# Aristotelian Species Pluralism (short)

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> Linnaeus and Cuvier have been my two gods, though in very different ways, but they were mere school-boys to old Aristotle
>
> Darwin (Letter to Ogle)

## 1 Introduction

Species pluralism allows for multiple species concepts. Given the overwhelming number of such concepts (cf. Mayden, 1997; Wilkins, 2011), this seems like an obvious interpretation of how 'species' is used in contemporary biology. But why has it taken so long for this approach to be considered? I argue that part of the reason pluralism was overlooked due to the widespread use of a particular rhetorical strategy developed by Ernst Mayr. This strategy provided a framework for debates about the correct conception of species. That is, the strategy offered a means of comparing modern concepts with a monistic-essentialist understanding of species. I ask what would happen if we replaced this concept with Aristotle's own pluralist-essentialist understanding of species. As recent scholarship shows, Aristotle's philosophy of biology allows for an approach to classification that is in practice highly pluralistic (Henry, 2011, 2014; Leunissen, 2014). From this new framework we can understand what sort of assumptions are at stake between modern forms of species pluralism. My analysis shows that the essentialist story told by Mayr and others left us asking the wrong questions about how to conceive of species in an evolutionary world. Having a deeper understanding of Aristotle's approach to the classification of animals allows us to shift focus from the so-called species problem in order to raise four issues that are relevant to current debates. These are questions about: (1) the explanatory power of taxonomic ranks, (2) the importance of the species category problem, (3) whether species are constituted by intrinsic or extrinsic properties, and (4) how to interpret the "cross-cutting"

metaphor endemic to the pluralist literature. In order to get to these questions I will first explain what sort of claim species pluralism is at the most general level, and a gloss on the standard interpretation of the historical shift from species monism to species pluralism.

## 2 From Species Monism to Species Pluralism

The distinction between species monism and species pluralism suggests they are contrary views. Thus, a first pass would designate species pluralism as:

(SP*) There is no singular, unified way of grouping organisms into species

Pluralism allows for multiple, non-unified systems of classification. Monism allows for only one true system and only one true species concept.[1] Pluralism allows for many species concepts. Holding either view dictates the way we argue about species concepts. Monists seek general and unified criteria for ruling out false concepts. Pluralists maintain that these criteria are too strict, because they weed out concepts we ought to retain.

Some worry that pluralism is dangerously close to relativism (e.g., Hull, 1999). A relativist would deny that there are principled and objective constraints on species concepts. If humans were to categorize species by how they taste, or by how cute they are, then this would be a legitimate concept. For an extreme relativist it's our fault that there is a proliferation of species concepts, but for the pluralist: 'It's the world's fault!' This is of course a caricature, there is no fault in the matter here. The important point is that denying relativism suggests a second pass at capturing species pluralism:

(SP) The world is such that there is no singular, unified way of grouping organisms into species

Pluralism requires constraints on which species concepts are admissible. This must be a claim about why the world is the way it is, which must be supported by our best biological theory.

Two *prima facie* and interrelated reasons for the shift from species monism toward species pluralism in and around the beginning of the 1980s suggest themselves. First, species pluralism is a consequence of the rise of pluralism in philosophy of science. Pluralism in philosophy of science is relatively recent, and is partly due to concerns about the feasibility of reductionism and unification (Suppes, 1978; Dupré, 1993). The true reasons why pluralism has become fashionable are not important here, for this is a very complicated story. What is important though is that it is not always clear at a global level what pluralists are being pluralist about, whether it's about

[1] See Sterelny (1999); Brogaard (2004); Henry (2011).

explanation, causation, theories, concepts, models, or some further thing. This paper will make important steps towards clarifying these difficult issues. However the way many have understood pluralism at the global level has ridden on the backs of local, empirical, investigations of pluralism (Kellert et al., 2006). Arguments for pluralist approaches to explanations of sex (Fehr, 2001, 2006), pluralist interpretations of behaviour (Longino, 2005, 2006, 2013), pluralist interpretations of how "concept" is used in psychology (Machery, 2009), etc, have also lent credibility to arguments for species pluralism.

