

RESEARCH

Definition and the Epistemology of Natural Kinds in Aristotle

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We have reason to think that a fundamental goal of natural science, on Aristotle's view, is to discover the essence-specifying definitions of natural kinds—with biological species as perhaps the most obvious case. However, we have in the end precious little evidence regarding what an Aristotelian definition of the form of a natural kind would look like, and so Aristotle's view remains especially obscure precisely where it seems to be most applicable. I argue that if we can get a better understanding of how the forms of natural kinds are or come to be known, and how they make things intelligible, we can get a better appreciation of the nature of form in general, as well as solve certain puzzles about form and definition.

Keywords: Aristotle; definition; hylomorphism; essentialism; natural kinds

§ 1. The Epistemology of Form and a Puzzle About Definition

The resurgence in interest in Aristotelian hylomorphism among both scholars and philosophers has yielded a variety of questions and puzzles about Aristotle's own position, as well as concerns about how hylomorphism in general ought to be developed. The questions about Aristotle's position are not just matters of detail either: they arise from some of his most well-known and foundational commitments regarding form, essence, and definition. He claims, in particular, that forms are the essences of natural beings,¹ that essences are the objects of definition,² and that definition is a fundamental goal of scientific knowledge or understanding (*epistēmē*).³ There is also good reason to think, further, that natural kinds, especially living beings and biological species, represent paradigm cases for Aristotle of substance and definable form.⁴

Broadly speaking, then, we have reason to think that a fundamental goal of natural science, on Aristotle's view, is to discover the essence-specifying definitions of natural kinds—with biological species as perhaps the most obvious case. However, we have in the end precious little evidence regarding what an Aristotelian definition of the form of a natural kind would look like, and so Aristotle's view remains especially obscure precisely where it seems to be most applicable.

In the various debates to which these questions have given rise, little explicit attention has been paid to epistemological questions about how we are supposed to come to grasp Aristotelian forms. This is surprising, since, for Aristotle, forms are what make nature and natural kinds intelligible, and so an understanding

¹ Canonically: *Physics* [*Phys.*] 194b26–29, *Metaphysics* [*Met.*] 1041b4–9, 1044a36.

² See *Posterior Analytics* [*Post. An.*] 90b30, 94a11, *Topics* [*Top.*] 101b39, *Met.* 1042a17–18.

³ *Post. An.* 74b5–12, 90a15, 31–34, B 8–10; *Phys.* 194b16–29, 198a14–35, 200a10–15; *Met.* 1031b6–7, 1039b31–1040a2.

⁴ See, e.g. *Phys.* 192b33–34, 200b3–5; *Met.* 1028b8–15, 1031a1–14, 1037a10–20, Z 12; *Parts of Animals* [*Part. An.*] 639a15–19; cf. *Met.* 1039a19–20. There are well-known questions and disputes about the relation between forms as they pertain to (biological) species and to the individual members of those species (for example, and perhaps most controversially, whether there are numerically distinct forms of individuals, or only forms of species). For purposes of this paper, I will remain neutral on such questions, under the supposition that questions about knowledge of species-level forms are directly relevant to Aristotle's hylomorphism, whether or not those species-forms are themselves components of individual hylomorphic compounds. Many modern versions of hylomorphism are framed quite explicitly in terms of a claim that individuals are compounds of (individual) form and matter (see, e.g. Koslicki 2008). With Aristotle's hylomorphism, especially in light of the complex argumentation in the *Metaphysics* concerning substance, form, universals, and related notions, we are not able simply to assume that this is his view.

of how natural kinds become intelligible would seem to be a likely window onto the nature of form itself. And while we have little direct evidence about how Aristotle would ultimately define a natural kind such as *elephant*, we have a good deal of evidence about how he conceived of epistemic progress in biology. I suggest, then, that if we can get a better understanding of how the forms or natural kinds are or come to be known, and how they make things intelligible, we can get a better appreciation of the nature of form as such.

Broadly speaking, according to Aristotle, scientific progress begins with a stage of gathering and sifting 'appearances' (*phainomena*), before advancing to a stage of causal explanation.⁵ Often, he describes our progress towards scientific knowledge as a move from what is 'better known to us' ('*gnôrimôteron hêmin*') to what is 'better known by nature' or 'better known full stop' (*gnôrimôteron phusei/haplôs*).⁶ With respect to the natural world, grasping the forms of natural kinds is evidently key to this progress.

There are, then, two relatively simple epistemological questions we may ask Aristotle about form: (1) A *Process* question: By what means do we come to know a natural kind's form or essence? (2) A *Progress* question: How does coming to know a natural kind's form in this way constitute moving from what is 'better known to us' (henceforth, more 'Familiar') to what is 'better known by nature' (henceforth, more 'Intelligible')?

The structure of the rest of this paper is as follows: I first briefly describe the relevant basic commitments of Aristotle's theory of scientific explanation, and the provisional answers they suggest for these two questions about natural kinds (§ 2.1). I then examine some of the difficulties we face in squaring these answers with certain key claims in the biological works, especially the *Historia Animalium*—in particular a problem about the unity of definitions, which has vexed recent commentators (§ 2.2). In § 3 I give an account of our epistemic starting points in understanding biological species, based on Aristotle's discussion in the *Hist. An.*, and develop a new puzzle that arises from trying to connect this account with Aristotle's claims about definitions. In § 4 I relate this puzzle to a problem in understanding Aristotle's more general commitments about formal and final causation, and suggest a way of solving it. I then argue that this solution in turn offers a satisfying response to the problem of the unity of definitions, and generates revised answers to the Process and Progress questions. At the same time, however, it puts pressure on some other elements of the basic theory of scientific explanation with which we began (§ 5).⁷

The solutions (and dissolutions) I offer are of course not the only ones available. I suggest, however, that they do have some advantages over other responses that have been offered, especially insofar as they allow the fundamentals of the basic picture of scientific understanding to remain more or less intact, while offering a more satisfying account of the relationship between empirical inquiry and Aristotle's more general theoretical commitments.

§ 2. Integration Problems: Scientific Knowledge in General and in Detail

§ 2.1 *Epistêmê* and its implications

Taken together, the discussions of causation and explanation in the *Physics*, *Posterior Analytics*, and the middle books of the *Metaphysics* suggest the following basic picture of hylomorphic explanation. Scientific knowledge requires grasping the essences of kinds, where essences are conceived of as explanatorily fundamental: the essence explains all or most of the rest of a kind's important properties.⁸ Knowledge of such essences is perhaps the core of a demonstrative science. In natural scientific inquiry, we are presented with observable individuals, whose features are available to perception; these individuals and properties are what is Familiar, and constitute what we may, following Sellars, call the manifest image. As it turns out, and as we learn in *Physics* I 7, these observable individuals are in fact hylomorphic compounds, such that, while no form is realized in nature without matter, form and matter are distinct. Further, the form has ontologi-

⁵ See, most prominently, *Phys.* I 1, *Pr. An.* 46a17–22, and *Post. An.* I 2. There is much discussion about whether and in what sense the *phainomena* in natural sciences are the same as those in other domains, and how they relate to reputable opinions (*endoxa*). The classic and most influential discussion of these matters is Owen (1961/1986).

⁶ See especially *Topics* VI 4, *Post. An.* I 2, 71b33–72a5, and *Met.* VII 3, 1029b3–9, as well as *Phys.* I 1, *De Anima* [*De An.*] II 2, 413a12; *Part. An.* I 1, 640a12–15. It is not certain how these two types of description (i.e. the language of beginning with *phainomena* and the language of beginning with what is 'better known to us') relate to one another, but they are clearly equivalent in at least some cases, though perhaps not all. In any case, they converge in the methodological remarks of the *Hist. An.* I 6, and *Part. An.* I 1, which suggest the two works belong together in ways adumbrated in the *Post. An.* (on this matter see especially Lennox 1991).

⁷ In this way we are indirectly testing the accounts given in Aristotle's more theoretical works against his biological works. The unity of his thought across all these treatises is the subject of ongoing investigation and dispute (see the beginning of the next section). For present purposes, I am presuming neither unity nor disunity, but rather that a good way to assess the unity question is to see what workable theories result from attempting to make good on the principal claims of the different treatises.

⁸ See especially *Post. An.* I 4 (esp. 73b16–18), B 2 (esp. 90a15) and B 8 (and cf. *Top.* 141a27–b2), as well as Charles (2000), ch. 8.5.

cal and explanatory priority over both the matter and the resultant compound. The form is the essence, according to *Met.* VII 17, and in seeking it we seek ‘the cause of the matter ... that by which it is some thing’ (1041b8).⁹ And this (i.e. form), he concludes famously, is substance. (1041b9) At the same time, form and matter are related as actuality and potentiality (*Met.* VIII 6), so that, to the extent that they are ontologically distinct, their distinction must be grasped intellectually or theoretically—they are not observed in their own right, at least not as such.

