
“The Unity of the Generative Power”: Modern Taxonomy and the Problem of Animal Generation

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Much recent scholarly treatment of the theoretical and practical underpinnings of biological taxonomy from the 16th to the 18th centuries has failed to adequately consider the importance of the mode of generation of some living entity in the determination of its species membership, as well as in the determination of the ontological profile of the species itself. In this article, I show how a unique set of considerations was brought to bear in the classification of creatures whose species membership was thought to be entirely determined by descent from parents of the same kind, in contrast with creatures whose generation could proceed spontaneously or through budding. Concretely, the relevance of mode of generation to the practice of taxonomy means that we must rethink the role of the early modern botanists in the development of a universal science of applied taxonomy. I argue that the task of classifying ‘higher’ biological kinds—those united, in Kant’s language, through their generative power—is one with its unique set of problems, arising as much from classical anthropology as from natural philosophy, and that the conception of zoological species that emerged in the early modern period was a consequence of these problems, and not primarily of the ‘applied metaphysics’ of classificatory practice.

1. Introduction

Beginning in the mid-16th century, a number of German and Italian naturalists innovated new techniques for the classification of at least a subset of biological kinds. Authors such as Leonhart Fuchs and Hieronymus Bock were among the first to move beyond the relatively haphazard botanical works of ancient authors such as Theophrastus’s *De causis plantarum*, to notice that the ancients were merely describing the species available in their own Mediterranean environment, and instead to come up with a universal

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method for categorizing new species that would not be tethered to any particular, contingent geographical circumstances. Their crucial conceptual innovation consisted in overcoming a concern for the ecological contexts of living kinds, and focusing instead on morphological analysis. This involved the conceptual, and often literal, removal of plant specimens from their contexts, with dried and mounted plant holotypes attached to the pages of many herbaria. These holotypes would then serve as the standards against which the species membership of some controversial specimen might be checked, in the same way that one might check a timepiece whose accuracy is in doubt against an atomic clock.

Lorraine Daston has argued that the establishment of botanical holotypes was an important part of not just the project of early modern taxonomy, but of a new sort of Adamic metaphysics, in which a dubbing ceremony would bring it about that a class of entities is subsequently, to speak with Kripke, rigidly designated by a name. “Instead of using names to subsume particulars under what John Locke called ‘general ideas’,” Daston writes,

the general idea, or what in logic as well as in natural history has for millennia been called the ‘species’, has here been mapped onto a particular individual. This is a radical solution to the several problems of how to compress the many into one, to render the abstract via the concrete, and to tether words to things. . . . Of course the botanists, who haltingly and heatedly debated the codes of botanical nomenclature that eventually laid down the type method for preserving the stability of names, were primarily concerned with practices, not philosophy. Yet it was precisely their gradual articulation of a set of practices (publishing, labeling, traveling, referencing, compiling) centered on a collection of objects (type specimens), that is, an *art* of transmission, that turned the code articles on nomenclatural types into a remarkable act of applied metaphysics. (Daston 2004, p. 157)¹

1. Daston, in contrast with Atran, does not wish to ascribe a theoretically foundational role to botany in particular, nor does she see zoology as secondary or derivative. Thus she notes that she is focusing on botany only “in part because of significant divergences in practices by circa 1850, and in part because important technical advances in the preservation of specimens in botanical and zoological collections have different chronologies” (Daston 2004, Footnote 8). Yet presumably, if the practices of the botanists resulted in an ‘applied metaphysics’, this metaphysics was something more than a metaphysics of plants. That is, the claim being made here is that practices in botany had important consequences for classification in general.

Modern taxonomy, on Daston's account, arises out of the work of the early modern botanists—the period that interests her most is the 19th century, yet she sees the practices of this period as emerging out of a gradual process that begins as early as the 16th century—who established prototypes in authoritative books, by means of either drying and mounting, or simply reproducing in '*künstliche Conterfeytung*' ['artificial counterfeiting', that is, artistic reproduction], a suitable specimen.

A number of other scholars have similarly attached a great deal of importance to the work of the early modern botanists, particularly the Germans, for the development of the theoretical underpinnings of modern natural history. Scott Atran, for example, in his *Cognitive Foundations of Natural History*, argues that the German 'fathers of botany' succeeded in "fix[ing] a medium of communication and establish[ing] a shared repository about the living world. In so doing, they managed to go beyond common sense by transcribing folk understanding in a manner that could be transmitted across local boundaries of time and place. The idea of a worldwide system became conceivable" (Atran 1991, p. 128).

In this paper, I propose to critically reassess key aspects of this account of the emergence of the modern biological species concept. In particular, I will argue that the conceptual innovations of the botanists have been too quickly extended to the domain of zoology, on the presumption that plants and animals constitute one single ontological category and thus that what works in botany may readily be seen to apply in the classification of zoological kinds. Quite the contrary, I will argue that many of the distinctive concerns about animals characteristic of the history of Christian thought and current still in the 17th century simply do not apply to plants, and vice versa. The reason for this difference has to do in large part with the perceived differences in the way plants and animals are generated, and with the metaphysical implications, drawn out in the following sections, of these different modes of generation.