Second, theorizing about species has reached *conceptual overload*. Monism makes more sense when there's only a small handful of competing species concepts, but when the number of concepts keeps increasing (cf. Mayden, 1997; Wilkins, 2011) there is eventually a point where pluralism becomes a more reasonable view. This of course isn't itself a great argument for pluralism, a monist can certainly stick to her guns. However, conceptual overload is still part of the explanation for why species pluralism has become more fashionable. But, as I will now show, despite there being more species concepts today than there were during the time of the New Synthesis in the earlier part of the twentieth century, there was still a significant amount of conceptual tension and conflict then.

Species monism was not questioned during the New Synthesis (e.g., Dobzhansky, 1935; Mayr, 1940; Simpson, 1951), which marks the first period where biologists were offering and debating explicit definitions of "species." However, at this time it was recognized that a monistic *classification* had problems: "No system of nomenclature and no hierarchy of systematic categories is able to represent adequately the complicated set of interrelationships and divergences found in nature" (Mayr, 1942, 103). This conflicted with the desiderata that a species concept should be universalizable and general. Holding onto monism in light of these conflicts involved what some have interpreted as *ad hoc* manoeuvres *sensu* Popper (e.g., Stanford, 1995, 76-77). One may wish to reserve one concept for 'species,' and have other concepts for other important biological groups. For instance, if we favoured a concept that requires sexual reproduction and interbreeding, then asexual organisms that reproduce by budding, binary fission, vegetative reproduction and the like will fail to form species. Many have argued just this (e.g., Dobzhansky, 1935, 355), have claimed that species produced through polyploidy "have all the earmarks of blind alleys of evolution" (1942, 191), and some have even claimed that asexual groups are rare in comparison with sexual groups (Mayr, 1942).

Now despite depriving asexual organisms rights to full species-hood, terms like 'agamospecies' (Cain, 1954) and 'uniparental species' (DeBach, 1969) were developed and used to aid in grouping asexual organisms. Everyone

agreed that concepts were needed, but it was maintained that these were not true species concepts. Today we tend to think differently about asexual organisms, because we have a better understanding of the continuum between asexual and sexual organisms, and we have reflected on the fact that sex itself is an evolved trait. Considerations like this have lead us to restore asexual organisms's full rights to species-hood. But it is important to note that this restoration has been achieved partly through the influence of species pluralism (e.g., Wilkins, 2003).

But why not consider pluralism, rather than seeking a unified definition of the species category, the class to which all the different species taxa belong? The *conceptual overload* story suggests a reason why pluralism took so long to develop. Up until around thirty years ago, there weren't enough species concepts on hand for pluralism to be considered. The development of pluralism in philosophy of science is certainly far more complicated than I have presented it here, and though pluralism of one sort or another can be traced back at least as far as the Vienna Circle and its critics, much of that approach to philosophy of science has taken a long while to trickle down to debates in biology itself. However, since there are longstanding ways of arguing that certain concepts are not *real* species concepts, this suggests that neither of these explanations are the whole story. There may also have been deeper reasons for holding on to species monism. Biologists may have assumed that "species" designates a natural kind, and as such there must be one true species concept. Though we will touch on some of this ontological issue now, a fuller treatment will be put aside until the fourth chapter where we consider species pluralism and the ontological status of species.

## 3 The Rhetorical Strategy

A monist needs reasons that favour one concept. This often involves a critique of the competition: and through critique and comparison between different species concepts what is better on some grounds often slips into what is best overall [2]. Mayr's strategy was built upon a complicated and deeply misleading story about how Aristotelian biology and evolutionary biology conflict at an ontological level. Winsor (2003; 2006) has dubbed this story "the essentialism story," which she argues was developed by Mayr, Cain and Hull. I will only focus on Mayr, because his version of the story has set the standards for how leading biologists debate about species concepts.