We can of course observe the bronze that composes a statue, but to observe bronze is to observe a hylomorphic compound as well, something made out of various quantities of the more basic elements.¹⁰ Form and matter are thus, strictly speaking, theoretical or intelligible entities—part of the scientific image—in contrast to the manifest, observable compound.¹¹

Thus, on this picture, a form is an intelligible essence, a theoretical entity not subject to observation in its own right, that explains the nature, properties, and unity of observable individuals that fall under natural kinds, the definition of which is a fundamental goal of natural science.¹²

The details of this overall picture of scientific understanding are of course important and disputed, and it may well be that parts of it cannot stand without serious revision. Nevertheless, it is worth starting with this series of commitments, since it is not clear which, if any, Aristotle would or must reject. Further, whereas previous generations of scholars tended to claim that in his biological works, Aristotle was ignoring or had even abandoned the theory of scientific demonstration and understanding he had developed in the *Posterior Analytics*, recent work tends to start with far more optimistic assumptions about the continued role of the *Posterior Analytics*’ ideal in the biology, and, more broadly, about the continuity and unity of Aristotle’s thought across his works in the foundations of natural science. Thus, recent commentators have tended to assume that the biological works present, perhaps at an incomplete stage, an inquiry aimed at finding definitions of natural kinds of the sort envisaged by the other works—though there are dissenting voices. And, as we shall see below, those optimistic assumptions in turn generate a puzzle about natural kinds and their definitions, one which has exercised recent commentators.¹³

Using the simple picture as a starting point, then, we may give a rough sketch of Aristotle’s answers to (1) and (2)—the Process and Progress questions—as follows:

- (1) Process: We come to know a thing’s form or essence by grasping or positing a theoretical entity, a form, distinct from the observable compound and its matter, such that the form is the cause of the unity and properties of the natural being.
- (2) Progress: By moving from the manifest domain of observable individuals to the theoretical domain of form and matter, we have moved from the confused but Familiar data of sense perception to the clear, Intelligible perspective of thought.

A corollary of these two answers is the familiar thought that epistemic progress—understanding form in this case—involves a shift in ontology: the manifest image is populated by observable individuals and perceptible properties, which are often subject to change; the scientific image is populated by form, matter, and causal relations which are largely stable. That is, the observable processes of growth and change in an organism are explained, in part but most properly speaking, as caused by the enduring formal nature—i.e. the essence—of the organism in question, the stability of which is key for its being scientifically intelligible at all.

A further feature of the simple picture, which Aristotle affirms, is that the axes of Familiarity/Intelligibility and perceptibility/imperceptibility line up with each other.¹⁴ As he puts it in the *Posterior Analytics*: ‘I mean by “prior and more familiar to us,” on the one hand, those things that are closer to perception, whereas

⁹ ‘to aition zêteitai tês hulês (toute d’esti to eidos) hôi ti estin.’ See especially 1041a33–1041b10 for these claims. One of the interpretive difficulties of book VII is to understand just what it means for the form to be that by which the matter is some thing (*tî*), since Aristotle does not specify whether he has in mind proximate or non-proximate matter, or whether being ‘some thing’ indicates bearing a predicate, or something else, such as being an object at all. I thank an anonymous referee for this journal for bringing this to my attention.

¹⁰ As he points out, ‘Matter is among the relative things; for there is different matter for different form.’ (194b9).

¹¹ For the purposes of this paper, I am using ‘theoretical’ in a broad sense, mainly as a contrast with perceptible entities, since it is unclear quite what that contrast is for Aristotle, but clear that he has some such contrast in mind. So while there are more precise ways of understanding what a theoretical entity is, these are not intended.

¹² For the explanatory priority of essence, see also *Post. An.* I 6, II 19.

¹³ Thanks to Jessica Gelber and Charlotte Witt for discussion on this point.

¹⁴ Cf. *Topics* VI 4, 141b13. Interestingly and perhaps significantly, a similar passage about the advance from the Familiar to the Intelligible in *Met.* Z 3 does *not* align or elucidate the distinction in terms of what is nearer or farther from perception (1029b3–9).

[I mean by] “prior and familiar *simpliciter*” those things that are further away [from perception].’ (72a1–3).¹⁵ As we move towards greater intelligibility, then, we move away from what may be given in perception. It is not clear on this picture, however, whether we should take the poles of these axes as strict contraries or not. One might think, that is, that what is ‘furthest from perception’ is simply not perceptible as such, and so, like the perceptible and non-perceptible, what is most familiar and what is most intelligible are extensionally disjoint. Alternatively, we might think that what is ‘farthest from perception’ is minimally or only confusedly perceptible, and so likewise what is familiar and what is intelligible need not be disjoint.¹⁶ The difference between these two options will be of significance below.¹⁷

§ 2.2 Difficulties with the basic picture

In any case, it is difficult to see how this account of hylomorphic explanation can work when it comes to Aristotle’s treatments of his paradigm cases of natural substance, the living beings he describes and explains in his biological works. Indeed, it has seemed to many commentators—even those who remain optimistic about the unity of Aristotle’s thought across the scientific works—that, when it came to the science of living beings, Aristotle must have either partly changed his mind about knowledge and scientific explanation in general, or somehow failed to square his general theory with his biological practice, despite the latter’s prominence in the corpus and the methodological self-awareness with which he approaches it.

It has been pointed out, for example, that the simple explanatory model, according to which the goal of scientific definition is to capture the explanatorily basic essence of a kind, is most at home in the sciences and examples treated in the *Posterior Analytics*, where geometry is the reigning paradigm. In such cases, it seems plausible that we can give a definition (e.g. of triangle) by marking it off as a species from the genus *figure*, in terms of a single property or differentia, which is identified with the essence. Aristotle’s preferred method of division in biology, on the other hand, proceeds by dividing along several tracks at once—such as means of movement, reproduction, and so on—yielding multiple differentiae for a given species, nor does any one differentia appear to have ultimate explanatory priority.¹⁸ If a definition names a kind’s genus and differentiae, but natural kinds are in fact defined by many co-ordinate differentiae arrived at by multiple lines of division, it is difficult to see how Aristotle can maintain the view that there is a single, property-like form corresponding to a thing’s essence-specifying definition. A definition would look, rather, like a list of descriptive terms, none of which could claim explanatory priority over the others or over the organism as a whole. This has been called the problem of ‘horizontal unity.’¹⁹

Further, explanation in Aristotle’s biological works is far more complicated than the simple picture suggests. One important aspect of this complexity is that biological explanation functions at various levels of generality simultaneously: many of an animal’s features will be explained by generic properties, while others will be explained by features peculiar to the species. For instance, all animals with lungs have them for the same reason, namely cooling the body, and so there would seem to be no reason peculiar to simians that explains why *they* have lungs.²⁰ There are also important distinctions of type among explanations in Aristotle’s biology. While having lungs may in some sense be formally caused, there are further causal consequences of having lungs, some of which are again not peculiar to individual species, but some of which are: all animals with lungs require an esophagus, since the stomach must be placed beyond them, whereas the size of the lungs will depend on other factors peculiar to the species.²¹ Thus, understanding any of the features that are supposed to be peculiar to an animal species will likely involve a number of contributing

¹⁵ Translations are mine unless otherwise noted.

¹⁶ At *Met.* VII 3, 1029b8–12, Aristotle describes our progress as being from what is only ‘slightly’ (*êrema*) and ‘poorly’ (*phaulôs*) knowable and has ‘little or nothing of being’ to what is knowable universally. Our starting points are thus described not as unintelligible, but rather minimally so.

¹⁷ The same passage cited above continues by asserting that the universal is furthest away from perception, while particulars are closest (*Post. An.* 72a4–5). It is unclear whether this is a gloss on the previous claim or a further assertion; either way, it appears to endorse the idea that moving from the Familiar to the Intelligible involves an ontological shift. To some extent, though, since it is also unclear quite what Aristotle means by saying we move from particulars to universals—the passages involved are some of the most notoriously obscure—these statements simply add to the problem of clarifying the nature of epistemic progress on Aristotle’s account.

¹⁸ See especially *Part. An.* I 2–3, and Balme (1987), and contrast *Met.* VII 1038a19–20.

¹⁹ It is called horizontal in contrast to the vertical problem discussed in *Met.* VII 12, mentioned below. See Gotthelf (1999, 47–8), Lennox (2001, 166).

²⁰ See *Part. An.* 668b33–669a6. By contrast, a certain kind of octopus is said to have only one row of suckers rather than two because of its peculiar size and shape, slimmer than the norm (685b13–16).

²¹ *Part. An.* 664a20–30. Consider also the triple explanation of why kidneys are fatty at 672a1–22: by causal necessity, since the waste products filter through them (672a2–3); for the sake of their safety and heat retention (672a15–16); and because being fatty aids in secretion and concoction (672a20–21).

factors at different levels of generality and of different causal profiles. This is a long way from the paradigm example from the *Posterior Analytics*, of explaining the fact that all triangles follow the 2R rule in virtue of what it is to be a triangle.

Indeed, Gotthelf (1997) illustrates just how difficult it is to get a grip on which features will be explanatorily basic to a kind, and which will be part of a species's *ousia*. (The elephant's peculiar 'nose' is teleologically explained, and so clearly in that sense non-basic; thus, perhaps surprisingly, not in the *ousia*.) After close analysis of Aristotle's discussion of elephants, Gotthelf suggests that their *ousia* contains features like: eating in water, being hot enough to require a cooling organ, being a land-dweller, and being large.²² All of these features jointly contribute to an explanation of the size, shape, material etc. of the trunk. Part of the trouble is that these essential features sound like a disconnected mix of relatively general (e.g. its bodily heat, being a land-dweller) and relatively specific features (e.g. its size, the height of the water in which it tends to eat). If the goal of the biologist is to find teleologically basic features, but these basic features are not all specific to the kind, it is again difficult to see what use biology will have for a single, explanatory essence for each distinct natural kind.²³

Finally, Aristotle claims that forms themselves have parts (*Met.* VII 10–11). He says very little about the parts of forms of natural kinds, however, and so disputes have arisen not only about what those parts might be but even about whether they in fact include matter of some sort.²⁴ Indeed, there are almost no sketches of what a possible definition of a biological species would look like, other than some toy examples (e.g. two-footed animal, *Met.* VII 12, 1037b12–13) or schemata of uncertain dialectical status ('this in this,' *Met.* VII 11, 1036b23–4). In addition, since Aristotle thinks that human beings are, as far as we know, *sui generis*, even these sketchy remarks may be misleading when it comes to natural kinds in general, many of which fall into wider genera (such as birds). This lack of attention to what would seem to be of paramount importance may justifiably make us wonder whether the simple picture overstates the importance of definitions.

