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Eidos as Norm in Aristotle's Biology

Anthony Preus

Binghamton University--SUNY, apreus@binghamton.edu

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EIDOS AS NORM (in Aristotle's Biology)
Anthony Preus, SUNY Binghamton

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Introduction

Eidos, species or form, is a central concept in many of Aristotle's works, but the peculiarly Aristotelian character of the *eidos* concept was developed in his biological investigations. Some scholars have studied the meaning of "*eidos*" in the biological works, notably Marjorie Grene and David Balme;¹ the present essay begins with an exploration of the same territory, but perhaps not always on the same paths. Once the biological sense of "*eidos*" has been presented, it will be possible to compare uses of this concept in the normative treatises. Two passages will be examined, *Nicomachean Ethics* X.4-5, and *Politics* IV, especially IV.4. In both places Aristotle appeals to the biological concept of *eidos* in order to explain, in the one instance, pleasure and the kinds of pleasures, in the other, the reasons for the variations in the kinds of government.

This essay will not examine the concept of *eidos* as it appears in the *Metaphysics*, although it is clear that an understanding of the biological concept of *eidos* would increase comprehension of many passages in that work, just as the metaphysical uses of "*eidos*" are often assumed and influential in the biological works. Indeed, Aristotle distinguishes his own philosophy from that of Plato partially in terms of the biological sense of *eidos*:

It is obvious that the generator is the same in kind as the generated in the case of natural products (for man begets man)... so it is quite unnecessary to set up a Form (*eidos*) as a pattern... The begetter is adequate to the making of the product and responsible for the *eidos* being in the matter. (*Metaphysics* Z.8, 1033b30ff)

Aristotle and Modern Taxonomy

A useful step in explaining Aristotle's biological sense of *eidos* as species or form is an examination of the meaning of 'species' for the modern philosopher and scientist. Ontologists and logicians often suppose that biological species are paradigmatic and intuitively obvious cases of natural kinds, from which one might confidently work toward a future ontology.² Biologists themselves admit difficulty in distinguishing species, to the extent that many taxonomists believe that species distinctions are essentially and necessarily arbitrary. The living world is seen as *continuous*, in two ways: in the first way, Darwinian evolutionary theory assumes that speciation over time occurs in very small steps; each generation belongs to the same species as its parents, but each individual has ancestors at some number of generations which are *not* the same in species. Thus there are no determinate temporal boundaries of species. Secondly, some parts of the living world present synchronic polytypical continuities, called "clines", in which variations are subspecific from each local population to

the next, but types removed at some distance are judged, by any standard, to be of different species.³ Thus there seem to be no dependable co-temporal boundaries between species. If a is the same in species as b , and b is the same in species as c , it seems not necessary but contingent that a be the same in species as c . Co-specificity is not necessarily a transitive relation, or rather it is a limitedly transitive relation.

Modern biologists approach the problem of distinguishing kinds in several different ways. Some⁴ start from the observed similarities and dissimilarities, feeding numerically analyzed data about the phenotype, the apparent form, into a computer; the procedure owes much to Hume and positivism, and claims to be objective and purely empirical. Other biologists believe that genetic relationships are the basis of class membership, and thus attempt to classify according either to genotype (ultimately and perhaps ideally, by the information content of the DNA) or by genealogy, by analysis of the evolutionary descent of the individual or population.⁵

Aristotle and Noah's Ark

Diachronic and synchronic continuities are taken to be good evidence against a taxonomic theory which Mayr, for example (1969, p. 66), calls Aristotelian essentialism or 'typology'; "This philosophy... attempts to assign the variability of nature to a fixed number of basic types at various levels. It postulates that all members of a taxon reflect the same essential nature, or in other words that they conform to the same type." Since Aristotle does not seem to have been an essentialist in the sense distinguished by Mayr, I would prefer to call this theory "Noah's Ark Essentialism."⁶ The popular understanding of species often does include the idea that it would be possible for a diligent Noah to select appropriate samples of each biological kind for inclusion in some capacious ark (or, for that matter, a museum or zoo); modern taxonomists assert that such a Noah would frequently be faced by non-obvious distinctions to be made, unless some Adam (to continue the Biblical metaphor) had already made them by selecting paradigmatic cases ("holotypes") and setting the boundaries of the kinds.

That Aristotle was not a Noah's Ark Essentialist may be seen from passages like *Parts of Animals* IV.5, 681a12-15: "Nature proceeds continuously from inanimate things to the animals through living things which are not animals, so that there seems to be an infinitesimal difference from one class to the next."⁷ His theory of "dualising", as A. L. Peck⁸ calls ἐπαμφοτερίζειν, also counts against any allegiance to Noah's Ark Essentialism. Kinds of animals "dualize" if they have characteristics which are typical of two different, and generally separate, classes. Sea-animals which live attached "dualize" with plants;⁹ the *genos* of pigs dualizes because there are both cloven-hooved and solid-hooved subspecies;¹⁰ the hermit crab dualizes between crayfish (in respect of *physis*) and testacea (in manner of life);¹¹ primates dualize between man and quadruped;¹² cetaceans "are in a way both land and water animals;"¹³ seals and bats also dualize,¹⁴ seals between land and water-animals, bats between land-animals and fliers: "διὰ τοῦτο ἀμφοτέρων τε μετέχουσι καὶ οὐδετέρων, thus they are of both and neither" (697b2). Similarly the ostrich has "some things of a bird, and some of a quadruped" (697b15). A dualizing animal is not exactly a borderline case; rather it is an example of the difficulty, if not impossibility, of developing

hard-line distinctions between kinds of life. Even more clearly, the generation of mules indicates the fuzziness of the edges of the species-concept in Aristotle; the mule forms a *genos*, even if *agonon*.¹⁵ Should Noah include mules in his ark or not?

Aristotle does say some things which sound rather like Noah's Ark Essentialism, for example in *Parts of Animals* I.4, 644a24ff:

... it is the ultimate species (*eide*) that are beings (*ousiai*), while these things [those which differ by the more and the less] (like Socrates and Coriscus) are undifferentiated in respect of species... . In so far as being (*ousia*) is that which is indivisible in species, it is best (if possible) to investigate separately those that are particular and specifically indivisible-- as of man, so of bird (for this is a genus possessing species) but of every sort of bird among the indivisibles, like sparrow or crane and so on.¹⁶

But despite statements like these, I believe that Aristotle is not committed to Noah's Ark Essentialism, to 'typology,' or to put it most paradoxically, he is not committed to the taxonomic theory which is sometimes called Aristotelian Essentialism.