According to the story, after Darwin's development of evolutionary theory, species essentialism became untenable. Essentialism is roughly understood as the view that species have fixed, distinct and unchanging essences that

[2]See Cracraft (2000) for an important discussion of this problem about the language used in species concept debates

all and only the members of a particular species partake in. In most versions of the story essentialism is not clearly understood, but the point is that essences make evolution impossible. Darwin's work was not just to revolutionize biological theory, but to revolutionize the very way that we conceive of species at an ontological level. Many believe that essentialism forestalled the development of evolutionary theory nascent in pre-Socratic biology (Simpson, 1961; Mayr, 1963; Ghiselin, 1969; Dobzhansky, 1970). Others have blamed the Aristotelian method of definition (Popper, 1966; Hull, 1965). The evolutionary shift requires giving up species essentialism, and calls out for a conception of species that allows us to keep species real, but one that fits with the intrinsic variation demanded by evolutionary theory. I'll now show how this story provided a framework or set of assumptions for arguing about species, which I'll now explain.

Consider the different species concepts as falling upon a line. At one end of the line we have an essentialist species concept. Different species concepts are placed in degrees of closeness to the essentialist species concept. An essentialist concept requires a set of necessary and sufficient conditions for species membership (Mayr, 1942). Species concepts would be closer to an essentialist concept the less they modify the way a species is defined from the essentialist starting point. For example, an ostensively defined species (the species is defined in reference to a type, or exemplar organism) might be considered further from essentialism than a species defined by a disjunctive definition (the species is defined as satisfying either this or that set of properties). If an essentialist species concept requires that we specify a set of typical phenotypic properties, then the more a species concept makes use of these sorts of properties the closer it is to essentialism.

Mayr's distinction between population (non-essentialist, post-Darwinian) and typology (essentialist, pre-Darwinian) thinking formed a basis for his reproductively based species concept, and is one of the most common ways that essentialism is still understood to this day in biology. On Mayr's account, *population thinking* concerns relating organisms to populations, whereas *typology thinking* is about relating organisms to types. According to population thinking, an organism belongs to a certain species in virtue of it participating in a certain population structure (gene flow) with other organisms. According to typology thinking, an organism belongs to a certain species in virtue of it sharing the relevant sort of intrinsic properties with its exemplary type. There is much to be said about the value of this distinction (e.g., Sober, 1980), but for our purposes it is more important to focus on how typological thinking translates into a definition of what a species is. Typological species concepts were based on species having essential properties. Though it is rare to find an explicit formulation, one can state that the 'typological species

concept' is as follows:

> (TSC) For any species, $S$, there is some one identical diagnostic feature or set of features, $x$, in which individuals, $a$, $b$, $c$, ... of $S$, share or 'participate,' and in virtue of $x$, the individuals, $a$, $b$, $c$, ... are members of $S$.[3]

Whether or not anyone actually held a **TSC**, Mayr argues that it fails for at least the following three reasons. First, because of polymorphism within populations (e.g., light and dark-morphs of the jaguar (*Panthera onca*). Second, because of geographic variation within species. Third, because of 'sibling' or 'cryptic' species: species with the same phenotype, but different reproductive capacities or genetic difference (e.g., recent DNA analysis the Two-barred Flasher butterfly (*Astraptes fulgerator*). This story of how the **TSC** fails in the light of such and similar reasons is quite common in much of the introductory systematic literature even today (Winsor, 2006). Following this, Mayr then sets up the biological species concept (BSC) as the non-essentialist, post-Darwinian species concept that can account for the failures of **TSC**, which he formulates as follows:

> (BSC) "species are groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups" (Mayr, 1942).

The **BSC** is better, because it can be used in explaining why there is a real boundary between species when the **TSC** cannot. To a certain extent polymorphic species, species with geographic differences, and cryptic species can be further understood by considering the reproductive, and thereby genetic connections that exist between them. Many people who do not adhere to the **BSC** will still set the problem of finding a post-Darwinian species concept in this very same way.