In sum: though Aristotle is committed to the idea that natural kinds have explanatory essences, we have very little idea as to what is strictly-speaking included in those essences, what is excluded, and of what a good definition of a natural kind might look like on his account. We have further reason to believe that some of his commitments are in tension with each other.

Indeed, given all these difficulties, some commentators have suggested that the basic picture needs radical revision, and that Aristotle may not, despite appearances, think that the definitions of natural kinds is a fundamental goal of natural science. Pellegrin (1990) argues, controversially but not groundlessly, that the primary unit of study for Aristotle's biology is in fact the parts of animals, rather than animal species, while Balme (1990) tentatively suggests that 'definition and its associated logical apparatus [sc. division] became as irrelevant to Aristotle as it has done to modern philosophers of nature' (54).²⁵ Charles (2000), somewhat less radically, suggests that Aristotle's study of biology precipitated a crisis in his earlier account of explanation, one which required abandoning some of its main criteria for a good explanation (336).²⁶

It may be that these and connected difficulties all have a satisfactory solution (or dissolution), or that Aristotle indeed changes his mind on some of the issues from which they arise. Even if they are only apparent problems, however, they give a fair picture of the problems faced by commentators looking for a consistent and coherent account of scientific progress in the Aristotelian corpus.

§ 3. Progress in Biology

To make some progress on these questions, we may note that while Aristotle says very little about the definition of natural kinds, his biological works are explicitly structured with reference to the epistemic progression from Familiar to Intelligible, beginning with the observational *History of Animals* and proceeding to

²² Gotthelf is not certain how many features should be thought of as in the elephant's 'essential nature' here; see especially 86–89. Charles (2000) agrees with the fundamentals at least of Gotthelf's analysis (336).

²³ That is, an explanation of a feature that is peculiar to the kind (but non-basic) will again flow from the complex interaction between features that are peculiar and basic, and features that are basic but not peculiar—there is no explanatory core of features that are both peculiar and basic.

²⁴ Among recent commentators, those who maintain that definitions of living beings must mention matter include Whiting (1991), Devereux (2011), and Peramatzis (2011). Their opponents include Frede and Patzig (1988), Gill (1991), Heinaman (1997), Code (2011), and Malink (2013).

²⁵ See also Lennox (1990) for doubts about the importance of definition in the *Hist. An.* (183).

²⁶ There are further difficulties one might raise about the commitments of the simple picture, independently of its adequacy for Aristotle's purposes in biology. For example, his remarks about moving from the Familiar to the Intelligible, and from the perceptible to the intelligible, must somehow be squared with two sets of remarks which are already difficult to square with each other: his remarks about scientific progress as a kind of induction, in which we move from particulars to universals, in the *Post. An.* II 19 and *Met.* I 1, and his remarks in *Physics* I 1 to the effect that we begin from a sort of universal and advance to particulars (184a16–b14).

the causal analyses of the *Parts of Animals* [*Part. An.*]. We can thus reconstruct a fairly detailed picture of the manifest image relevant to the study of biological species, and how we progress towards scientific understanding of them. In his exposition of that progress, Aristotle makes some key commitments which in turn have surprising results for our understanding of form, essence, and definition.

§ 3.1 Starting points and how they are established

The stated goal of the *Hist. An.* is to help us understand the various differentiae (*diaphoras*) and properties (*sumbebêkota*) of animals as a methodological preliminary to the explanatory stage: 'And after this we must try to discover causes. For this is to investigate in the natural way, beginning with the observational account (*historia*) of each [species]; for from these [sc. observational accounts], both those things about which and those from which the demonstration must be will become clear.' (491a10–14).²⁷ The *Hist. An.* thus presents itself as a survey of the *phainomena* from which we should begin our search for demonstrative explanations in the domain of living things, such that, at this stage, it is not yet clear what we should demonstrate or prove, nor what the bases of those demonstrations will be.²⁸

Aristotle then presents a general investigation of the differentia of animals, which fall into four categories: their parts (*moria*), mode of life (*bios*), habits (*êthê*), and actions (*praxeis*) (487a11). In general, then, we should expect the *phainomena* with respect to a given kind to include elements from these four classes. Aristotle's discussion is very detailed, but we can discern broad features of these categories of differentiae, and how they inter-relate.

First, it is clear that the category of parts (*merê*) has a special status: 'for with respect to these the wholes differ most of all and primarily (*malista kai prôta*, 491a14–16), either by some having and others lacking them, or in their position and arrangement, or also with respect to the differentiae spoken of before, in form and excess and analogy and by contrariety of attributes (*pathêmatôn*)' (HA 491a15–19). Thus, in giving a description of the differences among animal species, differences in parts apparently have a certain kind of priority, according to which differences in the animal as a whole—whatever that means—are determined by differences in the parts.

Aristotle then makes a further move in orienting the discussion of the observable features of animals: we should start our investigation with man, since 'man is necessarily, among animals, the most familiar to us (*gnôrimôtaton hêmin*)' (491a22–3). Further, the parts of human beings are 'not unclear' (*ouk adêla*) to perception (491a23). Indeed, Aristotle seems to think the parts of human beings are so easily graspable that the main reason to go through them is not to present any new information, but rather to observe the correct method and sequence: 'However, for the sake of not omitting anything in the sequence and of having an account along with perception, we must first state the organic (*organikon*) parts, and then the uniform (*homoimerê*) ones.' (491a24–26). In other words, the task is a bit laborious, but we should go through the parts of human beings since doing so—in the right sequence—will provide a clear example of the right methods in general, and observation will in many other cases be more difficult.²⁹

This passage raises a second important feature of the differentiae: Aristotle counts both the organic parts and the uniform ones as evident to perception. Indeed, insofar as we are to start with the organic parts, these would appear to be, strictly speaking, more observable than the uniform ones. This is in fact a plausible claim: limbs and sense organs are easier to observe than blood or tissue. More importantly, perhaps, organic parts are normally conceived of as functionally individuated: to be an organic part is to be in some way an instrument of the animal in the execution of its life-functions.³⁰ If the organic parts as such are nonetheless among the observable phenomena, available to perception as we catalogue what is familiar to us, this suggests that observation of parts involves observing at least their behavior and use, not merely their physical appearance.³¹ This is borne out in the *Hist. An.* in general. While there is of course much description of size,

²⁷ Thus, there is a stage in the progress from the appearances during which we do not know which facts are causally explicable.

²⁸ Nonetheless, as Balme and Lennox have shown, the *Hist. An.* is not simply a record of raw data: the facts presented appear to be organized with a view to the eventual causal explanations given in other works, especially the *Part. An.* Indeed, Lennox (1996) gives a qualified endorsement of Balme's hypothesis that the *Hist. An.* was written *after* the explanatory works, especially the *Part. An.*, which are methodologically posterior.

²⁹ Similarly for questions of orientation and relative position: see *Hist. An.* I 15, 494a19–494a26.

³⁰ See esp. *Part. An.* 645b14–17, and cf. *De An.* 412b10–22.

³¹ See the discussion of the various sense organs from I 9–12. He also appears to judge whether an animal has a given part by way of functional considerations: e.g. the mole does not have eyes strictly speaking, since it cannot see, even though it has eye-shaped parts beneath the skin where eyes would be expected in a mammal (491b26–491b33). See also, for example, the description of the elephant's 'nose,' as at 497b23–30. Indeed, the very idea of identifying analogous parts across species in different genera, an important feature in Aristotle's biology, requires a functional grasp of the parts.

placement, shape, and so on, Aristotle regularly adverts to function, and organizes his discussion of parts along functional lines. This suggests that proper observation and differentiation of parts requires observing their use.

Finally, Aristotle is committed to a striking view about the parts of animal species that fall under broader genera, such as birds and fish.³² He is explicit that the differentiae that mark individual, ultimate species off from their common genus and from one another are differences of degree only—beak length, softness or toughness of flesh, color, and so on.³³ This means that for such species, the physical features that distinguish them from others in the same genus—and hence, we might suppose, are essential—will not be parts considered generically, such as having two feet or even two feet split into four talons. Rather, the differentiae that characterize a so-called *infima species* of this sort will be a series of determinate differences of degree with respect to such features: having four talons of such-and-such approximate length and curvature, along with a tail of a certain length and plumage of a certain color, for example. Thus, for these species, the *only* differences in parts which mark them off as distinct species will be differences among observable properties that vary along a continuum such as size, texture, and color.³⁴

The three other categories of differentiae—way of life (*bios*), habits (*êthê*), and actions (*praxeis*)—interact in complex ways. Aristotle understandably has a difficult time maintaining a strict separation between the three categories, which are not themselves individual characteristics but rather groupings of characteristics: carnivorous/herbivorous/etc.; migratory/sedentary/etc.; hibernating/non-hibernating; living in groups/solitary; bold/fearful/etc.; natural enmities or friendships with other species, and so on. Broadly speaking, habits or character tends to involve personality characteristics (meekness, aggressivity); actions tend to involve things like ways of mating and modes of attack or defense; and way of life tends especially to involve habitat, diet, and the means by which an animal seeks food. In the *Hist. An.*, however, these features influence each other and seem not to be strictly separated.³⁵ We should perhaps not expect a precise demarcation, as these all seem to be subtly different ways of classifying what we might call animal behavior. Indeed, though Aristotle does not give them a common term, he treats them as a group in his long introduction to the *Hist. An.*, from 487a14–488b28, before turning to the parts. Despite the complexity among differentiae, then, we can distinguish between two broad classes of them: behavioral features, on the one hand, and morphological features (parts and their organization) on the other.

Gathering the *phainomena* about animal species thus involves observation of a far richer sort than simply recording physical magnitudes and qualities available to sense perception. It involves observing two broad categories of differentiae—parts and behavior—such that behavior covers a great deal of organized activity, ranging from means of motion to the way an animal interacts with its habitat, and such that the parts are initially observed in functional terms.