Genetic and Phenetic Species

A comparison of Aristotle's concept of a species with those developed in modern genetic and phenetic approaches to taxonomy can be rather complicated. We may say from the start that Aristotle leaves almost no room for a phylogenetic theory of kinds, because evolution is not a part of his biological theory. Aristotle generally assumes that the kinds of animals which exist today have always existed. But that leaves room for a Linnean (Noah's Ark) geneological theory-- each *eidos* as a geneological continuity. This is surely close to one aspect of his theory; in fact, as Balme points out (*CQ* 1962), Aristotle tends to use the word *genos* in this connection: a *genos* is formed by those individuals which share a common ancestry, though of course the word '*genos*' is used in other senses too. The root sense of '*genos*' (often lost sight of) is derived from γίγνεσθαι and γεννᾶν; we may say that Aristotle tends to have a genetic theory of *genos*, and consequently (to the extent that he uses *eidos* and *genos* as synonyms) a genetic theory of *eidos* as well. Unlike the modern biologist, however, he is not very concerned about inter-sterility (reproductive isolation) as a test of species membership. He thinks that the limitations on hybridization are in terms of the 'times', gestation periods, and general body size, not difference in *eidos* or *genos*.¹⁷ Fox and dog cross, and so do partridge and common chicken; the hawks and probably some fish also cross, and "Libya is always bringing forth something new,"¹⁸ because animals of different species meet at the water hole and copulate. Because he is familiar with the fertility of the hybrid canines and galliform birds, he is at great pains (*GA* IV) to explain the sterility of the mule. Hybrids do not necessarily breed true-- after several generations of interbreeding, they eventually revert to the appearance of the female, just as seeds of plants come to vary according to the soil on which they grow.¹⁹

If Aristotle does not have the idea of a species (or even *genos*) as a reproductively isolated population, then the *genetic* aspect of the modern species definition will not hold for him in that respect, or at least will apply only in a very much weakened form. (Also, his tendency to deny reproductive isolation is a further bit of evidence showing that Aristotelian essentialism is not Noah's Ark essentialism.)

But there is another form of genetic taxonomy, that which classifies according to the genetic material. It is theoretically, and to some extent practically, possible to classify species in terms of the character of the genetic information carried in the chromosomes. Theoretically a genetic taxonomy of this kind would have a high predictive and explanatory value; DNA² is supposed to be (have) the information by which the living being constructs itself, and that information, the genotype, is much less variant, we suppose, than the phenotypes which result after environmentally influenced developments. A genotypic taxonomy of this kind would be comparable to a taxonomy of buildings based on a comparison of their blueprints, rather than on a comparison of the appearances of the completed structures.

There is a sense in which Aristotle was groping for a genotypic taxonomy. In *GA* IV, when explaining why some individuals are generated as male and others as female, and why some individuals resemble one parent more, and the other less, Aristotle says:

When the *archē* does not control and is not able to concoct because of lack of heat, and cannot bring the material to its own *eidos*, but is worsted by it, necessarily it changes over to the opposite (*GA* IV.1, 766a18, after Peck). He means that the semen, in its attempt to impose its *eidos* on the menstrual fluid or egg, sometimes is not able to do so, and the *eidos* of the mother wins out. The account of form or species in generation has been rather thoroughly explored elsewhere;²⁰ let me just remind you that Aristotle has a theory that the semen and the female contribution to generation, whether mense or egg, has in it complex movements, perhaps movements of *pneuma*, which preserve the form of the parent through the process of generation. Having used this theory to explain why some offspring are male, others female, Aristotle goes on to use it to explain resemblance and lack of resemblance to parents, in *GA* IV.3. The *logos* of the movement (767b21) preserves the peculiar and individual, above all (767b30); but the *genos* is also present in generation, so if the "powers" (*dynamis*) of the individual are not imposed on the material, the generic movements gain the upper hand, first in expressing the character of an ancestor, but if not that, then "only what is common and what it is to be human. For this follows all the individual traits" (*GA* IV.3, 768b12). In some cases, the lack of resemblance, or failure of the movements to master the material, goes so far that that which is generated is not even human, but "only an animal," in which case it is a "monster" (*teras*), for animal is the "most general" (μάλιστα καθόλου, 769b13).

Aristotle's difficulty throughout this passage, and elsewhere in *GA* where he relies on this sort of analysis (notably II.3 and II.6), is that the *eidos* or *genos* which is present in the generative materials as 'movements' and 'powers' is not directly observable by him. The movements and powers are theoretical entities, and the evidence for their existence must be taken from what happens on the level of the phenotype. Consequently, although he believes (more or less correctly) that the form of the species, the *logos* of the *ousia*, is present in the generative semen and mense, he cannot use that belief for any taxonomic purpose, because he cannot test the genotype independently of the phenotype.

However, the theory of sexual generation in *GA* does show one way in which Aristotle's theory of *eidos* is normative: there is a scale of values explicitly employed throughout the account of 'mastery' and 'changing over', according to which the best result is assumed to be the preservation of the *idion eidos* of the male parent, next best the *idean* of the female (766a28), then general humanity, and finally animality, which is taken to be 'monstrous'. But although monstrous, it is not completely unnatural (IV.4, 770b10), because it does not "happen in a random fashion" (770b15), it is not an alteration "to a different nature" (770b24).

Thus there is a sense in which Aristotle has a genotypical concept of species (and he does use the word *eidos* at least once in this connection); this genotypical concept is at the same time normative, since the form which is carried in the generative material is regarded as carrying a potential for an entity with at least as much excellence as its male parent, and variations from the form of the male parent are regarded as *failures*. They are not, however, seen as failures to achieve an *ideal* member of a (Noah's Ark) species; semen is not trying to achieve the perfect man (horse, dog, whatever), but only reproduction of the powers of *this* man, and if not, of *this* woman, and if not, of ancestors, and if not that, hopefully of a human being (at least).

In fact, despite his genotypic instincts, Aristotle is driven to reliance upon phenotypic methods in classifying animals-- to the extent that he classifies at all. The word '*eidos*' rather obviously emphasizes *visible* characteristics, since it is derived from *εἶδω, 'see'; the word *eidos* originally meant the visible shape or form. Aristotle uses it this way sometimes-- the 'look' of a bird with variegated coloring (*HA* II.12, 504a13), the 'looks' which attract us through pleasure of vision to another person who may eventually become our friend or lover (*EN* IX.5, 1167a5). He often talks as though one can distinguish kinds of animals by simple inspection, and of course within one small geographical territory, at a given time, it usually is possible to make unambiguous species distinctions by simple inspection. Aristotle relies strongly on phenomenal characteristics, not only in the sense of the observed phenotype, but also in another sense of 'phenomena' nicely distinguished by G. E. L. Owen:²¹ as much as possible, Aristotle accepts the traditional distinctions and classifications of animals, at least for the purposes of doing the sorts of analyses of the parts and habits of animals which he carries out in the *History* and *Parts of Animals*.²² The traditional distinctions have been made, he notes, "mainly by the shapes of the parts and of the whole body, wherever they bear a similarity" (*PA* I.4, 644a8, Balme). Nature, Aristotle often says, is "that which happens always or for the most part,"²³ and that is a starting point for the distinction of natural kinds.

Parts of Animals I.2-4 seems to be an essay on classification, containing a good many recommendations about how one ought properly to carry out a zoological taxonomy.²⁴ These chapters can be quite misleading, for several reasons. Most importantly, the entire passage is *polemical*, directed against some Platonists, called "dichotomists" at 642b22, who proposed classifying animals by always dividing classes in two, and whose practice was always to use just one characteristic as decisive for taxon-creation. Aristotle's polemical passages are notoriously unreliable for his positive theory (how reliable is *Physics* I, for example?). Furthermore, Aristotle's positive practice is only very incompletely consonant with his recommendations here; we might say that *PA* I.2-4 represents an attempt to lay out the groundwork for a truly scientific classification of animals, but the *HA* and *PA* do not have as part of their purpose the building of that accurate systematic.²⁵ However, we should look at least briefly at this section, both because it reveals some similarities and differences between his approach and that of modern taxonomists, especially those taxonomists emphasizing phenotypical characteristics, and because we gain a clearer notion of Aristotle's ontological goals.