A further aspect of this strategy is to argue that any species concept that resembled a **TSC** can, and should be ruled out. A phenetic species concept, that uses an analysis of overall similarity, rather than the more constrained set of diagnostic features required by the **TSC**, fails for the same three reasons the **TSC** fails, and so we can label it "typological." This is defintely an oversimplification, but it shows the general structure of the species concept dialectic.

In sum, on Mayr's understanding, essentialism and monism were linked, and with the widespread adoption of his strategy, many were too distracted by the essentialist witch-hunt to notice whether or not anything was wrong with monism. I will now explicate Aristotle's account of species, to show how we should interpret species in a pluralistic context.

[3]Following Lennox (2001).

# 4 Aristotelian Species Pluralism

Traditionally Aristotle is viewed as an essentialist species monist. However, when we examine the ways that Aristotle carves up the biological world, pluralism seems the more likely interpretation. Aristotle offers multiple, overlapping classifications of animals. Each classification appears useful for understanding some causal aspect of the animal world. Single organisms are often described along multiple lines. Henry's (2011; 2014) recent work on Aristotle, following Pellegrin (1982), shows that essentialism and monism about species are not necessarily connected, despite what Mayr's essentialism story indicates (see also Balme, 1962; Lennox, 2001). In this section I will show why that is the case through a brief explication of Aristotle's approach to classification.

First, Aristotle has two relative terms for natural kinds: εἶδος and γένος. They have standardly been translated as 'species' (εἶδος) and 'genus' (γένος) via the Latin, into English.An εἶδος is almost always some further specification of a γένος, and a γένος isn't what it is without having different εἰδή (*Metaph.* Z. 12: 1036a6-9).[4] Both terms are used at all levels of biological organization, and a particular γένος may be itself an εἶδος of some higher order γένος. Since these terms do not indicate fixed ranks in a hierarchy in the way that genus and species do for post-Linnaeans, recent Aristotelian scholars have offered 'form' (εἶδος) and 'kind' (γένος) as more appropriate equivalents (Lennox, 2001). I will follow this translation of both terms.

Second, Aristotle seeks definitions of kinds and forms at various levels of generality, but explanations must be at the right level. We need to prove that an isosceles triangle has two right angles because it belongs to the kind triangle, not because it belongs to the kind isosceles triangle. The isosceles triangle is a form of triangle, and many of the properties isosceles triangles have, they have because of belonging to the kind we call 'triangle.' In the biological case this issue is presented as an *aporia*. Aristotle asks at what level should we organize our investigation: either to start with each substantial being on its own, and by this he seems to mean something like the *infimae species* or ατομα ειδή (undividible species), or to start with the more general kinds first (*PA* I. 1 639a15-19; cf. *APo.* B 13 98a1-19)? The answer Aristotle seems to give is that it depends on what we hope to achieve.

Further, even if we lack a name for a kind we still need to seek the right level for the explanation. Aristotle gives an example that involves considering how proportion (or ratio) alternates in the same way for numbers, lines, solids, and times (*APo.* A. 5 74a19-25). Though we didn't see the commonality between these four kinds of things at first, as we investigated ratio we came to recognize this new real kind: 'proportionate things.' In the biological

[4] Aristotle is willing to count humans as a γένος that doesn't differentiate into further εἰδή.

case, Aristotle was willing to invent new kind terms ('cephalopod,' 'selachians,' 'entoma'), if they revealed the common nature that pertained to such organisms.

