first step: identifying 'entry level kinds'

I begin with a passage from Aristotle's *On the Parts of Animals* (*PA*):

> In those cases where people refer to kinds in a clearly defined manner and where the kinds have [i] a single common nature and [ii] forms in them not too distinct from each other—we should refer to these animals in common as a single kind, as we do with the birds and the fish. And we should do the same with any other currently unnamed group that embraces—as kinds do—many forms within it. (*PA* I. 4, 644b1-6)[6]

What is Aristotle up to here? In the pages leading up to this quotation, Aristotle has introduced a method for organizing species into more general groupings. Very schematically, the method involves taking very general kinds—he uses Birds and Fish as examples—identifying all the general features they share (he calls them 'general differences'), and then sub-dividing those differences into more and more specific, determinate forms. To cite a single example: all birds have beaks, which differ markedly from the mouths of other kinds of animals; but some beaks are hooked while others are straight, some are wide, others narrow, some short others long, and so on. Aristotle recommends tracing down such differences for all the shared traits simultaneously, identifying more and more determinate forms of the general kind in this way. This discussion of multi-differentiae division is based, however, on an undefended assumption: that researchers should be able to identify these general kinds. Aristotle is well aware that this is not an obvious step: he notes, for example, that if you start with the general category 'flyer', you will be starting with a group that has many

---

[5] A somewhat richer account, but still introductory, can be found in my entry on 'Aristotle's Biology', in *Stanford Encyclopedia of Philosophy*. Much of the research on which that entry is based can be found in Lennox 2001b.

[6] Translations from *On the Parts of Animals* are based on Lennox 2001a.

(but not all) insects, many (but not all) mammals, and most (but not all)[7] birds in one group! Intuitively, this seems like a poor place to start. But Aristotle is not willing to base his thinking about where we should start on intuition. So the passage above asks, how do we identify kinds that are *appropriate* starting points for inquiry—which I have referred to as "entry level kinds".[8]

It will be noticed that the 'taxonomic' language I use in that passage consists of two words: 'Form' (*eidos*) and 'Kind' (*genos*). *Eidos*[9] is often translated 'species'—indeed many translators translate it as 'form' when it is contrasted with 'matter' as an aspect of natural objects, and 'species' in passages like the one above, where it seems to refer to a sub-division of a wider kind. I find this practice problematic for a number of reasons I have discussed elsewhere: Aristotle never suggests this word is used equivocally, and since this is one of his central philosophical concepts, and the one about which he and Plato disagree most significantly, it is very odd that he does not, if he does is in fact think it is equivocal; and since there is a reason why it seems sometimes to refer to a component of an individual substance and sometimes to the kind to which that individual belongs (namely, an individual's form is that in virtue of which it is a member of that kind) it is not a good idea to translate it in two entirely different ways. Moreover, it is perfectly acceptable English to characterize, for example, a red-tailed hawk as a form of hawk, or hawks as forms of raptor. So…form it is!

The point I want to focus on in this passage is that it is providing a *normative account of kind identification*: we should group different forms of animals into a wider kind when they have [i] a common nature and [ii] many forms *not too distinct*; and we should do so not only with commonly named animals like bird and fish, but also [iii] with animals that share characteristics [i] and [ii] but where no kind has been designated by a common name. I will soon give you an example of this theory in practice, so if all this is "floating" for you at the moment, bear with me. But one problem might be apparent to the reader even at this point: How is a

---

[7] He is quite familiar with Ostriches—see *PA* IV.14, 697b14-26.

[8] Lennox 2005. This language is intended to convey a core theme of *PA* I.4—that categories like 'flyers' and 'swimmers' are at too high a level, while categories like 'lion' and 'horse' are at too specific a level, to start an inquiry.

[9] You will recall that this Greek word appeared in the above quotation from Ernst Mayr (above on page 6), where he rendered it as 'type'.

researcher going to be able to identify groups with 'a common nature' at this preliminary stage, prior to knowing what that common nature is? This is Aristotle's version of the so-called 'Meno-problem' expressed by Socrates in Plato's dialogue *Meno*: if you do already know it, then you don't need to mount an inquiry to search for it; if you don't already know it, how are you going to identify it. Aristotle's solution to it involves articulating an epistemology that allows for stages of 'knowing': Aristotelian inquirers can have compelling reasons for thinking that a number of forms share a common nature prior to knowing what that common nature is—in fact getting to that stage provides you with clues in the search for that nature. We will see how this works shortly.