The "dichotomists" used single-character distinctions and negative characteristics, or "privations", in classification. Privations should not be used, says Aristotle, because "there cannot be *eide* of the non-existent" (*PA* I.3, 642b23). He obviously does not follow this recommendation in his own distinctions among animals; the major division of the animal kingdom is into

those which have (red) blood and those which do *not* have (red) blood (*enaima/anaima*).²⁶ Probably more crucial for Aristotle is the question of the number and kinds of characteristics which should be used in classification; Aristotle himself argues that one ought to use several sorts of characteristics at the same time, that species will be distinguished from other, closely related, species in terms of the *degree* to which they express a number of features. He adduces several arguments; most striking is that "the number of differences (which distinguish species) would be equal to the number of individual kinds of animals"²⁷ according to the dichotomists' system. If that were the case, then one could unambiguously use the 'last differences' as proper names of species; obviously that would be absurd. Sometimes students think that Aristotle really meant to do something like that with his definition by genus and differentia-- if the difference determines the species, wouldn't it uniquely designate? The example which students mention in this connection is "man is a rational animal;" wouldn't that mean that "rational" uniquely designates man? But even the legendary Platonists would not have fallen into that trap, for in defining 'man' as 'featherless biped' they surely did not mean to claim that man is the only featherless animal.²⁸ (Incidentally, that story gives a good example of a privation used to determine a species; Aristotle's argument is philosophically more destructive, if less dramatic, than the action of the person who threw a plucked chicken over the wall into the Academy garden shouting, 'Here's another student for you.')

"Rather one should try to take the animals by kinds in the way already shown by the popular distinction between *bird* kind and *fish* kind. Each of these has been marked off by many differentiae, not dichotomously" (*PA* I.3, 643b10, Balme). "All kinds that differ by degree and by *the more and the less* have been linked under one kind, while all that are analogous have been separated. I mean for example that bird differs from bird by the more or by degree (one is long-feathered, another is short-feathered), but fishes differ from bird by analogy (what is feather in one is scale in the other)" (*I*.4, 644a17, Balme; cf *HA* I.1, 486a16). Taken by themselves, these positive positions resemble the theory of the modern phenetic taxonomist, except that the modern taxonomist attempts to collapse the distinctions between kinds that are comparable only analogously, by trying to fit feathers and scales (for example) onto one continuum. In practice, Aristotle certainly does appeal to whole sets of characteristics in his definitions of kinds of animals; often these characteristics are somewhat hidden in the generic, or class, word, and not spelled out in the definition, but when necessary, he appeals to the appropriate features. However, despite the implicit appeal to measurement, proportion, and ratio, in *PA* I.4, Aristotle never gives any mathematical relationships, except in the most general qualitative terms. He obviously envisages the possibility of a "numerical taxonomy", at least among the species of one genus, but he does not seriously begin to carry out the project. He claims, for example, that "the larger the animal, the greater the quantity of corporeal or earthy matter there is in it" and thus horned animals are generally among the larger animals, as they tend to have a surplus of earthy matter which can be used for defensive weapons (*PA* III.2, 633b22ff). It would not have been difficult to weigh carcasses of various animals, then to weigh their bone systems, and to compare ratios, in order to substantiate this claim. But he simply relies on the general observation that large animals have larger bones, even in proportion. In theory, if not in practice, Aristotle does have tendencies which lead eventually to phenetic taxonomy.

But Aristotle's taxonomic theory is markedly different from that of modern phenetic taxonomists in one essential respect: the phenetic taxonomist tends to claim that he is prepared, in theory at least, to take account of *all* characters of living things; from fear of being called an "essentialist" (Platonist, Aristotelian, Typologist, or some other equally frightening thing), the pheneticist claims to compare "the total phenetic manifestations of the genome of an organism or a taxon."²⁹ But then some features are, after all, ignored because they are "not a reflection of the inherent nature of the organisms themselves" (p. 103). Precisely. Aristotle intends to select all and only those characteristics which are manifestations of functional needs of animals. Aristotle does not determine species-membership by abstracting from common characteristics, but rather he picks out as of prime importance those characteristics which are necessary for the existence of the species (at all). Thus large groups of animals are distinguished first by that which maintains their life (blood or some other fluid), and the 'blooded' animals are distinguished by their mode of reproduction (vivipara, ovovivipara, ovipara). Other characteristics which Aristotle often uses for distinguishing the larger groups include location of 'life' (water or land), means of cooling (i.e., respiration), type of food, method of locomotion.³⁰ The *major* distinctions between kinds of animals are all made in terms of the ways in which these animals carry out the functions which are necessary for life and for the continued existence of the species. From Aristotle's point of view, features which are conditionally necessary for life are most obviously 'inherent in the nature of the species.'

Three Normative Determinants of EIDOS

We may be more precise about Aristotle's account of how conditionally necessary characteristics determine the nature of kinds of animals, by applying three general scales:

- 1) the scale of degree of necessity,
- 2) the scale of generality (roughly, a hierarchical scale),
- 3) the scale of value or "scala naturae".

In proposing the application of these three scales, I recognize that I am imposing a scheme of interpretation on Aristotle's account which he has not himself developed in any precise way; his own theories of what he is doing are more allusive. Still, this hypothesis concerning his presuppositions may well fit the facts.

1) The scale of the 'degree of necessity' may be discerned in *PA* I.1, where Aristotle insists that the sort of necessity operative in biological contexts is conditional necessity; this sort of necessity is also defined in *Metaphysics* Delta 5, where we read:

We call 'necessary': that without which, as a condition, a thing cannot live; e.g. breathing and food are necessary for an animal; for it is incapable of existing without these; the conditions without which good cannot be or come to be, or without which we cannot get rid or be freed of evil; e.g. drinking the medicine is necessary in order that we may be cured of disease, and a man's sailing to Aegina is necessary that he may get his money (1015a20-27, Ross).

These two degrees, *sine qua non* and 'for the better', shade into one another in biological contexts, so we may say in a general way that all "adaptive" features of animals to which Aristotle appeals in defining species are 'necessary' along the scale of conditional necessity. That is, species-determining characteristics

are characteristics which are necessary or valuable for the species (or for the genus to which the species belongs, see 2), or are structural consequences of necessary or valuable characteristics. A great deal depends, for Aristotle, on 'where the kind has its life,' where it spends its time, feeds, reproduces. An example of this sort of argument may be found in *IA* 15, 713a15ff, where Aristotle argues that 'troglodytic' or hole-dwelling animals tend to have their legs out to the sides, close to the ground, and flexed to the side, "because that way they are useful for crawling easily into the hole and sitting on their eggs to guard them;" when they are out of their holes, they can lift themselves up by drawing the legs underneath.³¹

In *GA* V.1, Aristotle distinguishes the functional and non-functional features, stating the ways in which these may be related to the definition of the kind.

Whatever things are not the product of nature working upon the animal kingdom as a whole, nor yet characteristic of each separate kind, none of these is for some end or generated for something. An eye is for something, but blue is not for something, unless this characteristic is peculiar to a particular class. In some cases it doesn't even connect with the definition of the entity (*logos* of the *ousia*), but happens necessarily, leading back the causes to the matter and the moving origin (778a32ff; cf 778b11ff).