According to Aristotle, we get at the nature of a kind by acquiring a definition of it. Definitions are reached through division. Aristotle takes great pains to show why Plato's method of bifurcating division (e.g., in the *Sophist*), which separates kinds by means of a single difference, fails to uncover true kinds. Aristotle urges that we ought to group important forms together with their respective kinds, and that bifurcating division "tears kinds apart," because there cannot be many differences under a single dichotomous division (*PA*. 1 3 644a1-11). For example, there are many distinct forms of bird and fish, and we ought to follow the common people, and recognize birds and fish as genuine kinds of animals (*PA* I. 3 6439-16). Though some birds are water-dwellers, and being a water-dweller can explain some things about those birds, we would lose something if we failed to recognize birds as a kind. Nor should we combine water-dwellers and flying animals into one kind, because some water-dwellers are not birds. For Aristotle, the true mark of a natural kind is that it differs by degree and what he calls "the-more-and-the-less." Forms of bird differ by degree because they either have short or long feathers (*PA* IV. 12. 692b3-9), whereas birds and fish differ from each other by analogy because one has feathers and one has scales to fulfill analogous functions (*PA* I. 4. 644a12-23) (cf. Lennox, 2001). On Henry's reading of Aristotle "a genuine kind is a group of individuals sharing a "common nature" ... a nexus of correlations underwritten by a set of causally basic features (the kind's real essence)" (2011, 201). There is something causally basic about being a bird that causes birds to have things like feathers and beaks that differ in different environments, which are there used for different purposes.

According to Henry, Aristotle offers a realist and pluralistic, cross-cutting approach to classification (2011, 200).[5] At the core of each 'cross-cutting' kind, there is an essence, which corresponds to a cause (*aitia*) (2011, 201). He presents two reasons for viewing Aristotle as a pluralist about biological kinds. The first involves considering the relationship between Aristotle's four different major divisions of animals: by mode of reproduction, locomotion, mode of cooling, and the Greatest Kinds. The second involves the 'dualizers' (ἐπαμφοτερής), organisms that straddle different forms. Both show that Aristotle is open to cross-cutting classifications of organisms, and that he is thus a pluralist. The first example shows this with respect to kinds, and the second with respect to forms themselves.

The first division is by *mode of reproduction*: live-bearers, egg-layers, larva-producers, and animals that are

[5]There is some debate on how to understand Aristotle's biological classification (Balme, 1962, 1987; Pellegrin, 1982; Lennox, 2001). Henry understands 'classification' as 'the systematic arrangement of organisms into a hierarchy of kinds on the basis of shared similarities and differences.' If that's all we mean, surely Aristotle classifies animals. Other interpreters think that a classification of animals must be in some sense universal, and monistic in nature, but this is certainly imposed upon our reading of Aristotle.

spontaneously generated (*GA* II. 1, 732a26–733a1). This classifies lizards, turtles, fish, birds and snakes as egg-layers; cetaceans, humans, elephants, and bats together as live-bearers; some of the insects as larva-producers; some of the insects and some of the testacea as spontaneously generated animals. The second division is by *mode of locomotion* (*IA*; *HA* I 1, 5). First, by their *type of locomotion* (*IA* III): jumpers, walkers, swimmers and fliers (*HA* I 1, 487b14–32; *GA* I 1, 715a28; III 1, 749a15). Lizards, turtles, humans, elephants, and crabs are classified as walkers; cetaceans, fish, water snakes, and crustaceans as swimmers; birds, bats, and (some) insects as fliers. Second, by the *parts* used for locomotion: bipeds, quadrupeds, polypods, and footless animals. This classifies birds and humans as bipeds; elephants, lions, lizards and crocodiles as quadrupeds; insects as polypods; cetaceans, fish and snakes as footless animals. The third division is by means of their mode of cooling (*On Resp*): lung-possessors, gill-possessors, and membrane-possessors. This gives us cetaceans, lizards, humans, and birds as lung-possessors; fish, cephalopods, and other marine animals as gill-possessors; insects as membrane possessors.