The Second Step: Studying Continuous Variation within Kinds

The mythic Aristotelian biologist considers variation within 'types' as inessential 'deviations', on the Sober construal deviations due to interferences with what is normal or natural. What does the actual Aristotle think about variation? Variation among forms of a kind is addressed immediately after Aristotle's presentation of the above norms for identifying kinds in *PA* I.4.

> …it is by finding groups where the figures of the parts and of the whole body *bear a likeness* that the kinds have been demarcated; for example, members of the kind 'bird' are related in this way to one another, as are members of the kind 'fish', the soft-bodied animals [*cephalopods*] and the hard-shelled animals [*mollusks*]. For their parts are not merely analogous to one another, as bone in mankind is analogous to fish-spine in fish, but rather *their parts are of the same kind and differ only by being larger or smaller, softer or harder, smoother or rougher and so on--speaking generally, they vary by more and less.* (644b8-16; emphasis added)

When you start to observe what it is that birds have in common, you notice that, from one form of the kind to the next, the common features they all share vary continuously along many axes: feathers vary in length, color patterns, density and length of the barbs; beaks vary in hardness, length, depth, curvature; their two

legs can be longer or shorter, their toes can vary in all sorts of ways. These are the differences you take note of in distinguishing forms of a kind. There is a shared overall body plan and way of life, but each part, and each activity associated with it, differs in many measurable ways as you go from one form to the next. And importantly, this is precisely where Aristotle starts in the *History of Animals*. After laying out general categories of likeness, he turns immediately to the ways in which animals alike in kind (he again uses Bird and Fish as his examples) differ from each other.

> Practically speaking, most of their parts differ by way of the oppositions among their affections, for example by color or configuration, by them being affected some more and some less; and again by being greater or lesser, larger or smaller, and generally by excess and defect. For some of these [parts] have softer or harder flesh, some have a longer beak and others a shorter one, and some have many feathers and others few. Moreover, in these kinds different parts even belong to different animals; for instance some [birds] have spurs and others do not, and some have crests while others do not. But generally speaking, most of the parts from which the entire bulk of the animal is constituted are either the same or differ by opposition and according to excess and defect; for one can treat 'the more and less' as a sort excess and defect. (*HA* I.1, 486a25-b17)

This methodology allows Aristotle to identify nine Great Kinds,[10] within which the parts and overall bodily plan of the different sub-kinds vary only by 'more and less' along many dimensions. One way to measure the success of his methodology is by comparing it with Georges Cuvier's Embranchments of the Animal Kingdom, produced about 2,100 years after Aristotle had died.

I have highlighted the kind I am going to focus on in the next section in order to illustrate Aristotle's fascination with variation and how 'normal' and 'essential' he thinks understanding continuous variation is to understanding organisms. That kind is the one

[10] The Greek is μέγιστα γένη; See *HA* I.6, 490b7-6; II.15, 505b25-32.

he refers to simply as "the Softies" (*ta malakia*), and which we refer to as cephalopods, a form of mollusk.[11]

Table 1.

Aristotle's Blooded Kinds	*Aristotle's Bloodless Kinds*
Cetacea Four-legged live-bearing Four-legged egg-laying Birds Fish	Insects Soft-shelled Hard-shelled **Soft-bodied**
Cuvier's Vertebrates	*Cuvier's Invertebrates*
Cetacea (aquatic mammals) Mammals (land) Reptiles, Amphibians Birds Fish	Insects Crustaceans Mollusca (shelled) **Mollusca (soft-bodied)**

In order to get a concrete sense of Aristotle's method here, let us begin with the opening paragraph of his discussion of the cephalopods at the beginning of Book IV of the *Historia Animalium*. He has completed his discussion of the parts of the blooded animals in the first three books, and is now turning to the parts of the bloodless animals (or 'invertebrates').

> Among the animals called 'soft-bodies' these are the external parts: first, the so-called feet; second, the head, continuous with the feet; third, the sac, containing the internal organs, which some mistakenly call the head; and fourth the fin, which encircles the sac. In all of the soft-bodies the head turns out to be between the feet and the belly. Moreover, all have eight 'feet', and all have two rows of suckers, except for one kind of octopus.