His discussion of eye-color leads to the conclusion that he supposes that variability and non-variability of eye-color depends upon other characteristics of the species, some of which might very well be conditionally necessary.³² We may call this the lower end of the scale of conditional necessity-- neither useful nor indicative of class-membership.

2) There are some features of animals which are found in some individuals and species where they are non-functional, yet they have definitive significance because they are features which are functional in the genus (kind, class) to which this individual or species belongs. I have already mentioned the useless eyes of the mole in this connection; in *PA* III.7, 669b27ff, Aristotle says that some animals have a spleen which is non-functional (he seems to be wrong about its non-functional character, but never mind), but is present σημείου χάριν, "for the sake of a sign." I think that what he means is that the spleen is a sign or vestige of membership in a larger class of animals, in some of which the spleen is useful (it "draws off the residual humors from the stomach and ... assists in their concoction" (*PA* III.7, 670b5). Similarly at *PA* IV.10, 689b1, Aristotle argues that nearly all quadrupeds have a tail, though in some it is only a small one, σημείου γ' ἕνεκεν.

A complex example of this sort of thinking occurs in the explanation of the elephant's nose, *PA* II.16, 659b22. The elephant is a 'polydactylous' animal, with its feet divided into toes; animals of this kind generally use their forefeet for getting food and conveying it to their mouths, but the elephant cannot do this because his feet are spoiled for this function by the necessity of holding up all that weight. Thus, because there is a (conditionally) necessary function which cannot be performed by the usual organ, "nature presses into service" (καταχρηται) the nose, which was elongated anyway for the purpose of breathing in deep water.

This sort of concomitant variation is sometimes ascribed to the "*logos* of the *ousia*," for example in the case of a certain kind of octopus, which has only one row of suckers on its tentacles, because the tentacles are so long and

narrow. Aristotle doesn't tell us why the tentacles are long and narrow, though one supposes that he would think that *that* had a functional purpose; but having one row of suckers only is *per se* "not for the better" (PA IV.9, 685b13ff). Aristotle also thinks of consequences of functional structures at PA III.3, 664a30, where the trachea is said to be functionally long, and the oesophagus consequently also long; the phrase "*logos* of the *ousia*" is used again in this sort of connection in comparing the structures of males and females in GA II.1, and in discussion of the segmentation of insects at PA IV.6, 682b28.

The more general class to which a species belongs establishes a norm for all the various kinds which belong to it. This is clear from cases in which an entire species is said to be 'maimed' (πεπηρωμένον) in some respect, even when that feature of the animal is clearly adaptive for its way of life. The feet of the seal (IA 19, HA II.1, 498a32) are thus 'maimed' although clearly excellent for swimming; the feet of the bat (IA 19) also are maimed for walking, although well adapted to flight. The seal is also 'maimed' in comparison with other four-footed animals in that it does not have ear lobes, but only the auditory passages (PA II.12, 657a23), yet this is of advantage to the seal in its aquatic life (GA V.1, 781b22). Similarly the (spiny) lobster is a deformed species in respect of its claws, since it does not use them as claws (as crabs do) but for local movement (PA IV.8, 684a35). Even the whole class of testaceans (e.g. snails) is deformed in respect of their manner of movement, since they do not conform to the model of movement of higher animals (IA 19). At this point the idea of 'maimed' species shades into the idea of the *scala naturae*.

3) The third sort of continuum which determines characteristics of various kinds of animals is the "scale of nature" to which I alluded earlier in arguing that Aristotle is not a Noah's Ark Essentialist. Aristotle attempts to hold two principles simultaneously: that each kind of animal is best adapted to its particular kind of life, its particular ecological niche as we would say, and that nevertheless we can order the kinds of life, and correlative kinds of beings, on a scale of value corresponding to the absolute value of the functions performed. How he holds both principles together is best understood, I believe, by comparing the theory of the good in the *Nicomachean Ethics*. There, each of the functions of the soul has its own virtue or excellence, the good performance of what it is best qualified to do, yet the functions (powers, parts) of the soul are ranked in value: health is a summation of the excellences of the physiological powers, the moral virtues are excellences of the powers of the soul to act intentionally, prudence and wisdom are excellences of the mind. We may say that some degree of excellence is necessary conditionally for the possibility of excellence of the next level, and thus good as a means toward the 'higher' functions, but Aristotle makes it abundantly clear, particularly in EN X, that the activity of the intellect is the best activity possible for man-- just as it is the sole activity of God in *Metaphysics* Λ.

When, in EN I.6, Aristotle suggests that the word 'good' may be defined 'ἂφ' ἑνός', 'πρὸς ἓν', or 'κατ' ἀναλογίαν', he is at the same time allowing for not only an ethical but also a biological (and generally ontological) use of this distinction. "As sight is good in the body, so intelligence is good in the soul, and so other things are good within their respective fields" (1096b27). Similarly, as legs are good for land-locomotion, so wings are good for flight and fins for swimming (cf. HA I.1-6). The goodness of the organs and functions of various species of animals is relative to the life which each has, and is thus analogous, as the parts themselves are said to be analogous (if differing more than

by the 'more and the less'). But as the lower functions of man serve the higher, and ultimately the intellect, and are thus seen as πρὸς εἶν good, so "plants exist to give subsistence to animals, and animals to give it to men. ... As nature makes nothing purposeless or in vain, all animals must have been made by nature for the sake of men" (*Politics* I.3, 1256b17ff). Aristotle can argue in this (possibly frightening, from an ecological point of view) way because he has a prior concept of a scale of value running throughout creation; in every case, the less *timion* exists for the sake of the more *timion*.

This three-way analysis, in terms of degree of conditional necessity, of conformity (or lack of conformity) to the definition of the larger *genos*, and of comparative value of the species in terms of kind of function, shows how Aristotle's concept of species is normative in three ways: 1) features are selected as definitive of kinds on the ground of their conditional necessity, utility, or value for the life of the kind; thus Aristotle's taxonomy, although based for the most part on phenotype, is not purely descriptive, since there is an evaluative basis for selection of taxonomically significant characteristics. 2) Once a *genos*, of whatever degree of universality or 'generality' has been discerned on the basis of a communality of function, the possession of properly functioning organs typical of the *genos* is a kind of standard for all species in the class. Generally, failure to have fully actualized organic function is ascribed to a more pressing need for this particular kind, not typical of the genus as a whole (the feet of the elephant, the forelegs/wings of the bat, the earlessness of seals), or else to the lack of need for the generic function in a particular kind (the blindness of moles, the vestigial spleen or tail in various animals). These so-called 'mutilations' seem to be so because it is theoretically, in general, better for the animal to be able to actualize all its potentialities, for all its powers to be functional. In some cases, the power is actualized by a quite different organ than is normally the case for the genus, as the nose of the elephant. This generic normality leads easily to the idea of the scale of nature. 3) In the scale of nature, species and whole genera are compared to each other in terms of their relative value.

A good deal more could be said about Aristotle's biological concept of species (indeed, Grene, Balme, and others have much to add to the present account); however, some of the major features have been distinguished sufficiently to show, at least briefly, how Aristotle applies his concept of a normative *eidos* in some of his non-biological books. We may be sure that both the *Nicomachean Ethics* and the *Politics* date from the latest period of Aristotle's life, when he was teaching in the Lyceum, and that the *History*, *Parts*, and *Progression of animals*, if not the *Generation of animals*, were composed either entirely or for the most part during the middle period, even if completed or partially revised at the Lyceum. Thus the appeal in *EN* and *Pol* to concepts developed in the biological books is retrospective rather than prospective, and may reveal the consequences of biological thinking for other parts of Aristotle's thought.