These different divisions cross-classify one another. None of differentiae of one division explain those of the other (*GA* II 1, 732b15–27). Having a certain number of feet doesn't help explain how an animal reproduces. What explains reproduction is the material nature of the organism. Live-bearers are hot and moist, and egg-bearers are cold and dry. Mode of respiration also cuts across the division according to an animal's type of locomotion and mode of cooling. The egg-layers and live-bearers cross-cut the lung-bearers and gill possessors. Some egg-layers are lung-possessors (e.g., birds, lizards, turtles, all snakes except viper), but some are gill-possessors (e.g., bony fish). Some live-bearers are lung-possessors (e.g., humans, cetaceans, horses, vipers), but some are gill-possessors (e.g., some sharks and rays). Mode of cooling cuts across the parts an animal uses for locomotion (*On Resp.* 476a5). The lung-possessors cut across the different divisions according to parts used for locomotion. Some lung-possessors are bipeds (humans and birds), some are quadrupeds (e.g. horses, oxen), but some are footless (e.g. whales and dolphins). Some gill-possessors are footless (e.g., fish), but some are quadrupeds (e.g. the water newt). The four divisions also cut across the Great Kinds: the blooded animals: birds, fish, cetaceans, and the bloodless animals: the hard-shelled animals, soft-shelled animals, mollusks, and insects. Thus, there is no single unified classificatory scheme. Aristotle is not a monist.

The second reason for viewing Aristotle as a pluralist concerns his discussion of the ἐπαμφοτερής ('dualizers'). These animals show how even the bottommost forms (the *infimae species*) that Aristotle considers can, in some cases, cross-cut one another at the organismal level. More than one form is needed to explain why a particular

organism is the way it is. There are four major examples of animal forms that fall into this category: the Libyan ostrich, ape, seal, and bat.

First, the Libyan ostrich. This animal is both a bird (its lower parts are covered in feathers and it's two-footed) and a live-bearing quadruped (its upper parts are covered in hair and it's hoofed) (*PA* IV 14, 697b13–28). It doesn't fly, and its feathers are not useful for flight. Aristotle calls these feathers "hair-like" (τριχώδη). The general size of the animal corresponds to that of a quadruped, and this is partly why it doesn't fly. Second, apes, monkeys, and baboons can be classified both as bipeds (human-like) and as quadrupeds, since they share in the essential properties of both kinds (*HA* II 8-9. 502a16–24). The ape is both a biped and a quadruped: "The ape, because it is intermediate between the two (epamphoterizein) with respect to its form, and because it is neither and both, has neither a tail nor haunches: as a biped it lacks a tail, and as a quadruped it lacks haunches" (*PA* IV 10, 689b32–4). This explains why apes have hairy bellies and backs. Third, consider seals and bats (*PA* IV 13, 697b1-12). Seals are both land-dwellers and water-dwellers (the same for the cetaceans), because they have feet and fins (and their teeth are razor sharp). Bats are both flyers and land-dwellers, because they have feet, but lack tail and rump, and they lack tails because they are flyers, and have no rump because they are land-dwellers. Bats are membranous-winged, and nothing has a rump unless it is split-feathered. Being split-feathered is what causes certain organisms to have rumps.

These two sorts of cases, the higher order kinds, and the ἐπαμφοτερής ('dualizers') clearly show Aristotle's pluralism at work. Before I conclude this section, there are a couple of issues that come with reading Aristotle as a pluralist that I will flag here, because they call into the question the relationship between pluralism and essentialism. I won't attempt to resolve these issues completely here, but will suggest how resolving them may alter how Aristotle's approach can help us understand what is at issue between modern forms of species pluralism.

First, one might worry that this reading will lead us to the view that a particular organism may have more than one essence. Henry argues that a particular kind (or form) on this account will still have only one essence: "The single essence of the Libyan ostrich will thus be defined by a single complex of multiple attributes, some of which are characteristic of birds and others characteristic of quadrupeds" (2011, 206). On this reading of Aristotle, the essences just are in the individual organisms and nowhere else. If this is the correct account, it still remains to spell out in more detail how these pluralistic kinds cross-cut the world, and not just each other. I will gesture towards one way of working this out in the final section of the paper.