[11] Amazingly, Aristotle was well aware of the anatomical similarities between the body plan of the cephalopods and the hard-shelled Mollusks. Cf. *PA* IV.9, 684b11-26.

> The cuttlefish, and the large and small squids have a distinctive feature, two long tentacles, the ends of which are rough with two rows of suckers, by which they capture food and convey it to their mouth and fasten themselves to a rock when it storms, like an anchor. (*HA* IV.1, 523b22-32)

It is important to note both what is and what is not said in this passage. It opens with a list of six attributes shared by all the soft-bodied animals. (The first four are referred to as external parts, and are listed numerically in the Greek, but two more are mentioned in the next sentence, for reasons I'll get to momentarily.) In the first sentence the fact that they all have 'feet' (or 'arms'[12], as we would say) is mentioned, but not how many they have; and the unusual placement of the head and feet is mentioned, as well as the fact that people often refer to the 'sac' as the head because of its location. But in the next sentence he explicitly mentions that all cephalopods have *eight* feet, and notes the oddity (compared to most other animals with feet) of their overall bodily configuration. He then mentions two distinctive features of sub-kinds within the kind. Almost all cephalopods have two rows of suckers on there 'feet', but there is one kind of octopus that has only one row of suckers. And the squids and cuttlefish are distinguished from the octopuses in having two *additional* appendages, only the ends of which have two rows of suckers. This is only a discussion of the *external* parts; as with the discussion of the parts of the blooded animals, to which (after a six chapter methodological introduction) the first three books were devoted, the discussion is divided up into sections on the external (523b22-524b1) and then the internal (524b2-525a29). And as it proceeds, it focuses more and more on the distinctive way these parts are found in more and more determinate sub-kinds, and any distinctive parts they have. The main externally observable differences between the squids and cuttlefish, on the one hand, and the octopuses on the other, are laid out at 524a20-32; 524b23-525a12 is then focused on the former and the remainder of the chapter on the variations to be found in the many kinds of octopuses with which Aristotle is familiar.

---

[12] It is common to refer to the eight appendages shared by octopuses and other cephalopods are 'tentacles'; technically, however, that term is reserved for the two extra appendages of the squids and cuttlefish.

It is important, in order to counter a common misconception about the *HA*, to notice how general and universal these claims are, and how well organized the information is. Though I don't have the space to detail the argument here, a strong case can be made that Aristotle has good reason to think the form of organization he has chosen will facilitate the search for causal explanations of why the different animals have the different parts that they have.[13]

As interesting as what is in *HA* is what is not. Many unusual attributes are listed here, but not once does Aristotle provide any explanation for them. It might be thought that when he says that it is *by means of* those extra tentacles of the squids and cuttlefish that they capture food and anchor themselves during storms, he is providing an explanation. But notice that he does not say that these organs are present *for the sake of* doing these things, nor that they are essential to be a squid or cuttlefish. These are tasks for step three, which we find in treatises, such as the *Parts of Animals*, devoted to finding and providing causal demonstrations for facts of the kind organized in *HA*.

Step Three—the search for what is causally basic, aka "essences".

In the context of responding to The Myth, the next point that needs to be stressed is that there is no single Greek word that corresponds to the Latin 'essentia' or English 'essence'. Here are four Aristotelian words and phrases that are often so translated, with more or less literal translations. The common core of them all is the Greek verb εἶναι, to be.

- Οὐσία = lit. 'beingness'; often translated 'substance'
- Τὸ τί ἐστί= 'the what it is'
- Τὸ τί ἦν εἶναι= 'the being what it is'
- Τὸ ὀρνὶθῳ εἶναι= 'the being for (a) bird'

It will be noticed, then, that all of these phrases are referring to what things are, or what it is to be this or that kind of thing. And

[13] The case is laid out in the in Lennox 2001b, chs. 1-3. See too Pellegrin, 1986, Balme 1987a.