§ 3.2 Priority between parts and behavior

Aristotle appears, then, to commit to two important claims about the differentiae of animals: (1) parts enjoy a certain kind of priority over the other categories (suggested by his claim, noted above, § 3.1, that whole animals differ ‘most of all and primarily’ with respect to their parts), and (2) observation of parts requires having some grasp of how they are used or what they are for (since observing functional parts is the first step). Both of these claims, we can see, suggest that behavioral differentiae need to be observed either before or along with morphological ones.

The claim that the parts are somehow prior to the other kinds of differentiae, insofar as animals differ ‘most of all and primarily’ by them, would seem to suggest that parts are more fundamental to the essence of the kind than behavior. If so, then parts would seem to be more Intelligible than behavior, while behavior is more Familiar than parts. This would make a certain amount of sense: if we are attempting to understand a given species, the first thing we would be presented with would be the living being, engaged in its various life activities, i.e. its behaviors. Observation of its parts and how they differ from other species in the same genus would seem to require a further stage of careful observation and comparison.

On the other hand, there is good reason for thinking that Aristotle is committed to claiming that behavior is prior in definition to, and so more Intelligible, but less Familiar, than parts. He is famously, or notoriously,

³² The so-called ‘*megista genê*’ are listed at 490b6f.

³³ *Hist. An.* I 486a15–b4; for discussion see Lennox (1980).

³⁴ Aristotle does not apply this point to the other categories of differentiae. Many of these seem discontinuous, especially those that appear to be classed as differentiae of *bios*, such as living in water or on land, hibernating or not, migratory or sedentary, carnivorous or frugivorous, which particular animals constitute prey or an enemy, and so on.

³⁵ Noted by Lennox (2010, 336).

committed to the claim that (what many would call) bodily parts such as hands and eyes that cannot perform their functions are merely homonymously hands and eyes—the lifeless orbs of a cadaver have no better claim to being eyes than the white and black ovals in a painting.³⁶ Further, he claims in the *Parts of Animals* that subordination relations between parts follow from subordination relations between their functions. (645b28–32) Claims such as these suggest that behavioral differentiae ought rather to be more fundamental, i.e. more Intelligible, than morphological ones—to know the definition of a part, at least, we would have to come to know its proper function. This, too, is a plausible view: we tend to distinguish parts by observing what they do, and to distinguish the physical boundaries of parts and organs in virtue of their contribution to the function. The parts can of course in an ordinary sense be seen and described without reference to a function, but in order to consider the relevant physical material as a part, as having non-arbitrary boundaries, we typically suppose that it has a distinctive function, even if we have not yet determined what it is. Thus, by stating that we should begin with the organic parts, Aristotle is still suggesting that functional/behavioral information is present at the first stage of our inquiry.

Thus, we either begin our observations with animal behavior, or with parts conceived as functional units. Either way, animal activity seems to be an ineliminable component of the starting points of inquiry into biological kinds, including the examination of the parts of animals. However we approach the question of priority between morphological and behavioral differentiae, then, they seem to be at least roughly on a par with one another, in terms of observability. They constitute our maximally Familiar epistemic starting points, and there is good reason to think that we cannot observe them independently of one another—at least not well enough for the purposes of biology.

§ 3.3 *Essence and explanandum*

A further puzzle results from taking these observable differentiae as our epistemic starting points. The differentiae are supposed to be what is distinctive of individual animal species, and as such, are prime candidates for constituting the definable essences of those species.³⁷ Such a conclusion is all the more appealing if we allow that even observing parts properly involves observing activity or behavior, insofar as Aristotle's entire approach to the nature of soul is to treat it as the ground of a living being's capacity for engaging in certain kinds of activity.³⁸ However, the differentiae are also our most Familiar starting points, collected at the observational stage. This makes them seem like bad candidates for essences, which, according to the simple picture, ought to pick out what is more Intelligible and explanatory of the Familiar *phainomena* with which we begin. Differentiae appear, oddly, to be both explanans and explanandum. Aristotle has asserted that prior to investigation, neither the facts to be explained nor their demonstrative bases are clear. But now it looks as though they are in fact the same.³⁹

Now, the class of differentiae that purportedly define a kind will be smaller than the class of differentiae that we initially observe. As Aristotle shows in the *Parts of Animals*, there will be causal (normally teleological) relations between some observable parts and others, such that the function of one is subservient to the

³⁶ See in particular *Meteorology* 389b29–390a2, *De An.* 412b18–413a3, *Part. An.* 640b33–641a5, *Politics* 1253a18–25.

³⁷ This is a quite general claim about definition to which Aristotle is committed. See in particular *Met.* VII 12, which asserts that the final differentia is the substance and definition of a thing (1038a19–20). Though, as noted above, Aristotle gives very few clues as to what a definition of an animal would include, at various points in the *Part. An.* he indicates that certain observable differentiae would be in the *ousia* or definition of a species. For example: at *Part. An.* 642a27–28, Aristotle tells us we must divide species by the things in the *ousia* of the animal rather than the necessary properties (*kath'hauta sumbebēkota*); just before making that claim, he states that a form is 'the differentia in the matter' (*hē diaphora en tēi hulē*, 643a24). At 682b28 it is stated that the segmentation of insects is necessary, since it is in their *ousia* to have multiple principles (*archai*). At 685b13–16, the presence of a single line of suckers (as opposed to a double line) on a kind of octopus that is especially long and thin by nature is explained as resulting necessarily from the specific account of its substance (*dia ton idion logon tēs ousias*). More general (but still observable) features are sometimes mentioned as being in a generic kind's substance: being blooded is in the *ousia* of birds and fishes (639b13, 695b20), and being swimmers also belongs to fish in their substance (695b17). Lennox (2009) makes this general point with particular emphasis on the activities that constitute an animal's way of life (*bios*) (355 and 362).

³⁸ See, canonically, *De An.* II 1.

³⁹ In the face of this puzzle, one might suggest that Aristotle's discussion of differentiae in the *Hist. An.* is not meant to apply to the notion of differentiae pertinent to defining natural kinds, but rather merely a catalog of the ways animals differ (the possibility was suggested to me by an anonymous reviewer). Against this possibility, we have the account of division in *Part. An.* I 2–3, which describes the same types of differentiae of animals, and clearly states that (i) 'the species is the differentia in the matter' (643a24), and (ii) that 'we must divide by the things in the substance (*en tēi ousiā*) and not by the *per se* co-incident features' (643a27–8); Aristotle further discusses division by multiple differentiae explicitly with regard to the goal of defining kinds (see esp. 643b23f.) It may be that Aristotle does not have this project in mind in the discussion of '*diaphorae*' in the *Hist. An.*, but if so this would be because, as Balme tentatively suggested, Aristotle at some point stopped caring about definitions (see above, p. 25).

function of the other. Thus, for example, the function of the windpipe is subordinate to the function of the lungs.⁴⁰ Perhaps, then, the biologist begins by compiling an array of differentiae, without knowing which ones are causally basic and which ones are causally dependent, and the causal stage of inquiry consists in discovering these dependencies, until we arrive at the basic, unexplained properties that constitute the essence of the kind. That is, we proceed by restricting the class of differentiae that constitute a kind's essence to the ones that are causally ultimate—those whose functions are not subordinate to that of another part but only to the unified activity of the whole organism.⁴¹ If this exhausts the process of determining a kind's essence, then it would seem that at no point in our progress are we required to move beyond observables, in contrast to the simple picture. Even thus restricted, however, the elements of the Intelligible essence turn out to be, not just observable, but maximally Familiar. Thus, the puzzle remains that the elements of our ultimate, explanatory essence are included among the most Familiar features of the animal, but, precisely insofar as they are a diverse group of manifest features, they are also what we set out to explain in terms of a unified something which is less Familiar but more Intelligible.

§ 4. A Predictable Puzzle

Aristotle appears to be committed, then, to a pair of claims about differentiae which are in tension with one another: (1) A species's differentiae—or a privileged subset thereof—are what we grasp when we come to know its Intelligible essence, which is explanatorily fundamental for the kind, and which is unified in a non-trivial way; (2) A species's differentiae constitute the Familiar, diverse *phainomena* which we establish at the start of our investigation when gathering a *historia*, and which ought to be explained by its essence.⁴² These claims are also, taken together, in tension with the aspects of the simple picture according to which a move in the direction of explanatory priority is a move towards a distinct ontology of entities that are further from perception or observation. Thus, they put pressure on our original answers to the Process and Progress questions: it is no longer clear how we go about grasping a species's essence, nor what role differentiae ought to play in that process; nor is it clear how that grasp constitutes moving from the Familiar to the Intelligible.

We should not be surprised, however, that Aristotle is committed to claims which yield a puzzle like this. Throughout his more general discussions of his hylomorphic approach to substance, life, and nature, he claims that the formal and final causes are, for natural substances, 'one' or the same, in some sense which he does not fully clarify. Most canonically, perhaps, he says in *Phys.* II 7 that 'since the causes are four, the natural scientist must have knowledge of all of them, and he gives an account of the 'Why' in the natural-scientific way by referring it to each—the matter, the form, the mover, that for the sake of which. But these three often come to one thing; for the what-it-is and that-for-the-sake-of-which are one, and the primary source of change is the same as these in species.' (198a22–26).⁴³

How we understand this sameness relation is obviously crucial, but already we can see, from this general perspective, that Aristotle is committed to some sort of close connection between a natural substance's form, typically identified as its essence, and the characteristic activity or activities that constitute its final cause or *telos*. And if activities are considered part of the manifest image, as they clearly are in the case of the biological works, then something which is in some sense the same as a thing's essence is to be found among our familiar observables. So the puzzling result that differentiae are at the same time among the things that are most Familiar and those that are most Intelligible may in fact be a special case or a consequence of Aristotle's general view that there is a sameness relation between a species's formal essence and its characteristic activities.