A second worry concerns how Aristotle held two seemingly opposed views. First, the view that forms of a kind differ only in the relative magnitudes of their structures. Second, that there are complete discontinuities between one form or kind and all others. Lennox's solution to this problem hinges on how we understand 'the more and the less.' His position is that: "For two individuals to differ in degree, they must both be the same general sort of thing. With respect to that sort they do not differ in degree. But the general sort is constituted of features with range – any sub-kind may have these features exemplified by different specifications of that range" (Lennox, 2001, 167). This solution seems to involve being careful about level Aristotle is talking about when he uses 'the more and the less.' Thus, we must ask if he's talking about some individual white-capped Chickadee as some form of bird, or as belonging to the kind bird. Henry's (2014) solution to this problem focuses on Aristotle's conception of analogy. On this reading, kinds are distinct because they have parts that fulfil analogous roles (e.g., birds and fish are distinct because one has feathers while the other has scales). Now, whichever solution to this problem we opt for, we get a clearer understanding of how Aristotle's hierarchy of kinds works, which is further complicated by his use of only two relational terms 'form' and 'kind,' as discussed above. This issue has some bearing on the explanatory nature of higher taxa, which I will raise in its proper context in the following section.

## 5 Rethinking the Rhetorical Strategy

Mayr's strategy allowed for the use of a particular understanding of an essentialist species concept to shape disputes about post-Darwinian species concepts. This has shaped the way species concepts are introduced today. Pluralists can also use a version of the rhetorical strategy that Mayr developed in order to introduce different versions of species pluralism. The incompatibility between evolutionary theory and Aristotle's classification schema is still retained, but essentialism is no longer the main point of comparison, even though it is clear that what Mayr meant and what Aristotle meant by essentialism are completely different things. In closing, what I want to suggest is that having a deeper understanding of Aristotle's pluralistic approach to biology allows us to ask about the importance of at least four different issues, which I will outline here. These are questions about: (1) the explanatory power of taxonomic ranks, (2) the importance of the species category problem, (3) the question of intrinsicalism, and (4) how to interpret the "cross-cutting" metaphor endemic to the pluralist literature.

First, Aristotle doesn't have a fixed hierarchy of definable ranks: "His approach to classification does not involve an attempt to pigeonhole animals into the fixed ranks of some predetermined taxonomic hierarchy" (Henry, 2011,

217). Aristotle's greater kinds, e.g., bird, fish, land-dweller, lung-possessor, etc., are real. That is, they have a mind-independent existence and are explanatory. We want to know why certain things have certain features. All animals have certain features because they are animals, and other features because they are certain kinds of animals. The work of the biologist is to explain features at the right level of biological organization (*APo.* B 14 98a9-19). Modern pluralists generally do follow Aristotle in arguing that we retain species concepts that are real. However, modern pluralism raises questions about the nature and usefulness of taxonomic ranks. Some species pluralists have argued that we ought to abolish the Linnean system of taxonomy (Ereshefsky, 2001), and others have argued that species are not real in any special sense when compared with higher order taxa (Mishler and Brandon, 1987). Those behind the development of the PhyloCode, a new classification scheme that is meant to be more general than existing codes of nomenclature (e.g., the International Code of Botanical Nomenclature), have found no use for a hierarchical system (cf. Rieppel, 2006; Ereshefsky, 2007), though this may be due to an preoccupation that exists amongst some biologists with the search for monophyletic taxa (taxa that include a common ancestor and all of its descendants). With this in mind, one question Aristotle's pluralism allows us to ask is whether or not there is something real about bigger paraphyletic groups (e.g., Reptiles, Gymnosperms), taxa that include a common ancestor but not all of its descendents. The fact that these groups cross-classify doesn't make them any less real, and this is an option that modern pluralists should still consider, rather than only recognizing monophyletic groups. I address the role the concept of monophyly plays for different forms species pluralism in the remaining chapters.