what becomes very clear in *Posterior Analytics* II is that there is an intimate connection between discovering what is *causally basi*c to being a certain kind of thing and what it is *to be* that thing. With respect to animals, it is an animal's peculiar way of life and the activities that are required by that way of life that explain why each animal has the parts it has with those more and less variations characterized in *HA*. Every animal of course has those general kinds of capacities that Aristotle collectively refers to as their *psychê* (misleadingly translated 'soul'), their abilities to reproduce, maintain themselves by acquiring and transforming nutrients, to perceive and to locomote. But what Aristotle is clearly fascinated by is the wildly varied way in which animals do these things. And there is no clearer example of the intimate link between knowing what it is to be something of a certain kind and knowing what is causally fundamental to it than an animal. As he puts it in the *De anima*:

> The soul is the cause and principle of the living body. But these are said in many ways, and soul is similarly a cause in three of the delineated ways; for the soul is the cause whence motion begins, for the sake of which and as the beingness (οὐσία) of the ensouled body. That it is the cause as beingness (οὐσία) is clear; for the beingness (οὐσία) is the cause of being (εἶναι) in all cases, but being (εἶναι) for animals is living, and the soul is the cause and principle of this. (415b8-14)

I've put the Greek in and used the neologism 'beingness' so that the reader not imagine that Aristotle is uttering tautologies here. In this case, οὐσία is a stand in for the animal's form or 'first actuality,' which was the conclusion of the argument in *DA* II.1—soul is the animal's fully prepared capacity to perform the activities characterizing its way of life. Notice that the central theme in this brief, dense passage is that the animal's soul is both what it is to be the animal and also its cause in two other ways—those living capacities are the source of its movements, and that for the sake of which it has the kind of body it has. A scientific definition is, that is, a disguised causal explanation.

Aristotle makes this point in *APo*. II.10 with a more prosaic example, thunder:

> For there is a difference between saying why it thunders and what thunder is—in the former case you will answer in this way: 'Because the fire in the clouds was quenched.' But to answer 'What is thunder?' you will say 'A noise of fire being quenched in clouds.' So the same account is given in a different way—in the one case it is a continuous demonstration, in the other a definition.

And of course there will be no end of complications when this simple idea is translated for a domain where there are four causes, and one entity plays the role of three of them.

So far this has been pretty abstract—let us now return to our cephalopods and see the same group of animals as the object of a stage 3 inquiry.

You will recall that there was a 'near' universal feature of octopus arms: "…and all [octopuses] have two rows of suckers, except for one kind of octopus." (523b28-29; see Figure 1)

In *PA* IV. 9, having established the fact in *HA*, he is ready to identify the reason why.

> Now while the other octopuses have two rows of suckers, one kind has a single row. This is because of the length and thinness of their nature; for it is necessary that the narrow tentacle have a single row of suckers. It is not, then, because it is best that they have this feature, but because it is necessary owing to the distinctive account of their being (οὐσία). (685b13-17)

Figure 1. Lesser Octopus. Photo credit: Ross Elliott on Visual Hunt / CC BY

There are a number of features of this explanation that are expected, given Aristotle's views about scientific knowledge, but at least two that are surprising. There is a fact to be explained, an attribute common to all members of a species; and the explanation appeals to something that is referenced in the distinctive account of the being(ness) of the lesser octopus. What is surprising is [a] that the feature said to be in the account of its being is not a capacity of the soul but the dimensions either of the part or the whole body[14] and [b] that the explanation is not teleological—"not because it is best." But these features of the explanation are less surprising when you know what Aristotle says about biological explanation in *PA* I.1.

[14] It is unclear in the Greek whether the 'nature' referred to is that of the animal as a whole or to the arm that has the suckers.

> Hence it would be best to say that, since this is what it is to be a human being, on account of this it has these things; for it cannot be without these parts. If one cannot say this, one should say the next best thing, i.e. either that in general it cannot be otherwise, or that at least it is good thus. (640a32-b1)

Thus that the appeal to the being of the animal to explain one of its features is not teleological in form is not surprising—what is surprising, according to most accounts of Aristotle's philosophy of science, is that its *bodily dimension* would appear in 'the distinctive account of the being' of the lesser octopus. But this is, in point of fact, what distinguishes it from other kinds of octopus, and thus serves as the defining difference.