The Taxonomy of Pleasures

The taxonomy of pleasures, in *EN* X.4-5, is a good deal simpler than a taxonomy of animals would be, if only because pleasures do not have an internal structure which can be used in classifying them. A pleasure has a complete *eidos* at any moment, it does not have any unactualized potentialities (*EN* X.4, 1174a15, b5). Pleasures are classified by the sense of which they are completions (1174b26), since each sense has its own peculiar pleasure; they are also classified by their source (X.5, 1175a22), since different activities bring about different and possibly contrary pleasures; and finally they are classified by the species of animal or man in which they are typical (1176a3).³³

Taking *EN* X.4-5 by itself,³⁴ we may see that Aristotle gives a classification based partially on the material conditions of pleasures, first in terms of the sensory organ or power which can experience this pleasure, then in terms of the species of animal or type of man which can experience this pleasure; we may say that these are two ways of looking at the necessary conditions of pleasure. The other basis of classification is the moving cause; in this respect the taxonomy proposed is genetic in character. To the extent that Aristotle could possibly give a phenetic account of pleasures, he would be forced to appeal to the common experience of mankind, since nothing could be more difficult than to describe a pleasure objectively, independently of its sense and source!

We may also note that while Aristotle attempts to argue for discrete kinds of pleasures, since they may conflict, and since we make value judgements, finding some of them good and some of them not so good, nevertheless he is quite willing to find continuities and overlappings in pleasures, particularly in those which are experienced by men as distinct from those experienced by animals (1176a10). That is, Aristotle is not a Noah's Ark Essentialist about pleasures, even though he does try to distinguish several kinds.

If we apply our three continua, the degree of conditional necessity, the scale of generality, and the scale of nature, we can see rather quickly that pleasures are distinguished normatively in all three ways. The *scala naturae* is applied directly-- "Each animal is thought to have its own proper pleasure, just as each has its own function... . As Heracleitus says, an ass would prefer chaff to gold" (1176a3, Ostwald). As everyone knows, there are certain pleasures which are proper to man, most particularly the 'theoretical life'.³⁵ The *scala naturae* thus appears in the proof that the life of the mind is the best life, and the pleasure of this life is the best pleasure.³⁶

The scale of conditional necessity is not applied by Aristotle in this passage as clearly as it was to be applied by Epicurus (e.g., *Letter to Menoeceus* 127b, ff), but there are indications of degrees of value dependent upon the desirability or 'avoidability' of the activity which gives rise to the pleasure (1175b24ff). Just as the various species of animals have their proper pleasures, so the individual organs and activities have their pleasures, and these are ranked in terms of the value of the activity. It's interesting to note that Aristotle does not rate the pleasures belonging to the *sine qua non* activities very highly-- food, drink, and sex are regarded as rather banal sources of pleasure, they are activities which exist not for their own sake, but for the sake of some higher end; the better or more honorable pleasures are those for the sake of which the physical activities and pleasures exist. I think that we can read this distinction of pleasures back into the distinction between degrees of conditional necessity, and understand that those features of animals which are *very* necessary conditionally differ from those which are 'for the better' by an

inverse scale of value. So I read 1176a1: "Sight is superior in purity to touch, and hearing and smell are superior to taste... the pleasures of thought in turn are superior to the pleasures of the senses" (Ostwald). As in Plato, this scale of value of the various activities is laid off against the scale of complexity (sensitivity) of the various kinds of living being.

The generic normative concept is applied most clearly in the comparison between virtuous and vicious pleasures, on the one hand, and healthy and sick pleasures on the other (1176a10ff). Aristotle appears to suppose that the *spoudaios* is the standard by which the activities and pleasures of other men are judged. Biologically, we may say that the *spoudaios*, if one may be found, would be the "holotype" which determines species membership. Pleasures which do not match this standard are consequently "corrupted and perverted" (1176a21), comparable we may say to the maimed nature of the eyes of the mole or the reproductive organs of the mule. Some whole groups of human beings seem to be less than human: savage tribes near the Black Sea "delight in eating raw meat or human flesh" (VII.5, 1148b15); "those who are irrational by nature and live only by their senses, as do some distant barbarian tribes, are brutish" (1149a9, Ostwald). We may well be reminded of the notion of "dualizing" and the continuity of the scale of nature; how much higher than the apes would Aristotle think these *θερσιωδεις*, animal-species, men who delight in things which are natural for animals but not natural for man? "Some things are pleasant by nature, and of these some are simply pleasant, some according to the *genos* of animals and men; some are not pleasant except through maiming [*πηρωσεις*, like the feet of the seal] or habit, some because of perverted natures" (1148b15ff). Brutishness is taking pleasure in that which is not generically typical of man to enjoy, though it may not be untypical of some beasts. If through bad habituation or mental illness a man has depraved pleasures, he has fallen away from the norm of humanity as the *teras* is born no longer human but only animal.

A good deal more could be said on the biological concept of *eidos* as it is applied in the *Nicomachean Ethics*; these remarks indicate something of the way in which the problem may be approached.³⁷

The Taxonomy of Constitutions

A good case could be made out for saying that Aristotle has a philosophically more developed taxonomy of political organizations than he has of animals. Certainly he regards the project of determining the "essence and attributes of the various kinds of governments"³⁸ as of pre-eminent importance. Influenced by Plato's classification of kinds of government in the *Republic*, Aristotle tries several different sorts of classifications; for example, in *Pol.* III.7 he lists three 'true' (*ορθαι*) kinds and three 'perversions': kingship/tyranny, aristocracy/oligarchy, *politeia*/democracy. He then begins a subdivision of each kind, listing four (or five) kinds of kingship (III.14), and turning his attention to what we may call a phylogeny of the various forms of government (III.15, 1286b8). Book IV returns to the contrast between oligarchical and democratic governments, trying to make sense of their many forms. Distinguishing between rich and poor, various sorts of armament which citizens may afford, and the various sorts of economic functions, he argues that "of these elements, sometimes all, sometimes the lesser and sometimes the greater number, have a share in the government. It is evident then that there must be many forms of government, differing in kind (*ειδε*), since the parts of which they are composed differ from each other in kind" (IV.3, 1290a5, Jowett).

It is at this point in his argument that he appeals to the analogy between the *eide* of animal and the *eide* of state:

If we aimed at a classification of the different kinds of animals, we should begin by enumerating the parts, or organs, which are necessary to every animal. These will include, for example, some of the sensory organs: they will also include the organs for getting and digesting food, such as the mouth and stomach; they will further include the organs of locomotion which are used by the different animals. Now if there are only so many parts, and if there are differences of these, different kinds of mouths, stomachs, sensory organs, and organs of locomotion, we shall conclude that all the possible combinations of these will produce the kinds (*eide*) of animals. ... It is the same with the constitutions mentioned (*Pol* IV.4, 1290b25ff, Barker with modifications).

Enumerating eight necessary functions of the state, he argues that the varieties of oligarchies and democracies depend upon the ways that these functions are performed. Democratic governments are related in an evolutionary series, each causally related to the next (IV.6). Then a scale of value is introduced, with the *politeia* at the top, and completed with the claim that all other forms of government are 'perversions' by comparison (IV.8).