If this is correct, then, how shall we understand that sameness relation? Aristotle not only does not clarify the relation, but he in fact uses various locutions to connect the two causes: he says in different places that

⁴⁰ Discussed in detail in *Part. An.* III 3; cf. *De An.* 420b23–24.

⁴¹ Compare the claims about functional subordination at *Part. An.* 645b28–33, and the claim that there is also some full or complete (*plêrous*) action for the sake of which the body as a whole is organized: 'Since, then, on the one hand, every tool (*organon*) is for the sake of something, and, likewise, each of the parts of the body is for the sake of something, and the 'that-for-the sake-of-which' is some action, it is clear that the whole body is also composed for the sake of some complete action.' (*Part. An.* 645b14–17).

⁴² For contrast, in *Post. An.* II 8, the proposed explanandum of the observable features of thunder, one of Aristotle's key examples, is the quenching of fire in the clouds, which is not among our initial data about thunder. There, further, he states that while in exceptional cases the 'fact' (explanandum) and the 'reason why' (explanans) may be grasped at the same time, the reason why cannot be familiar (*gnôrisai*) before the fact (93a18). In principle, this order would indeed be possible for biological species as Aristotle describes them, even likely: we would notice that elephants live on land (explanans) before observing that they have lungs (explanandum), and that sharks are swimmers (explanans) before knowing that they have flexible spines made of cartilage (explanandum).

⁴³ See, further: 198b1–4, 199a30–32, 200a32–35; *Gen. et Corr.* 335b6; *Gen. An.* 715a5–9; *Met.* VII 1041a27–32, 1044a36–b1.

the form and ‘that for the sake of which’ are ‘one’ or ‘the same’ or ‘more or less some one thing,’ (in addition to noting elsewhere, as he does with so many fundamental terms, that ‘one’ and ‘the same’ are themselves ‘said in many ways’).⁴⁴ Commentators have glossed these claims in a variety of ways, usually assuming that Aristotle has one particular relationship in mind in all of them.⁴⁵ This may be a mistake, since he makes the claims in diverse contexts—most notably, perhaps, in discussing both the process of generation and the natures of completed substances.⁴⁶ Further, given the complexity of Aristotle’s views about form, matter, essence, definition, actuality, and potentiality, there may well be more than one way in which a thing’s formal and final cause could turn out to be somehow ‘the same,’ or their sameness might involve multiple aspects—and of course Aristotle may not intend only one or another of these aspects, or even clearly distinguish them. For present purposes, then, it will be enough if we can determine one plausible way in which we can characterize their sameness which helps illuminate and solve the puzzles raised about our knowledge of essences for natural kinds.

The first way of addressing the relation between the formal and final causes in the context of living beings or natural kinds, and perhaps the most natural one, would be to argue, reasonably enough, that the relevant sort of sameness is not strict numerical identity.⁴⁷ Rather, since Aristotle maintains in the *De Anima* that the soul is a first actuality, constituting the ground of the exercise of life activities (second actuality), perhaps we should distinguish between form as such and the activities that constitute its fullest realization, in much the same way that we distinguish between a capacity and its exercise.⁴⁸ Thus, we could claim, the sameness between essence and activity is subject to failures of Leibniz’s law—the form may be fully or continuously present when the activities are not, for example—giving us a prima facie reason for considering them to be numerically distinct.⁴⁹ At the same time, we may recognize that a capacity and its exercise are intimately connected, so that describing them as somehow the same is still warranted. As Aristotle says, discussing the relation between form and proximate matter, ‘what is in potentiality and in actuality are somehow one (*hen pôs*)’ (1045b21), and what is potential is discovered by being brought into actuality (*Met. IX*, 1051a29–30).⁵⁰ Nor is there anything especially perverse about such a view, insofar as capacities are normally individuated by the manner in which they manifest—for a capacity to manifest is, in a natural sense, for it to be fully realized (as distinct from its being perfected, as when one’s ability to speak French can no longer be improved).

⁴⁴ In the canonical passage from the *Physics*, quoted above, he says the ‘what it is’ and ‘that for the sake of which’ are ‘one’ (*hen*, 198a25); at *Met.* 1044b1, he says that the form (*eidos*) and ‘that for the sake of which’ are perhaps ‘the same’ (*to auto*); in *Gen. An.* I 1 he says both that the ‘account of the substance’ and ‘that for the sake of which as end’ should be grasped ‘as more or less some one thing’ (*hôs hen ti schedon*, 715a6), and that they are ‘the same’ (715a8). In other cases, he connects them anaphorically (as at 199a30–32). For the multivocality of ‘one’ and ‘the same,’ see *Met.* V 6 and 9 and *Met.* X 1 and 3.

⁴⁵ Rosen (2014) has recently criticized a number of such construals, and argues that in fact the claim (and attempts to understand it) should probably be abandoned. I am not so pessimistic, though most of his criticisms of certain glosses are correct. He does not, however, consider the possibility I suggest below, which I have not seen suggested elsewhere. In any case, even if we wish to deny that there is a coherent reading on which the formal and final cause of a natural substance are ‘the same,’ they are clearly ‘closely related,’ as Rosen also claims (105), and it is enough for my purposes to provide a suggestion about one aspect of their close relation. I shall continue to refer to the relation as a sameness relation for present purposes, however, both for simplicity’s sake and because Aristotle indicates the relationship in such terms in so many important contexts.

⁴⁶ *Gen. et Corr.* 335b6 is in the context of discussing generation, while *Met.* VII 1041a27–32 is explicit that the nature of the complete substance, not just generation, is at issue.

⁴⁷ Rosen devotes a large section of his paper to an argument that Aristotle cannot mean identity in what he (Aristotle) considers to be the strict sense, i.e. sameness (a) in number and (b) in definition. The argument is plausible, on the assumption that ‘sameness in number’ means more or less what we would call numerical identity (I discuss the possibility that it does not at the end of this section). Such a claim, indeed, would be in clear tension with some of Aristotle’s locutions, e.g. ‘more or less some one thing,’ at *Gen. An.* 715a6.

⁴⁸ See *De An.* II 1, 412a27f., as well as II 5, where Aristotle claims that to go from a state of first to second actuality is not in fact changing in the standard sense, i.e. by losing and gaining a property, but rather ‘preservation by what is in actuality of what is in potentiality’ (417b2–7). Rosen raises this possibility at the end of his paper (§ 4.4), but rejects it on the grounds that it seems too subtle or metaphysically involved to be what Aristotle means when he makes the sameness claim in works of natural science and biology (102).

⁴⁹ One might argue, nonetheless, that the failures are merely apparent, and that essence and activity are indeed numerically identical, but that, as with well-known cases of intentionality, certain features only seem to apply relative to a description, or relative to one’s epistemic status. Thanks to Kit Fine for calling this possibility to my attention. Rosen (2014) is also aware that his argument does not rule out numerical identity (93).

⁵⁰ Further textual evidence of this connection would be Aristotle’s striking claim that if the eye were an animal, vision (*opsis*) would be its soul (DA 412b18–19). And in *Met.* IX Aristotle claims at 1050a9 that ‘the end is actuality, the capacity is acquired for the sake of this’; then, half a Bekker page later, he concludes that ‘thus it is clear that substance, i.e. the form, is actuality’ (1050b2), where by ‘actuality’ he clearly has in mind the relevant end or *telos*. By transitivity, it seems, we ought to conclude that the form, in some sense, is actuality, conceived of as *activity*, despite (or in addition to) the prima facie case for thinking of form as the *ground* of activity).

On this view, then, the move from Familiar to Intelligible is still, as on the simple picture, a shift in ontology, from the observable, varied behaviors and parts of an individual substance to an unobservable, single, capacity-like entity that underlies and explains them—the substance or form.

This proposal has some clear virtues and textual support, but also some important drawbacks. One could argue that the capacity-activity relationship does not really warrant the sameness claim, since, on many views at least, a broadly dispositional property (such as having a given capacity) may also be picked out in categorical terms. Indeed, given the clear need to draw an ontological distinction between an individual's manifest activity and its enduring capacity to engage in that activity even when not doing so, one might think it a step backwards to insist that they are 'the same'—even if the capacity is to be defined with reference to its correlative activity.⁵¹ Aristotle himself tends to focus on the distinctness of what is potentially as opposed to actually F, rather than their sameness, since failure to do so is an important source of philosophical confusion.⁵² Furthermore, in *De Anima* II 4, when he identifies the soul as the efficient, final, and formal cause of the body, he does not appeal to the distinction between first- and second-actuality, despite having just presented and deployed it in II 1 and II 2 (and it is about to return for II 5). Rather, he says that the soul is both the substance of the body, insofar as it is the cause of life for living things (415b12–14), and the final cause of the body, insofar as living bodies (of animals and plants) are organized for the sake of the soul, i.e. the activities of life (415b15–20). Thus, the claim does not appear to be that there are two items, capacity and activity, which are nonetheless somehow one or the same, but rather that some one thing, the soul, bears two distinct causal roles in relation to the body. But this claim simply raises our question again: if the body is unified by some stable, enduring cause, but, as is clear, it is organized as it is for the sake of *activities* which are distinct and may be intermittent, in what sense can we say that some one thing bears both of these causal roles—i.e. that the form of the body is the same as the activities for the sake of which the body is organized?

Furthermore, and perhaps more importantly, as we have already seen, most natural kinds are characterized by an array of distinct activities, some of which can be explained independently of one another, on the basis of elements that are 'in the *ousia*' of the kind but nonetheless distinct. Insofar as these distinct activities are grounded in different features of the animal, the grounds themselves are, *prima facie*, distinct from one another. Thus, even if we accept the claim that the dolphin's capacity for swimming is 'the same' as its swimming, and so on for its other characteristic activities, if the activities that characterize the species are an aggregate rather than a unified whole, then their capacities seem to suffer from just the same problem.