For my second example of a stage 3 inquiry I remind you that we were told in *HA* IV.1 that the cuttlefish and squids have two long tentacles, the ends of which are rough with two rows of suckers. (See Figure 2.) This was a feature that these three kinds had in common which distinguished them from the other cephalopods. There was also a clear hint of what the explanation for these tentacles would be, since we were told what they do with these parts. But knowing what they do with these parts only becomes an explanation when we are told that they have these parts for the sake of doing these things—that doing these things is the reason why they have these parts. Something like the following!

> Since the cuttlefish and squids have small 'feet' that are useless both for taking hold…of the rocks when there are waves and storms, and for feeding…they have two long tentacles by which they moor themselves…and by which they hunt down prey from afar and bring it to themselves. The octopuses, on the other hand, don't have these, because their 'feet' are useful for these activities. (*PA* IV.9 685a33-b2)

That is, these animals share with the other cephalopods eight 'feet' (i.e. arms) for locomotive purposes. Now in octopuses these are long and suitable for finding food and grasping onto rocks—but in cuttlefish and squid they are not. They thus need two additional

tentacles that can be used for feeding and anchoring in storms. That is the reason why they have these two additional tentacles.[15]

Figure 2. Giant Squid. Courtesy of the Oregon Coast Aquarium's Oceanscape Network.

Now it is true that both the facts and the explanations are universal claims about kinds and sub-kinds of cephalopods, rather than about individual variations within these kinds. But notice how attuned Aristotle is to variations within wider kinds—differences, as he would say. If you see a difference displayed by a form of a kind, you need to look for something distinctive about that form of animal to explain the difference. If cuttlefish have two additional, extra long tentacles, look for something distinctive about their way of life that explains why they have them.

But what about individual variations—has Aristotle really no interest in them, or does he see them as mere deviations or accidents? That idea is hard to reconcile with the following passage, from Aristotle's account of inheritance in *GA* IV.3:

> In relation to generation the distinctive and particular features are always stronger. For Koriskos is both a man and an animal; but the man is nearer to what is distinctive [to Koriskos] than the animal. And both the particular and the kind generate, but more so the particular; for this is the being (οὐσία) [of the animal], and what is coming to be is, while a certain *sort* of animal, also *this* animal here, and this is the being [of the animal].

[15] Aristotle is once again correct. For a somewhat horrifying introduction to cuttlefish feeding behavior, see: https://www.youtube.com/watch?v=MUCduZyCHes

> Wherefore the motions present in the seeds are from all such powers, potentially even from the ancestors, but more from those closer to one of the particulars, and by particular I mean Koriskos and Socrates. (767b31-768a3)

GA IV is entirely concerned with variations among members of what we would refer to as 'species', starting with the most obvious and important one, sex differences between males and females. By chapter three he has moved on to puzzling facts such as that offspring may resemble one parent with respect to one trait and the other with respect to another trait; that sometimes they will look more like a grandparent than a parent; or that female offspring may resemble the male parent in non-sexual characteristics. The passage above provides a general framework for understanding these puzzling facts about inheritance. The central theme of this framework is that specific and generic characteristics are *general* characters passed on along with the powers (δύναμεις) or movements (κίνεσεις) representing the features of individual parents. It is in the distinctive characteristics of the individual parents that being resides, not in the general characteristics. However, and this is what even most scholarly commentary on this passage misses, the movement aimed at reproducing Socrates' distinctively snub nose will of necessity also be a *human* nose and an *animal* nose. You can describe a particular person's nose in a way that focuses on its uniquely individuating features, or its distinctively human features, or those features which make any nose a nose. Individual variations are not, for Aristotle, "deviations due to interference with the animal's nature"—quite the opposite! It is in those features that the being of the animal exists. Universals, Aristotle tells us repeatedly, do not exist, other than in the souls of human knowers.[16]

4. Summing Up: Dispelling Myth No. 1

At this point, it is my hope that the reader has a reasonable grasp of an Aristotelian approach to the study of living things—his philo-

[16] To keep this discussion manageable I'm being fairly dogmatic here. For a defense of this way of reading Aristotle, see Lennox 2001b, chapters 7 and 8, and Lennox 2005; and compare Balme 1987b.

sophy of biology, if you will. Before moving on, this is a good time to sum up our findings about Aristotle's philosophy of biology.