So much for a brief reminder of the taxonomic argument of *Pol* IV.4; in fact, the analogy of state and animal is one which carries forward much of the argument in the entire work, as a comparable analogy gave shape to Plato's *Republic*.

It would be futile to point out the many passages which cite continuities, *contra* Noah's Ark Essentialism, in the *Politics*. One of many such passages tells us that "in many states the constitution established by law, although not democratic, owing to the education and habits of the people may be administered democratically, and conversely in other states the established constitution may incline to democracy, but may be administered in an oligarchical spirit" (IV.5, 1292b12, Jowett). Given the manner in which historical continuities between different forms of government occur, one would be rather surprised if clear lines of demarcation could be made (cf. V.1, 1301b13).

If we apply genetic and phenetic standards to Aristotle's taxonomy of states, we learn very quickly that neither fits precisely, both are suggestive but both inadequate. In fact Aristotle expressly claims that his taxonomy is *functional* in character, and he is quite willing to accept the idea that various forms of states arise according to the conditions, that one kind of state may be more advantageous under one set of conditions, another under another: "democracy may meet the needs of some better than oligarchy, and conversely" (IV.2, 1289b19). Similarly, barbarians tend to have rather despotic kings, because of their servile characters (III.14, 1285a18), while "the people who are suited for constitutional freedom are those among whom there naturally exists a warlike multitude able to rule and to obey in turn by a law which gives offices to the well-to-do according to their desert" (III.17, 1288a12, Jowett). The functional parameters include not only the character of the people, but also the character of the territory, and the character of surrounding countries (II.6, 1265a19). In other words, the character of the state is determined at least in part by the proximate matter (citizens) and ecological niche which it occupies.

In dealing with political realities, Aristotle has much less motivation to suppose that each *eidos* is everlasting than he had in the biological books. Some constitutions seem to be fairly permanent, but others are obviously subject to destruction and revolution (see *Pol* V). We have historical evidence which

tends to support some hypotheses concerning *regular* ways in which one sort of system or organization may turn into (or be turned into) another. Socrates in the *Republic* (VIII) had already developed an evolutionary theory of this kind; Aristotle attempts to extend and improve upon that theory. Just because political organizations are unstable, Aristotle is all the less tempted to suppose that a particular *eidos* of state is unified by its geneological history. To be sure, an individual state is unified by its genetic history, at least in part; indeed, the racial unity seems more permanent than the *eidos* of the government: "Shall we say that while the race of inhabitants and their place of abode remain the same, the city is also the same? ... Since the state is a partnership, of citizens in a constitution, when the form of the government changes, then it may be supposed that the state is no longer the same, just as the tragic differs from the comic chorus, although the members may be identical" (III.3, 1276a35, Jowett with modifications). This difference between states and individuals points up a limitation on the organic theory of the state, the analogy between individual states and individual persons so strongly presented in III.4: if the form of government is comparable to the soul, then a revolution would be like a death, but revolutions occur with less damage to the component parts of the state than deaths do to the organs of the body. A state may change its system of government with considerably more ease than the leopard its spots.

A different, and more accurate, form of genetic continuity in the *eidos* of government is that which occurs when a state endeavors to establish its own form of government in its neighbors; Aristotle notes that Athens tried to establish democracies, Sparta oligarchies, during the time of their conflict (IV.11, 1296a32; V.7, 1307b21). But although Aristotle notices this formal and efficient cause, working from outside on an appropriate matter, he does not claim an analogy with the male principle imposing an *eidos* on the female principle. The failure to do so may well be significant; we tend to think of species as continuities carried in the act of procreation, and passages which we noted in *GA* show that that idea is not foreign to Aristotle either. However, once we accept the idea of the state as an organism, we easily think of the imposition of a form of government by some foreign power as analogous to Aristotle's description of the action of the male on the female; the procreational model must not be very important in Aristotle's own eyes, since he does not appeal to it in his discussion of the forms of the state, even though he is well aware of possible examples.

If we base a decision upon a contrast between genetic and phenetic taxonomies, we will come to the conclusion that Aristotle's taxonomy of systems of government is much more nearly based upon phenotype, upon the apparent structure of the state. As is well known, Aristotle supervised the description of 158 different constitutions, of which the *Athenaion Politeia* is the sole surviving example. These descriptions, or some of them at least, were surely a basis of his mature taxonomy of states.³⁹ The other basis is the *a priori* schemes of Plato's *Republic* and other utopian theorists, outlined in some detail in *Pol* II.1-8. His thought-process seems to have been one of starting from a schema of the various types of states, then adjusting it to the observed facts. He clearly believed that the standard accounts of the various types of states were ultimately inadequate to the phenomena, that there are more kinds of states than commonly supposed, "for democracy, like other constitutions, has more than one form" (IV.13, 1297b29). Clearly too, he considers previous attempts to classify states as inadequate largely because they have emphasized just one criterion (or one criterion at a time). Some have distinguished states simply on the basis of

how many people share in its affairs; Aristotle is rather scornful, saying that on that basis, "a government in which the offices were given according to stature, as is said to be the case in Ethiopia, or according to beauty, would be an oligarchy, for the number of tall or good-looking men is small" (IV.4, 1290a4). Just as he emphasizes the simultaneous application of several criteria in *PA* I.3, so he appeals to the same principle in *Pol* IV.4.

Also as in the biological works, Aristotle's principle of selection of classificatory criteria is functional; that is why height or beauty of rulers are only curiosities, but the wealth and talent of rulers tend to determine the kind of state in which they rule.

The three scales of normative determination distinguished earlier, the scale of conditional necessity, the scale of class extension, and the scale of nature or relative value, may also be discovered in the *Politics*. There are clear similarities between states and animals in respect of the degrees of conditional necessity and of relative value, and very possibly one might also find an analogy of the genus/species series applicable in the political context.

Governments, like animals, are defined by their organs and functions, the ways in which their conditionally necessary activities are performed. On the basis of the analogy posited in *Pol* IV.4, Aristotle argues for a scale of value of governmental functions like that which he finds in animals, putting the production of food, a *sine qua non* function, at the bottom of the scale, and those functions which are 'for the better' at the top: "As the soul may be said to be more a part of the animal than the body, so the higher parts of states than those ministering to the necessary functions" (IV.4, 1291a24). The military, judicial, and administrative functions are both more important and more definitive of the state than the productive and distributive functions. In other words, we do not classify states by their mode of food production--some states live on agriculture, some herd cattle, some rely on hunting or fishing, but although these occupations have some influence on the kind of state which depends on them for its life, yet Aristotle (and we) do not use them as the critical factor for classification; rather Aristotle concentrates on the deliberative, executive, and judicial powers (IV.4, 1297b40)--who may exercise them, how much involvement each class of citizen has with each of these functions.