Second, Aristotle has no definition of the species category. Quite often a 'species concept' is thought to be a way of defining the species category. By providing a definition of what it is to be a species, whether it's the **TSC**, the **BSC** or something else, we provide a way of putting things into the species category. But, as we have seen, Mayr understood essentialism as a failed way of doing this. Aristotle has no hard and fast rules for what counts as a species and what does not. His approach usually involves starting at the widest explanatory kinds and working down to the narrowest. But sometimes, as in the case of humans, we need not seek a wider kind to explain most of the features the thing has. For these reasons, Aristotle's approach to kinds and forms clearly doesn't fit the earlier model developed by Mayr. Aristotle mainly uses his classifications of animals to explain why organisms have the various parts they have. However, this does mean there are no constraints on what it is to be a form for Aristotle. A minimal condition is that a form is such that it is a real way of differentiating a kind. But the other key thing is that there are many different ways of satisfying this condition. Species pluralism in the modern context may also

imply that we do not have a well-defined "species category" as many have pointed out, but we need constraints on what is to count as a legitimate species concept. Aristotle presents constraints in terms of how forms relate to their respective higher order kinds, whether cross-cutting or not. Whether or not there should be any analogous sort of hierarchical constraint on species concepts for modern forms of pluralism is a question that needs to be raised. I address the relationship between species pluralism and the species category further in the following chapter.

The third issue Aristotle helps us address, though certainly not solve, is the question of intrinsicalism. There are many modern debates about whether species are relational entities, or whether there is something intrinsic to each organism that makes it a member of a particular species. Unfortunately, the issue of intrinsicalism is not entirely clear even in Aristotelian scholarship. Are essences just sets of intrinsic properties, or is there something more resembling relational properties that might be present in the essence of a particular form? Aristotle does say that animals differ from one another in their modes of subsistence, in their actions, in their habits, and in their parts (*HA* I. 1 487a11). If this is the case, there may be a way for an essentialist view of species to move beyond the intrinsic properties of organisms. More work needs to be done to understand Aristotle's view on this issue, because in the modern context the debate over intrinsicalism is alive and well. We still want to know the degree to which the properties of the organisms themselves determine their species status. I discuss the issue of intrinsicalism in more detail in my fourth chapter.

Lastly, Aristotle's pluralism allows for cross-cutting kinds. His higher divisions of animals cross-cut one another, and the ἐπαμφοτερής fail to fall under one uncuttable form, though they still retain a complex essence. Aristotle allows for kinds and organisms to be cross-cut, but modern pluralists might require that populations and lineages be cross-cut, or even something further than that. There may be ways of cross-cutting for modern pluralists that accord with Aristotle's account. This is a metaphor that needs to be sorted out, and I will make further progress on this question in the following chapter.

In sum, the importance of *these* questions to the modern species literature, especially when it comes to pluralist approaches to species, shows the importance of revisiting Aristotle's approach to biology, in particular, his approach to classification. I have here only begun to sketch the connections we can draw. The important part of this chapter is to note that there is much more to the essentialism story than what we find in the textbooks, and much more that we ought to be putting in new textbooks. Mayr and others have assumed that essentialism must be a form of monism, but looking carefully at Aristotle, the archetypal essentialist, shows that this is not the case. I'm

not suggesting that revisiting Aristotle will help clarify everything that is going on in modern systematic biology, for in many ways there is not a strong Aristotelian tradition for us to draw on. What I am suggesting is that revisiting Aristotle's work on classification can help us raise more questions and hopefully disabuse us of some of the assumptions that plague contemporary debates about species concepts and the ontological status of species taxa. Mayr's interpretation of the history of biology before Darwin has set the standard for comparison among species concepts for far too long. A new, more pluralistic, essentialism story of pre-Darwinian taxonomy needs to be told, especially if Darwin is to be taken at his word when it comes to old Aristotle.

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