1. Aristotle is not a typological essentialist
2. Aristotle is an explanatory essentialist
3. Aristotle considers variation within and between kinds natural and important and in need of explanation.
4. Individual variations are most real, general similarities are consequences—determinables of which the individual variations are the determinants.
5. Biological research progresses through three empirically driven stages:
    a. A grasp of general, 'entry level' kinds (e.g. cephalopods)

        i. These are identified as loci of correlated parts, activities, habits, which I have dubbed 'predicate profiles' of the kind.

    b. A study of the continuous (more-and-less) variations of the common features provides more and more determinate characterizations of the many similar forms of the general kinds (e.g. from cephalopod to octopus to 'lesser octopus').
    c. Finally, an investigation into the causal relationships among those differences—the causally basic features of an animal constituting its 'essence', those features that constitute its being. As we saw, causally basic features may be activities fundamental to its way of life or distinctive features of its body.

5. Dispelling Myth No. 2

Myth number two, it will be recalled, is that it was Aristotelian typological essentialism that Charles Darwin was up against. In order to dispel this myth, we need to answer the question, 'What was Darwin *really* up against?'. Part of the answer, of course, is that since Aristotle was not the sort of essentialist that the mythologists claimed him to be, it is unlikely that Darwin had to deal with it. But

that reply will be unsatisfactory without a positive picture of the problems that Darwin faced in convincing the naturalists of his day to at least consider the idea that species are genealogically related. A good place to start is with a book that Darwin considered his bible while on H. M. S. Beagle, Charles Lyell's *Principles of Geology*. Near the beginning of Volume 2, much of which is devoted to the very problems at the core of *On the Origin of Species*, Lyell writes:

> …the majority of naturalists agree with Linnaeus that all individuals propagated from one stock have certain distinguishing characters in common, which will never vary, and which have remained the same since the creation of each species. (Lyell Vol. II 1832 [1990], 3)

And the following comment of William Hopkins, reviewing Darwin's *Origin*, is a good example of the perspective described by Lyell:

> Every natural species must by definition have had a separate and independent origin, so that all theories…which assert the derivation of all classes of animals from one origin, do, in fact, deny the existence of natural species at all. (Reprinted in Hull 1973, 241)

The first thing to note here is the concern about origins and creation. Aristotle, though he was aware of cosmogonists before him who had tales to tell about the origins of animals and humans, found them all to be fanciful speculation, not much better that the myths they were intended to supplant. The second thing to note is that each origin must be 'separate and independent'—that two species could have had a common origin is ruled out. And finally, once created each species must not vary and must stay the same. What Darwin was up against was a thinly naturalized version of a Genesis-like creation myth. How does Charles Darwin respond? In *Origin*, ch. 2, after reviewing the evidence that highly trained naturalists cannot agree on how to distinguish between varieties and species, he stipulates how he will use the 'term' species:

> From these remarks it will be seen that I look at the term species, as one arbitrarily given for the sake of convenience to a set of individuals closely resembl-

> ing each other, and that it does not essentially differ from the term variety, which is given to to less distinct and more fluctuating forms. The term variety, again, in comparison with mere individual differences, is also applied arbitrarily, and for mere convenience sake. (Darwin, 1859, 52)

It is important to stress that Darwin is discussing the terms 'species' and 'variety', *not* species terms such as *Canis lupus* (which according to Wikipedia has 38 sub-species, one of which includes the hundreds of varieties of domestic dog) or *Octopus gardineri*, one of dozens of species of Octopus. In this passage, Darwin identifies two 'more-and-less' distinctions between varieties and species: resemblance and constancy. To be given a species designation, a group of individuals must be more distinct and less 'fluctuating' than individuals that constitute a variety. But he is stressing that these distinctions fall along continuua, so where one 'draws the line' will be somewhat arbitrary. Again in the concluding chapter of *On the Origin of Species*:

> In short, we shall have to treat species in the same manner as those naturalists treat genera, who admit that genera are merely artificial combinations made for convenience. This may not be a cheering prospect; but we shall at least be freed from the vain search for the undiscovered and undiscoverable essence of the term species. (Darwin 1859, 485)

Once again it is important that it is the species *category*—'the essence of the term species', as he puts it—about which Darwin is here concerned, and this is because he wants there to be space for the process of species origination that he is defending in the *Origin*. This is a process whereby, within a single species, more and more distinctive and stable varieties slowly and gradually diverge until at some point they are distinctive enough and stable enough to deserve to be considered distinct species and designated as such.