Aristotle's scale of value comes to us in at least two forms: in the one, there are three valid forms of government and three perversions; in the other, the best form of government is the *politeia*, and all other forms are ordered in a series of decreasing worth. The second arrangement more nearly resembles the scale of the animal kingdom in *HA* VIII.1 and *PA* IV.5. "They all fall short of the most perfect form of government, and so they are reckoned among perversions, and the really perverted forms are perversions of these" (IV.8, 1293b25, Jowett). So in VII, Aristotle begins over again, from the top (so to speak), describing the best state, and presuming that the examination of the functional parts of the best state will reveal the model to which *all* states may be compared. Again, Aristotle's normative method seems to us a good deal more plausible when applied to the political context that it does in biology; although everyone will agree that the system of government must be adapted to the education, culture, climate, topography, and international relations of the state, nevertheless most people believe that some forms of government are better than others, for roughly the sort of reason which Aristotle gives in *Pol* VII--the citizens are happier

in one sort of state than they are in another, one form of government carries out the superior functions of states more satisfactorily than another. For Aristotle, it was just as obvious that eagles are superior to jellyfish as it was that the rule of law is better than the rule of men. While some social scientists may pretend not to make evaluative judgements of this kind, true objectivity (or relativism) is probably rare; biologists are more likely to take each species for what it is, and if they make any assertions about value, may want to claim that all life is intrinsically valuable. In any case, Aristotle finds a continuum of value in his comparison of the various forms of government which he himself finds analogous to the continuum of value derived from a comparison of the forms of life. This way of thinking unifies Aristotle's theoretical investigations; states and animals are categorized as 'defective' in comparison with the best state or animal, and the ordering of degrees of defect defines the nature of each.

The scale of generality would be discerned in the definition of states by discovering cases in which Aristotle claims that some state has some particular feature because it is typical of the *eidos* of this state, although in the given instance this feature is either of no particular advantage, or is actually disadvantageous. We can easily find passages in which Aristotle says that some given state has a disadvantageous feature because that is one of the defects of this kind of state; oligarchies, for example, are composed of men accustomed to command slaves, and they tend to work to their own disadvantage in their treatment of free citizens in a high-handed manner (1280a, 1305b, *et al.*), but that sort of thing can be ascribed to the scale of value. We can also find passages in which certain constitutions are said to share in two different kinds of government, in some cases to some relative disadvantage; the discussion of the Ephorate in Sparta is like that: "It is a defect of this institution that it is so important, and so much in the nature of a dictatorship, that even the kings have been compelled to court the favor of the Ephors. The result has been that ... the whole constitution has suffered from their overgrown power, and from being an aristocracy, it has tended to turn into a democracy. But it must be admitted that the Ephorate is a force which holds the constitution together" (II.6, 1270b7ff, Barker). One might say that Sparta "dualizes" in this respect. The account of the government of Crete is comparable: the Cosmoi have the power and some of the defects of the Spartan Ephors, remedied by a method typical of a "dynastic" state rather than a constitution; confederacies are formed to put bothersome Cosmoi out of office by force. This has the effect of a period anarchy; "for a time it is no longer a *polis*, but political society is dissolved" (II.7, 1272b10-16). These 'second best' methods used to remedy defects in some systems of government may remind us of the alternative means which some animals have for remedying theirs, like the elephant's nose. In the biological works, such instances were regarded as indications of the membership in a class, and may be so here too.

No doubt more might be said about the ways in which the normative scales apply to the definitions of states in the *Politics*; my objective here has been only to suggest several parallels which can be illuminated by a consideration of Aristotle's biological method, and to suggest the application of the normative aspects of this method to Aristotle's objectives in the biological books. Clearly he believed in a systematic continuity between biological and social levels of complexity, and also believed that normative parameters are applicable in comparable ways, to the extent that analogies and continuities exist. This is one of the ways in which Aristotle contributed to the mode of investigation which we now call "systems theory".

1. M. Grene, "Aristotle and Modern Biology," Journal of the History of Ideas 33 (1972), reprinted in The Understanding of Nature, and "Is Genus to Species as Matter to Form? Aristotle and Taxonomy," The Understanding of Nature Chapter VI; D. Balme, "Genos and Eidos in Aristotle's Biology," Classical Quarterly 12 (1962) 81-98; "Aristotle's Use of Differentiae in Zoology," Articles on Aristotle I: Science, ed. Barnes, Schofield and Sorabji; "Form and Species in Aristotle's Biology," paper presented at the 1976 Princeton conference on Aristotle; see also A. C. Lloyd, Phronesis 7 (1962) 67-90; G. E. R. Lloyd, Phronesis 6 (1961) 59-81; Montgomery Furth, paper presented to SAGP 1975.

2. Hilary Putnam, "Is Semantics Possible?" and W. V. Quine, "Natural Kinds," in S. P. Schwartz, Naming, Necessity, and Natural Kinds, 1977.

3. Morton Beckner, The Biological Way of Thought, ch. 4, citing the work of A. C. Kinsey with wasps; my discussion of contemporary taxonomy follows G. G. Simpson, Principles of Animal Taxonomy, NY 1961 (Columbia UP), Ernst Mayr, Principles of Systematic Zoology, NY 1969 (McGraw Hill), and R. A. Crowson, Classification and Biology, NY 1970 (Atherton).

4. Cf. R. R. Sokal and P. A. Sneath, Principles of Numerical Taxonomy, San Francisco 1963.

5. Michael Ruse, The Philosophy of Biology, 1973, ch. 7 and 8, compares the genetic and phenetic approaches to taxonomy, and I rely partially on his analysis; see also Grene, Understanding of Nature, p. 99; G. G. Simpson, Ernst Mayr, and R. A. Crowson, opera citata.

6. A less contentious name would be "museum" essentialism, see Crowson pp. 281 ff, but not all museum systematists are essentialists in the requisite sense. It should be noted that I am not attempting to discuss Aristotelian essentialism in the sense distinguished by, for example, Nicholas P. White, "Origins of Aristotle's Essentialism," Review of Metaphysics 26 (1972/3) 57-85. There is a sense in which the present essay *fills in* many of White's comments, and perhaps makes the difference between Aristotle and formalistic philosophy more obviously clear.

7. PA IV.5, 681a12-15: ἡ γὰρ φύσις μεταβαίνει συνεχῶς ἀπὸ τῶν ἀψύχων εἰς τὰ ζῷα διὰ τῶν ζώντων μὲν οὐκ ὄντων δὲ ζῶων, οὕτως ὥστε δοκεῖν πάντων μικρὸν διαφέρειν θατέρου θάτερον τῷ συνεγγυῶς ἀλλήλοις. Cf. HA VIII.1, 588b4-17; in PA II.9, 655a17, the continuum of the skeletal structures of chordata is described, παραλλάται κατὰ μικρὸν ἡ φύσις; cf. GA II.1, 733a34; 3, 736b32.

8. Aristotle, History of Animals, Loeb ed., Peck Introduction to Vol. I, p. lxiii.

9. PA IV.5, 681b36ff: ἄς δὲ καλοῦσιν οἱ μὲν κνίδας οἱ δ' ἀκαλήφας, ἔστι μὲν οὐκ ὀστρακόδερμα, ἀλλ' ἔξω πίπτει τῶν διηρημένων γενῶν, ἐπαμφοτερίζει· δὲ τοῦτο καὶ φυτῶ καὶ ζῶῃ τὴν φύσιν. "The so-called Cnides or Akalephae are not testacea, but fall outside the defined classes; it dualizes in nature both to plant and to animal."

10. *HA* II.1, 499b11, b21, cf. *HA* I.1, 488a1: some animals are gregarious, some solitary, some dualize; of dualizers in this respect, man is mentioned.

11. *HA* IV.4, 529b20ff.

12. *HA* II.8, 502a16; cf. *PA* IV.10, 689b32.