Thus, the variety of independent capacities by which an animal species is defined are still subject to the unity problem—and it does not obviously help to posit one underlying form when it seems so clear that many activities, at least, have independently specifiable grounds. This first suggestion, then, does not help us understand how an animal species' diverse manifest activities are the same as its intelligible, unified essence. And it is this progress, from a plurality of observable features to a unified essence, that is supposed to be characteristic of the scientific understanding of a natural kind.

On a second approach, then, we might think the unity of the formal and final cause lies in the fact that we cannot specify the form without adverting to the activities that characterize the species. Thus, we might maintain that if certain kinds of manifest activity or functionally-defined parts are elements of the definition of the species, then those activities and parts must be 'part' of the species-form in a more robust way—by constituting it, at least partially.⁵³ Or perhaps more precisely, these activities and parts—considered as types—occupy the role of essence, and that is enough for them to constitute the form of the species. Aristotle does indeed claim that forms have parts, independently of the highly disputed question of whether matter is or is not one of them.⁵⁴

The second proposal differs from the first in two important ways. On the first proposal, there are two ontologically distinct items—an individual's capacity to X and its Xing-activity, when present—between which we nonetheless posit a sameness relation (but one that falls short of numerical identity). This second proposal,

⁵¹ For example, if what grounds a dolphin's ability to swim is simply identified as its particular combination of shape and rigidity, these are quite clearly distinct from the activity of swimming which they enable and sustain, and it might be considered obfuscating to insist on their sameness. See also Rosen (2014), §§ 3 and 4.4.

⁵² Indeed, one of the main burdens of *Met* IX is to arrive, in chapter 6, at a sense of actuality as distinct from capacity, even when both are present continuously, as in an action like seeing.

⁵³ In fact, one of the puzzles of *Met*. III (995b27–29) suggests these two alternatives: that the principles and elements of things are either their genera or the parts into which they are divided.

⁵⁴ The nature of the parts of definitions, substance, and form is the topic of *Met*. VII 10.

by contrast, appears to function at the level of the species rather than the individual—the assertion is not that an individual's form is the same as its function or activity, but rather that for a given species, the form is in fact constituted by those types of activities that are distinctive of the species. Second, on this suggestion, the form is treated not a distinct entity, but rather as a theoretical role occupied collectively by the distinctive activities and parts of the natural kind.

We may say, then, on this view, that scientific understanding will come from (a) recognizing that some manifest activities must be distinguished from all the others as essential—hence part of the definable form—and (b) from grasping that they bear an explanatory relation to the animal's other activities and the organization of its body. On this view, the move from the Familiar to the Intelligible is no longer a shift from an ontology of familiar entities to a more scientifically sound ontology. Rather, it turns out to be a shift of perspective with respect to a given observable or collection thereof, relating it (or them) to other observables as having explanatory priority, and a special mereological relationship with the form, i.e. the essence, which they jointly compose.

However, the second option still faces the drawback mentioned earlier: for natural kinds like living beings, there do not appear to be, on the one hand, single differentiae which explain all or even most of the kind's properties, nor does Aristotle suggest at any point that finding such a single explanatory differentia for a natural kind is his aim. And yet, on the other hand, it is difficult to see how an aggregate of these various activities are supposed to constitute an essential unity. We are still left with a view of essence that would make a definition look more like a disconnected list of features such that, we claim, something is an instance of the species if and only if it has all of them.⁵⁵

Aristotle's own treatment of differentiae in his mature discussions of division, however, suggests an alternative to, or perhaps a refinement of the second suggestion. He urges that, unlike the Platonists, who allegedly would divide a differentia like *footed* by an unrelated one such as *tame/wild*, we ought to 'divide the differentia by the differentia' (1038a9–10), i.e. to divide *footed* by *two-footed/four-footed*, and *two-footed* by *cloven-footed/not-cloven-footed*, until we reach the final differentia, a type of footedness that has no further differentiae, which will be 'the substance of the thing and its definition' (1038a19–20). Aristotle makes these comments explicitly in response to the vertical problem of the unity of definition, viz. how the descending terms of a genus-species definition could constitute a genuine unity. Insofar as he identifies the final differentia with the definition, and suggests that this feature of differentiae is what makes the definition a unity, perhaps the same feature also accounts for the sameness of the final differentia with the essence.

An alternative type of sameness is available, then, which is analogous to the relation between determinates and determinables, such as colors and their shades. In the stock example, being a determinate shade of *crimson* is what it is for certain objects to be *red* (the determinable). For such an object, its redness consists in its being that determinate shade of crimson, and similarly for objects of other shades, nor is there any point in looking for any actual entity which is just-plain-red. Its being that shade of crimson is, we might say, the same as its redness.

If we apply a similar notion of sameness to the relation between differentiae and form, we might take a genus, such as bird or hawk, to be a theoretical, determinable entity, such that what distinguishes one species of bird or hawk from another is precisely—and nothing more than—its typical manifest activities and the physical characteristics that accompany them.⁵⁶ A species, then, would be defined by a number of determinates—having a beak with such-and-such curvature, feeding in a certain manner on given kinds of prey, fighting with a certain predator, living in a given niche, following a certain pattern of migration—relative to determinables such as having a curved beak, being carnivorous, migrating, and so on. For the species, its having distinctive ways $\{D_1 \dots D_n\}$ of rendering the generic features $\{G_1 \dots G_n\}$ determinate would be the same as its being a member of the genus, and so on until we reach the most general life functions—thus, for the white-tailed hawk to fly using wings of its peculiar size and shape is what it is for it to be a flyer, and hence also what it is for it to be a mover.⁵⁷ Further, the activities (and parts) peculiar to the white-tailed hawk, for

⁵⁵ Something Aristotle explicitly wishes to avoid; see *Met.* VII 4, 1030b8–10, VIII 6.

⁵⁶ It may sound odd to assimilate Aristotle's differentiae with the notion of a determinate, since one of the hallmarks of the latter is that the more specific determinate is *not* derived by combining a genus with a differentia. However, the traditional mark of such genus/differentia/species relations is that the differentiae are independently specifiable: e.g. a housecat is a domestic feline, and domesticity is neither defined with reference to, nor does it entail, being feline. By contrast, when Aristotle speaks of final differentiae, he does indicate that they are not conjunctions of independently specifiable features: being two-footed is a kind of being footed and entails it, just as preying on rodents is a kind of preying, one which is not arrived at by combining preying with 'on rodents.' (See especially *Met.* Z 12, 1038a9–35, and *Part. An.* 639b17–644a11).

⁵⁷ Thus, as is standard, I take determinates to be type-level properties. For a similar analysis of the relation between the features or

example, by making for a determinate species of the more generic kind *hawk*, are what it is for the species to be a form of hawk—and to this extent, they are what it is for the white-tailed hawk to be a species at all.

On this alternative, then, there are thus not two things—a form and an end—which are held to be metaphysically the same or one (as on the first proposal), nor is the form treated as a role which is occupied by an aggregate of differentiae (as on the second). Rather, in the case of natural kinds, there is one entity, a form, individuated and made determinate by certain types of manifest activities and functional parts, such that the determinate differentiae already include the more generic features that they determine (moving, feeding, mating, and so on), and so, for the species, they are, in this sense, the same as what they determine.⁵⁸ Thus, on the third account, the activities and functional parts that characterize the species are the same as the form, not by aggregating to compose it, but by making it determinate relative to a higher genus. Since the genus does not, Aristotle thinks, exist independently, it would be inaccurate to say that the genus and differentiae compose the essence as parts. In terms of Aristotle's own distinctions regarding the ways of being 'one,' then, this would seem closest to the sense described at *Met.* V 1016b1–3: 'In general those things of which the thought that grasps the essence is indivisible, and not able to be separated in time or place or in account (*logos*), these are most of all one. And among these [especially] those that are substances.'⁵⁹ That is, the form of the species and its final cause would be what is often referred to as the same 'in formula' (in *logos*).

We may wonder, though, whether the form should not more appropriately be specified in terms of capacities, rather than activities, since for a particular living being to have a given form—i.e. to be a member of the species—is precisely for it to have an enduring first actuality, often thought of as something capacity-like, rather than the activity (sleeping hawks are still hawks). At the species level, however, it is arguable that the notion of capacity does not really apply, or even that the distinction collapses.⁶⁰ To say that the activity of X-ing is essential to a species of living being usually implies that its members are essentially capable of X-ing, and that actually X-ing is typical of them as well, though they need not (and probably do not) always X. By contrast, the only reason to declare that a *species*, as opposed to an individual, *can* but *need not* X would be in order to claim that Xing is not part of its essence.⁶¹ Perhaps this is another way of making the same point: at the species level, there is no real difference between saying what a thing is ('a thing that X-es') and what it does ('an X-ing thing')—one formula suffices to indicate both.

If this is correct, it turns out we can also justify and explain the first option for interpreting sameness in terms of the connection between capacity and activity at the level of the individual. Since there is one account of the species-form which is made determinate by activity-types, but the activity-capacity distinction is only relevant at the level of the individual member of the species, it makes sense to suggest that the same definition that determines the species applies both to the capacities and the corresponding activities of the individual members: for an individual to be a thing that Xes is, in one way, for it to be capable of Xing, and in another for it to be a thing that actually Xes. The same definition of what it is to X will apply in one

behaviors of animals and their habitat or *bios*, see Gelber (2015), 283. This is of course not to say that, for an individual to be a member of the kind is for it actually to manifest those capacities (otherwise it would cease to be a member of the kind when not manifesting them), but merely for it to be capable of manifesting them in the relevant sense—but see below regarding the status of individuals in this schema. One might worry whether individuals that can manifest some but not all of the activities in the essence are indeed members of the kind; this, however, is a familiar worry which Aristotle or indeed anyone who defines species in terms of a genus and differentiae must address in any case, and for similar reasons. Notoriously, insofar as Aristotle thinks rationality is the *telos* of human beings, he must accommodate or deny the possibility of irrational or insane humans.