Does Darwin think species are undefinable? Clearly not. Consider the following passages, also from the concluding chapter, where Darwin is explaining the advantage for systematics of the view he is defending.

> Systematists will have only to decide…whether any form be sufficiently constant and distinct from other forms, to be capable of definition; and if definable, whether the differences be sufficiently important to deserve a specific name. (Darwin 1859, 484)
>
> Hence…we shall be led to weigh more carefully and to value higher the actual amount of difference between two forms. (Darwin 1859, 485)

Again, Darwin is stressing the importance of the degree of constancy and difference in deciding when a species designation is important. There is no skepticism about giving a specific name and definition in this passage. Darwin is stressing that greater value should be given to what Aristotle would call 'more-and-less differences' between forms. And again, this is for him a matter of making conceptual space for the sort of process he is imagining is the source of new species.

6. Aristotle and Darwin: Common Ground and Worlds Apart

Explaining the subtle differences between forms of a kind is a shared goal of Aristotle and Darwin, and both see differences between forms of a kind falling along measurable continuua. For both of them, explanations of such differences will most often, but not always, appeal to the *value* of the difference to the organism. Neither Aristotle nor Darwin consider taxonomic ranking as written into nature by a Creator God. Both of them think the way we classify organisms should be tied to our explanatory goals, and both of them think that while there are actual, measurable similarities and differences that form the basis of our classifications, it is up to us to decide when those similarities and differences are sufficient to identify new forms or bring many forms together into one kind.

Yet it is equally important to remember that these two brilliant thinkers were worlds, and millennia, apart. Eighteenth Century Europe saw an explosive growth in knowledge and understanding of fossil sequences and assemblages worldwide and of the relationship between recent fossils and current populations in different regions—along with a parallel explosion in knowledge and understanding of the amazingly complex geographic patterns of

distribution of species. The complexity was in part due to an explosive growth in the discovery of completely unknown orders of organisms, distinctive to newly explored and colonized biogeographic regions. None of this knowledge was available to European thinkers even two hundred years before Darwin, let alone two thousand.

And it had momentous consequences. It led to the recognition of the need for a classification system capable of indefinite expansion, with Carl Linnaeus taking the leading in fulfilling that need. For the first time in history there was an urgent need for an explanation for the puzzling patterns, both regional and global, in the fossil record and in the geographic distribution of species, and Georges Cuvier played an important role in bringing newly discovered fossils into systematic relation with current species. Rather quickly, a number of thinkers realized that descent with modification, as Charles Darwin would call it, was a possible solution. Charles Darwin supplied the most satisfying solution of this kind, but he was far from the first—among his French predecessors were the Comte du Buffon, Jean-Baptiste Lamarck, and Geoffroy St. Hiliare; in Great Britain there were Charles' grandfather Erasmus Darwin, Robert Grant, his early mentor at Edinburgh, Robert Chambers, the no longer anonymous author of *Vestiges of the Natural History of Creation*, and Alfred Russell Wallace, author of the paper that pushed Darwin to rush *On the Origin of Species* to completion. Evolutionary thinking was a response to the need for a comprehensive explanation of a vast range of information unavailable until the 18th century. It is hard to imagine how Aristotle would have responded to that information—that is certainly not a thought experiment I am interested in pursuing.

But we do know how Darwin responded to what Aristotle had accomplished. In the last two months of his life, Darwin reads Aristotle's *On the Parts of Animals* for the first time. To remind the reader of his note to William Ogle, Aristotle's translator:

> From quotations which I had seen I had a high notion of Aristotle's merits, but I had not the most remote notion what a wonderful man he was. Linnaeus and Cuvier have been my two gods, though in very different ways, but they were mere school-boys to old Aristotle.