13. *PA* IV.13, 697a29.

14. 697b2, cf. *HA* VI.12, 566b27.

15. *GA* II.8, 747a25, b34, cf. I.20, 728b10. See also Richard Rorty, "Genus as Matter: A Reading of *Metaphysics Z-H*," in Lee, Mourelatos and Rorty, eds., *Exegesis and Argument*, *Phronesis* supplement 1, 1973, pp. 393-420. He jokingly calls this paper 'Two Concepts of Mules,' discussing the use of *genos* as applied to mules at 1033b-1034a2, pp. 412ff.

16. Balme's translation in the Clarendon Aristotle series, with minor changes; Peck's reading is idiosyncratic-- cf. Düring, *Aristoteles De partibus animalium*, Göteborg, 1943. The passage from which this quotation is taken is discussed below.

17. *GA* II.4, 738b27; 7, 746a29.

18. *GA* II.7, 746b8, cf. *HA* VIII.28, 606b17.

19. *GA* II.4, 738b32.

20. See my *Science and Philosophy in Aristotle's Biological Works*, Hildesheim 1975 (Olms), chapter 2, or *Journal of the History of Biology* 1970; Furth's 1975 SAGP essay, *et al.*

21. G. E. L. Owen, "Τιθέναι τὰ φαινόμενα," *Symposium Aristotelicum*, ed. S. Mansion, Louvain 1961, pp. 83-103.

22. *PA* I.3, 643b11, ὡς οἱ πολλοί, cf. I.4, 644b3; see Peck's introductions to the Loeb editions of the biological books; G. E. R. Lloyd, *Phronesis* 6 (1961) 59ff; Balme, *opera citata*.

23. *Phys* II.8, 198b35; *GC* II.6, 333b5; *Juv passim*; *GA* IV.8, 777a20; and especially *PA* III.2, 663b27: "One must investigate nature looking at many cases, for the nature is in the universal or in the majority" (ἐν τῷ παντί ἢ ὡς ἐπὶ πολὺ).

24. David Balme, *Aristotle's De Part. An. I and De Gen. An. I*, Oxford 1972, pp. 101-122, has the best discussion of this passage.

25. Cf. Balme, *CQ* 1962.

26. Balme (1972) pp. 108-110 makes a good case for claiming that Aristotle's practice does not really contradict his position taken against the dichotomists; *they* made privations into essential characteristics of species, while Aristotle believes that the essence of the bloodless animals includes whatever they have instead of blood, of footless animals whatever they have for locomotion instead of feet. Balme does suggest that blindness is a positive characteristic of the mole, referring to *de An* III.1, 425a11, but that is a mistake I think; the blindness of the mole is a 'deformity' which 'happens in the process of generation' (cf. *HA* I.9, 491b28; IV.8, 533a2). Aristotle makes a point of arguing that the mole does have eyes, which are an essential characteristic of the 'blooded' animals. A mole with unimpaired eyes would still be a mole, on Aristotle's showing and for the modern biologist-- for there are sighted moles too.

27. 643a8; a18: ἔσονται δ' αἱ διαφοραὶ ἴσαι τοῖς ἀτόμοις ζώοις ... ἀναγκαῖον ἴσας τὰς ἐσχάτας εἶναι διαφορὰς τοῖς ζώοις πᾶσι τοῖς ἀτόμοις τῷ εἶδει.

28. Cf. *Metaphysics* Z.11, where it is suggested that a man could exist made of a different matter. If a machine were capable of doing everything which human beings now do, would that machine be human, on Aristotle's showing? It wouldn't be an *animal*, and thus not a member of the same *genos*, but Z.11 indicates the possibility of some vacillation on this point. The idea of humanoid automata was not foreign to Aristotle; Homer (*Iliad* XVIII.368ff) writes of 'golden maidens' of Hephaestus who "looked like real girls and could not only speak and use their limbs, but were endowed with intelligence and trained in handiwork by the immortal gods." Plato mentions the statues of Daedalus, reputed to be so lifelike that that might run away (*Euthyphro* 11b, *Meno* 97d); Aristotle uses the existent automata of his own day to explain animal movement (*Movement of Animals* 7, 710b2-10) and animal generation (*GA* II.1, 734b11-13, and my *Science and Philosophy* (1975) p. 291).

29. Sokal and Sneath, p. 96.

30. For details, see Peck's introductions to *HA* and *PA*.

31. For a discussion of conditional necessity in *PA* I.1, see my "Aristotle's Natural Necessity," *Studi Internazionali di Filosofia* I (1969) 91-100, and *Science and Philosophy in Aristotle's Biological Works*, 183-200. Aristotle's account of conditional necessity and teleological explanation are well-known, particularly his often repeated line, "nature does nothing in vain, but is always the cause of the better of the possibles" (*PA* II.14, 658a8; *IA* 8, 708a10; *GA* II.5, 741b4; II.4, 739b19; *PA* IV.11, 691b4; 12, 694a15; III.1, 661b24; IV.13, 695b19, etc.; cf. *Science and Philosophy* 223-248.

32. See *Science and Philosophy* 153ff.

33. The two extended discussions of pleasure in *EN* have been examined recently by several scholars: among the more useful articles are G. E. L. Owen, "Aristotelian Pleasures," *Proceedings of the Aristotelian Society* 1971/2, 135-152, with reply by J. C. B. Gosling, "More Aristotelian Pleasures," *PAS* 1973, pp. 15-34, and Amelia Oksenberg Rorty, "The Place of Pleasure in Aristotle's Ethics," *Mind* 83 (1974) 481-497. Ms Rorty's paper puts most emphasis upon what I call the taxonomy of pleasures.

34. Given the discrepancies between VII and X, I prefer to stick with the one passage for my present purpose, rather than to try to synthesize theories which seem to have been developed with different goals in mind.

35. *Bios theoretikos*, see Trond Berg Eriksen, *Bios Theoretikos*, Oslo: Universitetsforlaget 1976, 56ff, 96ff.

36. John Cooper, *Reason and Human Good in Aristotle*, 1975, ch. III, 144ff, argues that the intellectualism of *EN* is more extreme than the theory of the best life in *EE*; it may also be that Aristotle gives more credit to variations among kinds of men in *EE*, allowing for alternative truly human lives.

37. Other relevant studies include W. Jaeger, "Aristotle's Use of Medicine as a Model of Method in his Ethics," *Journal of Hellenic Studies* 77 (1957) 54-61; T. Tracy, *Physiological Theory and the Doctrine of the Mean in Plato and Aristotle*, Chicago 1969; G. E. R. Lloyd, "Aspects of the Relations between Medicine, Magic, and Philosophy in Ancient Greece," *Apeiron* 1975, 1-16.

38. *Pol* III.1, 1274b33: τῷ περὶ πολιτείας ἐπισκοποῦνται, καὶ τίς ἐκάστη καὶ ποία τις, σχεδὸν πρώτη σκέψις περὶ πόλεως ἰδεῖν, τί ποτ' ἐστὶν ἡ πόλις.

39. See W. Jaeger, *Aristotle*, ch. X and XIII. Jaeger is right in supposing that the extensive empirical investigation of large numbers of constitutions dates from the last period of Aristotle's life; unlike Jaeger, I believe that the *History* and *Parts of Animals* were mainly completed in the middle period, providing a kind of model for the political investigations.

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