⁵⁸ Cf. *Met.* VII 17, 1041a28–30: 'Plainly one seeks the cause; and this is the essence, to speak abstractly. For some things it is that for the sake of which, such as a house or a bed, while for others it is what moved first; for this is also a cause.'

⁵⁹ Cf. *Met.* X, '[other things that are one are] those things the account (*logos*) of which is one. Of this sort are those the thought of which is single, and such are those of which it [i.e. the thought] is indivisible.' (1052a29–30).

⁶⁰ Unless there happens to be an important class of activities which are never unactualized, and for which there are no corresponding capacities.

⁶¹ Indeed, it makes little sense to say of a species as such—rather than its members taken in the aggregate—that it is *capable* of Xing, where this implies that the species can but need not always X, since a species as such is not a continuant with a temporal career in the appropriate sense (we would simply say that some members of the species X and some do not). We can see, as I shall suggest below, that this proposal is consistent with *also* taking the animal's activities to be 'the same' as its capacities—the two claims of sameness are simply different. We might represent the definition of *rainbow trout* as the set of differentiae {D1...Dn}, while also claiming (or denying) that each of the capacities and parts that are elements of the definition is 'the same' as its exercise (i.e. insofar as the exercise is the completion or actuality (*entelecheia*) of the capacity). Insofar as those activities are unified (along the lines suggested in the next section), we might also wish to claim that the animal's activity as a whole bears this sameness relation to its parts and capacities, taken as a whole—but this, again, would be a further claim, or at least a second aspect of the close connection between the formal and final cause of a living being.

way to the activity and in another to the capacity. In terms of Aristotle's own distinctions regarding unity and sameness, this again amounts at least to sameness in account or formula (*logos*)—now applied to distinct aspects of the life of the individual animal, since we specify the capacity for the individual by reference to the account of the activity.⁶² Both sorts of sameness turn out to be justifiable, then, but the first appears to depend on the third.

In fact, though, one might argue that this is insufficient for capturing Aristotle's intent, since, in the canonical passage quoted above, he claims that the what-it-is and that-for-the-sake-of-which are one, in contrast to the efficient cause, which is (merely) the same in species (*tôi eidei*, 198a26). In the chapter from *Met.* V on 'one,' however, Aristotle sums up by saying that everything which is one in number is also the same in species, but not vice versa, and glosses sameness in number there as applying to 'those things whose matter is one' (1016b32–3).⁶³ It is in fact very plausible that, when it comes to the activities and capacities that characterize a form of life, Aristotle thinks of them as sharing a single matter, at least in some sense—namely, the living body. It is only the living body that is potentially alive (*De An.* 412b25–26), after all, and, for some of the 'parts of soul,' their actuality is also the actuality of parts of the body (*De An.* 413a5–6).⁶⁴ A bird's wings, for example, are plausibly the material basis of its ability to fly, as well as of its actual flying. In this special Aristotelian sense, then, it would turn out that the formal and final cause for an individual living being are after all, 'one in number,' as well as sharing an account or formula which applies in two different ways.⁶⁵

As mentioned above, it is unclear whether Aristotle has one single relationship in mind in all the contexts in which he claims that what something is and what it is for are 'one' or 'the same,' or that this relationship has only one main aspect, or that he clearly delineated the possibilities—and commentators have been quick to assume that he does. One advantage of treating this sameness in terms of the determination of the species form by its distinctive activities and functional parts, as above, is that it allows us to make good sense of further plausible aspects of the relationship between form, function, capacity, and activity, especially at the individual level. Most importantly for present purposes, however, is that we can see how the properties catalogued by a biologist can turn out to be both observable data and theoretical essence, by recognizing that an animal's observable activities are not merely metaphysically connected to its form, nor are they simply parts of it, but that certain of them are essential to the species precisely insofar as they are what make the species-form determinate.

How, then, does grasping such an essence on this third account constitute progress from the Familiar to the Intelligible? Like the second suggestion above, this view seems to involve a shift of perspective with respect to familiar entities rather than a shift in ontology. However, this shift involves explicitly recognizing those observable differentiae as determinations of a more generic entity, such as being a bird or animal full-stop, rather than as summing to compose a whole. Those more generic entities in turn have a claim to be theoretical entities, or at least to be intelligible in some way that contrasts with their being perceptible, insofar as they are not directly observed, and their concepts must be acquired by a process of induction and abstraction. On this view, then, Aristotle's position seems to straddle the divide between taking essences to be straightforwardly theoretical entities, and taking them to be observables whose explanatory power we come to recognize.⁶⁶

⁶² See *Met.* V, 1016a32–35. Indeed, Aristotle seems to say precisely this at *De An.* 415b14–15: 'Further, the actuality is the account of what is in potentiality (*eti tou dunamei ontos logos hê entelecheia*). Rosen, I think, considers and objects to a view that comes close to this, but which he glosses differently. In particular, the view he considers would have it that there is 'some single selfsame item' which is at one time in potentiality and at another time in actuality (102). The view I suggest here is different and rather simpler: there are two items, e.g. one's activity of dancing and one's ability to dance, and the account of what it is to dance applies to both (as activity in one case and capacity in the other). Nor would this be an instance of 'mere homonymy,' as Rosen claims in reference to the view he considers (102).

⁶³ Interestingly, his gloss of being 'one in number' in *Met.* X 1 does not refer to matter, though his gloss on sameness in *Met.* V does, more succinctly: 'those things the matter of which is single either in species or in number are called the same, as well as those of which the substance is one' (1018a5–7).

⁶⁴ For a recent treatment of the question of the matter of the soul's activity see Johansen (2012), ch. 8.

⁶⁵ I do not claim that Aristotle would or does commit to this thesis explicitly, and the question is of course fraught when it comes to the notorious actuality of thought; however, it makes good sense for him to do so, and the difficulties one might raise for the thesis might plausibly account for the way he hedges his sameness claim at times. Nor are Aristotle's discussions of being 'one' in *Met.* V and X without difficulty.

⁶⁶ One might object that determinables such as hunting or being an eagle simply are observables, and so not theoretical entities at all. However, Aristotle is committed to the claim that generic items such as *bird* do not exist 'apart' from, and indeed are somehow posterior to, their species (see, prominently, *Met.* VII 12), and that neither the genus nor the universal is substance (*Met.* VIII 1, 1042a21). Further, as noted above, he associates being more universal with being 'farther' from perception (see n. 17).

So in the end, perhaps the reason Aristotle does not give clear examples of definitions of species (other than toy definitions of *man*) is that such a definition would after all be a list—though not a mere list—of the determinate differentiating activities and their corresponding parts that turn out to be basic relative to the other differentiae. Such natural kinds are, to some extent, as they appear to be, and we can grasp their essence without supposing that we must make some further leap from the observable differentiae to a determinate, perhaps unobservable X behind them, or that we must shift to an alternate ontology.

§ 5. Consequences For the Unity of the Definition

A further virtue of this third account of the sameness relation between formal and final causes is that it offers a natural way of solving the unity problem, one that has consequences for the recent debate concerning 'explanatory unity' in Aristotle's biology.

As noted above, Aristotle's patterns of explanation in biology defy the kind of simple explanatory structure described in the *Posterior Analytics*, according to which we are to seek a single, or at least non-trivially unified, theoretical essence which is explanatorily fundamental for a given kind. Aristotle continues to presuppose in the biological works that natural kinds have essence-specifying definitions, however, and so he must provide some basis for thinking that the various differentiae by which a kind is marked off are unified in a non-trivial way.

Two prominent responses have been suggested for this problem about the unity of biological kinds. Charles (2000) suggests that Aristotle partially abandons the simple picture, and takes biological kinds to be 'interactive unities' (§ 12.10), since they do not in fact exhibit the explanatory structure demanded by the simple picture. Lennox (2010) suggests that the concept of *bios* (mode of life) is explanatorily fundamental for biological kinds (on the evidence of the *Historia*, even though, as he notes, Aristotle does not take the opportunity to declare it as such in the *Parts of Animals*, where we find causal accounts). Though the constituents of an animal kind's *bios* are themselves numerous, they may constitute an 'integrated unity,' so that in a way Aristotle does retain the simple picture after all. The difference between the two views is important, but both agree that Aristotle preserves unity in the definition insofar as the differentiae name basic features of the kind which are, though distinct, inter-connected, and that he must settle for a modified and somewhat looser conception of unity than the simple picture leads us to expect.

To say that these differentiae are unified insofar as they are 'integrated' or 'interactive' does not really help, however, unless we can clarify how such integration or interaction yields genuine unity. There are, after all plenty of aggregates that involve reasonably tight integration or interaction among their elements—neighborhoods, sports teams, ecosystems, and so forth—but which do not thereby exhibit the kind of unity we would expect for the essence of a natural kind. It is striking, further, that Aristotle does not betray any sign of having struggled with this particular problem about 'horizontal' unity in the definitions of animals, despite being aware of the parallel (or perpendicular) problem of vertical unity. While he may simply be oblivious to it, or may have struggled with it in ways that are not apparent to us, it is nonetheless surprising if the problem cuts as deeply as suggested.