What I did not share with the reader when I originally quoted that note of Darwin's was William Ogle's utterly charming response:

> Thank you for your kind and eulogistic letter re "the parts of animals." It gave me much pleasure. I am glad also to have added a third person to your gods and completed the Trinity…[17]

As a more recent translator of *On the Parts of Animals* for Oxford, and an admirer of Charles Darwin, I enjoy imagining that when Darwin could do little else with his time, he found pleasure in reading Aristotle's *De Partibus* and was not in too much pain to smile at Ogle's irreverent note.

References

Amundson, Ron. 1998. 'Typology Reconsidered: Two Doctrines on the History of Evolutionary Biology' *Biology and Philosophy* 13 (1998) 153-177.

Balme, David. 1987a. 'Aristotle's Use of Division and Differentiae'. In Allan Gotthelf and James G. Lennox eds. *Philosophical Issues in Aristotle's Biology*. Cambridge: Cambridge University Press.

Balme, David. 1987b. 'Aristotle's Biology was not Essentialist'. In Allan Gotthelf and James G. Lennox eds. *Philosophical Issues in Aristotle's Biology*. Cambridge: Cambridge University Press.

Beatty, John. 1985. 'Speaking of Species: Darwin's Strategy' in D. Kohn, ed., *The Darwinian Heritage*. Princeton: Princeton University Press.

Darwin, Charles. 1859. *On the Origin of Species by Natural Selection*. London: Charles Murray.

Depew, David. 2008. 'Consequence etiology and biological teleology in Aristotle and Darwin', *Studies in History and Philosophy of Biology and the Biomedical Sciences* 39 (2008), 379-390.

Ghiselin, Michael. 1997. *Metaphysics and the Origin of Species*. Albany: SUNY Press.

Gotthelf, Allan. 1999. 'Darwin on Aristotle', *Journal of the History of Biology* 32 (1999) 3-30. [Reprinted in Allan Gotthelf, *Teleology, First Principles, and Scientific Method in Aristotle's Biology*, Oxford: Oxford University Press, 2012, 345-69.]

[17] For a full discussion of this correspondence (including letters I've not discussed) see Gotthelf 1999.

Hull, David. 1965. 'The effects of essentialism on taxonomy: 2000 years of stasis', *BJPS* vol. 15, no. 60, 314-326.

Hull, David. 1973. *Darwin and His Critics*. Chicago: University of Chicago Press.

Lennox, James. 2001a. *Aristotle*: On the Parts of Animals I-IV. Oxford: Oxford University Press.

Lennox, James. 2001b. *Aristotle's Philosophy of Biology: Essays in the Origins of Life Science*. Cambridge: Cambridge University Press.

Lennox, James. 2005. 'Getting a Science Going: Aristotle on Entry Level Kinds'. In G. Wolters, ed., *Homo Sapiens und Homo Faber* (Festschrift Mittelstrass), Berlin: Walter De Gruyter, 87-100.

Lennox, James. 'Aristotle's Biology'. *Stanford Encyclopedia of Philosophy* (Fall 2017 Edition). Edward N. Zalta (ed.), URL = (https://plato.stanford.edu/entries/aristotle-biology/).

Lennox, James. 'Darwinism'. *Stanford Encyclopedia of Philosophy* (Fall 2017 Edition). Edward N. Zalta (ed.), URL = (https://plato.stanford.edu/entries/darwinism/).

Lyell, Charles. 1832 [1990]. *Principles of Geology*, Volume II. Chicago: University of Chicago Press.

Mayr, Ernst. 1970. *Populations, Species and Evolution*. Cambridge MA: Harvard University Press.

Pellegrin, Pierre. 1986. *Aristotle's Classification of Animals: Biology and the Conceptual Unity of the Aristotelian Corpus*. Berkeley: University of California Press.

Popper, Sir Karl. 1945. *The Open Society and Its Enemies*. London: Routledge and Kegan Paul.

Sober, Elliott. 1994. 'Evolution, population thinking, and essentialism'. In *From a Biological Point of View*. Cambridge: Cambridge University Press.

Walsh, Denis. 'Evolutionary Essentialism', *British Journal of Philosophy of Science* 57 (2006), 425-448.

Wilkins, John. 2009. *Species: A History of the Idea*. Berkeley: University of California Press.

Winsor, Mary. 2001. 'Cain on Linnaeus: The Scientist-Historian as Unanalysed Entity', *Studies in the History of Biology and the Biomedical Sciences* 32 (2001) 239-254.