Given this absence of discussion, it is worth noting that Aristotle does treat questions of unity relating to the various capacities of life or soul, but at the generic level, and in the *De Anima* and the *Metaphysics* rather than in the biological works. In *De Anima* II 3, for example, he maintains that the generic account of soul he has just given is to some extent incomplete or even inadequate as a definition, and that we should instead 'seek, for each thing, what is its soul; for example, what the soul is for plant, and what it is for man or beast' (414b32–33). He claims further that these various kinds of soul form a sort of progression, each one of which contains the previous kinds potentially, the way *square* contains *triangle* (414b28–415a1). Aristotle then draws connections between the various general capacities of soul, noting that some never occur without others: touch may be found alone, but no other sense is found unaccompanied by touch; perception is found without locomotion, but never the reverse, and so on (415a1–11). Finally, he also claims that the various capacities pertinent to each type of soul involve teleological bundles of a sort, such that one activity governs the rest.⁶⁷ For non-stationary animals, for example, (Aristotle has in mind a contrast with certain

⁶⁷ He claims that nutritive soul is for the sake of reproduction at *De An.* II 4 416b22–25. Perception, which is evidently characteristic of animals as distinct from plants, is related to desire, pleasure and pain, and motion (in non-stationary animals). For teleological reasons, all (non-stationary) animals have perception.

'But animals necessarily have perception, nor is anything capable of being an animal without this, if nature does nothing in vain. For all the things that exist by nature are for the sake of something, or will be accompaniments of what is for the sake of something. If, then, every body capable of moving about, but not having perception, would perish and not go towards its goal, which is the

stationary sea creatures like sponges), perception is explained teleologically as necessary for (successful) motion, the latter being necessary for procuring food and avoiding harm. Thus, Aristotle describes the various types of soul as teleologically unified, with one basic activity governing the rest, but he does so at this generic level rather than at the level of individual species, as some commentators seem to think he should.

Given the connection between the differentiae and the most generic capacities of life, when treated along the lines suggested above, we can respond to the unity problem by denying that the differentiae form a mere aggregate whose components are in need of a source of *per se* unity. Since, on this account, the various manifest activities of animals are in effect the determinate parts and behaviors that constitute what it is for each of them to be a perceiver, mover, reproducer, and so on, then Aristotle could claim that the teleological unity that obtains among the generic capacities is sufficient for unity full-stop. Thus, for a given species of bird, the differentiae that constitute its flying in this particular way would jointly be the same as its flying, and in turn as its moving; its perceiving in these particular ways would jointly be the same as its being a perceiver, and so on for each of its basic capacities; these, in turn, are already unified generically, insofar as, for example, perception in general for animals is for the sake of motion in general.

Indeed, it might be a mistake to look for a further sort of unity among the animal's manifest properties and activities. To take an related example, since some things are breathers because they are land-dwellers, according to Aristotle, it would be (in most cases) wrong to expect that their specific ways of being breathers is to be explained by their specific ways of being land-dwellers (e.g. living on grassy plains). Or, to take an Aristotelian analogy: a house is a teleological unity, constructed for the sake of shelter from the elements and protection of belongings (we may suppose). Houses need roofs and walls to fulfill their function, and need foundations to have roofs and walls. Foundations in general are therefore explained by the need for roofs and walls in general. There are specific types of roof, however (shingle, tile) and specific types of foundation (slab, basement, cement, cinderblock), and any roof or foundation must be of some specific type or other—but there is no reason to expect, for a given type of house, that the specific manner of being a roof will explain the specific type of foundation. They may be explained entirely independently of one another (e.g. the roof-type by climatic conditions and the basement by soil conditions). The fact that these specific attributes of the house are independently explained, however, need not compromise the functional unity of the house, which belongs to it generically.

Thus, for certain complex entities at least, whatever explanatory connections there are at the level of manifest properties need not—and probably do not—mirror those that occur among the generic properties. So also, analogously, it would be wrong to expect that we should be able to explain the unity of a species's life functions in virtue of the specific ways in which it manifests its capacities for life, when such unity is already explained at the level of generic capacities.

Aristotle, as the example shows, is indeed already committed to generic-level explanation for many features of animals, especially where there are many species under a genus (such as birds). Since the various species have all their parts in common, which differ only by 'the more and the less,' the explanations for those structures themselves will also be generic across species.⁶⁸ There will be specific explanations for specific variations—a particularly swampy ecological niche may explain the particular length of a bird-species' legs, for example—but a great deal of the explanatory work is done by and among more generic features. Perhaps, then, unity at the generic level of soul-functions is sufficient for unity full-stop, and thus, a species defined as such by a series of manifest behaviors and parts may constitute a genuine unity even if its unity is not grounded by relations among those manifest differentiae.⁶⁹

function of nature (for how will it feed? Stationary animals are able to do this from where they grow, but it is not possible to have both body and soul and a mind capable of making judgments, but not to have perception, if one is not stationary, and is such as to come into being...)—therefore no body which is not stationary has soul without perception.' (434a30–b8).

Further, again for teleological reasons, touch is fundamental: 'Since an animal is an ensouled body, and every body is tangible, necessarily the body of the animal is capable of touch, if the animal is going to survive. For the other senses perceive through other things, for example, smell, sight, and hearing; but if one is touched, but does not have perception, one will not be able to flee some things and grasp others. And if that is the case, the animal will be incapable of surviving.' (434b11–17). Cf. also *De An.* 413b23, 433b27–30, as well as *De Sensu* 436b13f, where more specifically the senses other than taste and touch are asserted to be for the sake of motion (i.e. for the pursuit of food and the avoidance of harm).

⁶⁸ Cp. also 639a15–29, 645b1–14, where Aristotle notes that for some features, e.g. respiration, it is better to explain them for different species taken collectively (as long as the feature is indeed the same rather than merely analogous), since otherwise our account would be repetitious.

⁶⁹ It may be that the special status of human beings for Aristotle has created the illusion of a problem. For humans, Aristotle does seem to think that there is a single, species-specific activity that teleologically explains all of our various other activities, namely the rational activity identified as the human good, but since we are (he supposes) not a species within one of the great genera, there is no reason distinguish human rationality from rationality as such, at least among animals.

Lennox and Charles, then, may well be right to think that what will turn out to be essential to a kind are its various modes of behavior, considered as a unity, even an 'interactive' or 'integrated' unity, since these jointly constitute what it is for a species to be a kind of mover/perceiver/etc. These differentiae are, however, on this suggestion, a manifestation of unity rather than the source or locus of it, and we can reject the apparent pressure to treat them as the latter.⁷⁰

§ 6. Conclusion

Our two questions about form were these: (1) By what process do we come to know something's form or essence? (2) How does coming to know a thing's form constitute progress from what is 'better known to us' to what is 'better known by nature'?

Our revised answer to (1), the Process question, seems to be the following: we come to know the form of a natural kind by (a) isolating those observable activities and physical features (i.e. functional parts and their differentiae) that (i) constitute its ways of executing the basic, generic life-functions of which it is capable (e.g. nutrition, perception, motion, etc.); that (ii) differentiate it from other members of the same genus; and that (iii) are explanatorily basic. Further, we (b) treat those diverse activities as collectively determining a genuine instance of the relevant genus, hence as a unity (whose unity is explained generically), rather than as a mere aggregate of activities. That is, the various types of manifest activity that serve to differentiate a species are what it is for that species to be a determinate instance of the kind, and are unified at a more abstract, generic level.

We seem to have two possibilities for answering question (2), the Progress question. By first making careful observations, we put ourselves in a position to grasp the relevant *phainomena*. We must then order the differentiae by causal priority, determining which ones have *per se* causes, which are necessary consequences of things that have *per se* causes, and which are teleologically basic. At this stage, we may claim to have discerned an epistemically important relationship among various observable features which initially presented themselves indifferently or as lacking order. By ordering them with respect to causal priority, however complex the relations involved, we may claim to have rendered the causally posterior features intelligible in light of the prior ones.

This is a fair—and fairly deflationary—understanding of epistemic progress in biology, and if that is all that is required for grasping the essence of a natural kind, then we need never leave the domain of what is available to perception in a broad, but still familiar, sense. That is, this causal reordering among *phainomena* need not, for all that has been said so far, involve appeal to relations that are theoretical in any sense that precludes their being observable—though one might also claim they are *difficult* to observe. The work of determining the definition of an animal species would, as we have seen, simply be the complex and perhaps laborious task of noting the subtle but determinate ways in which kinds differ from one another, and trying to understand how those differences relate to different aspects of the various activities in which it engages, which ones can be explained in terms of the others, and which ones seem to be teleologically basic.

Alternatively or in addition, when we have grasped the differentiae of a given kind as comprising a theoretical unit, identifying them collectively as a determinate manifestation of a genus, we may claim to have grasped an intelligible entity in a somewhat more traditional sense.⁷¹ This involves some sort of abstraction, though it still need not be understood as a straightforward move from the observable to the unobservable.

On either interpretation, these features of Aristotle's understanding of scientific inquiry suggest that, on his view, progress in biology does not entail a shift to a distinct ontology, contrary to the simple picture. If there is such a shift to be made, at least, it need not occur in the determination of the definitions of natural kinds. Further, on either view, the process by which we grasp a species-form would in the end look much like the ordinary work of a biologist cataloguing the various traits and behaviors peculiar to it, and trying to understand how they inter-relate, particularly with respect to causal priority. Aristotle's view of how we should come to grasp forms would thus align nicely with his conception of actual scientific practice.

⁷⁰ So Lennox (1980) appears to be wrong in claiming that properties are essential and hence part of the *logos* iff they serve a function necessary for that species' life (343), whereas his (2010) seems correct on the same point.

⁷¹ There is a further complexity, due to Aristotle's distinction in the *Posterior Analytics* between three types of definition or account (*logos*) of what a thing is, corresponding to different stages of inquiry (see *Post. An.* II 10, esp. 94a11–14), on which see especially Bolton (1987). On the one hand, insofar as a definition of the sort discussed in this paper requires understanding the causal priority relations among differentiae, it would appear to be a properly scientific definition in Aristotle's view. However, there remains a great deal of unclarity on the issue, in part because, as mentioned earlier, Aristotle gives us so little information about what a scientific definition of a natural kind would look like.

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