2. The Separate Cases of Botany and Zoology in the 16th Century

Atran justifies treating living beings as one homogeneous ontological class on the grounds that "[a]nthropological data show the universal presence of similarly structured plant and animal taxonomies even in the absence of any evidence for a totalizing organic theory" (ibid., p. 73). Yet even if knowledge of plants and of animals is very similar in relation to knowledge of artifacts, and even if domain-specific reasoning about plants and animals yields similar classificatory practices across cultures, there are a number of important theoretical differences between plants and animals in the Western tradition of natural philosophy. At least since Aristotle,

special pleading for the worthwhileness, and often the propriety, of zoological investigations has had to accompany the investigations themselves. Thus the Greek philosopher explains in the *De partibus animalium* that “[W]e must avoid a childish distaste” for zoological researches, “[f]or in all natural things there is something wonderful” (PA 645a 15–24). And Konrad Gesner repeats this admonition in his 1551 work *De Quadrupedibus* when he notes that “[m]inutorum animalium contemplatio non spernenda [est]” (Gesner 1551). Edward Tyson laments as late as 1699 that “we’ve ransacked both the Indies” in search of rare and exotic plants, while neglecting what is most noble in nature—the animals (Tyson 1699).

What is the source of the childish distaste, and of the simultaneous belief of a self-avowed enlightened minority that the study of animals is in fact not childish but noble? Botany and medicine—and decidedly not zoology—were two branches of a common project until the 17th century, while zoology was scarcely on the agenda. Botany was preoccupied with finding useful herbs, and there was no analogous perception of the usefulness of animals. To the extent that zoology begins to emerge in the 16th century, it does so as a consequence of a concerted campaign of principled arguments—fueled by the recent translation and publication of Aristotle’s biological treatises by Theodor Gaza in 1483 and then, along with the rest of the oeuvre, in the great Lyon edition of 1529–39—for the intrinsic value of coming to know nature itself independently of human concerns. In the early modern period, the study of animals, as opposed to the anthropomorphic use of them for the drawing of moral lessons, continued to require explicit defense as a project worth undertaking. In this respect, it could not have been more different from botany. The relevant differences between plants and animals, then, seem to have more to do with the theoretical concerns of Hellenic and Christian anthropology than with the pretheoretical cognition of life-forms that interests Atran. In short, claims about animals have often functioned as stealthy claims about human beings themselves. Since the ancient period, consideration of animals, in works such as those of Aelian and the earlier Stoics, was motivated by a concern for moral edification rather than, as was the case with plants, for the extraction of use-value. Animals were a reflection of human characteristics to be learned from; plants were a resource to be exploited. Thomas of Chobham gives a vivid statement of the traditional role of animals as moral teachers in an early 13th-century treatise:

The Lord created different creatures with different natures not only for the sustenance of men, but also for their instruction, so that through the same creature we may contemplate not only what may

be useful to us in the body, but also what may be useful in the soul . . . there is no creature in which we may not contemplate some property belonging to it which may lead us to imitate God. . . . For the whole world is full of diverse creatures, like a manuscript full of different letters and sentences in which we can read whatever we ought to imitate or flee from. (Thomas of Chobham 1988, p. 275)

Beyond the morally salutary benefits of thinking about animals, even in the perception of their basic biological features we might discern a deep-seated tendency to regard animals, but not plants, as sharing a similar plight and destiny with human beings *qua* particular kind of mortal corporeal substance. Animals appear to be made from the same stuff as are humans; plants do not so appear. As Porphyry reasons in *On Abstinence from Animal Food*, “the principles of the bodies of all animals are naturally the same. I do not say this with reference to the first elements of their bodies; for plants also consist of these; but I mean the seed, the flesh, and the conscent genus of humours which is inherent in animals” (Porphyry 1965, p. 139). Animal motion, moreover, appears to be governed by intentionality, the growth of plants does not. While plant reproduction involves the propensity of individuals to produce in new individuals the characteristics typical of a kind, the path from parent to offspring is for the most part not apparent; plants do not, that is, appear to have ‘babies’ in any meaningful sense. As Theophrastus reasons in the *Enquiry into Plants*, the ‘offspring’ of plants are unlike those of animals in that, as concerns the former, “we should reckon as ‘parts’ even those things to which the plant gives birth, for instance their fruits, although we do not so reckon the unborn young of animals” (Theophrastus 1916, p. 5). In animals, true numerical distinctness pertains to offspring as soon as they are even discernible; plants are much rather outgrowths or offshoots of their ‘parents’. Finally, there is no meaningful notion of a ‘monstrous’ plant, either in antiquity or in the early modern period, except, as in the case of self-moving plants, zoophytes, mushrooms, and other problematic cases in which the plant is perceived to overlap with the animal kingdom. A plant is never monstrous in itself, even if it might qualify, along with noteworthy gems, rock formations, clouds, etc., as ‘marvelous’ or ‘wonderful’.²

2. Of course, plant hybrids and grafting have been known at least since classical antiquity. Thus for example Virgil attests in the second book of the *Georgics*: “When the trunks are cleft—how wondrous the tale!—an olive root thrusts itself from the dry wood. Often, too, we see one tree’s branches turn harmless into another’s, the pear transformed bearing engrafted apples, and stony cornels blushing upon the plum” (Bk. II 30–35). As we will discuss below, hybridity is the marker *par excellence* of animal monsters. In animals, though, it is something rare (other than in hearsay and legend), as well as something that violates the ordinary conceptual categories that shape the folk-scientific perception of reality. In

3. Essence and Aberration in the Aristotelian Tradition

What then is a monster? And why are there no monstrous plants, minerals, or artifacts? As a first stab at a definition, we may say that a monster is a creature that is somehow aberrant. It may be either an aberrant species relative to the genus level, such as egg-laying or marine mammals, or flying rodents, or cloven-hooved cud-chewers; or an aberrant organism relative to the species level, such as mules, tailed humans, or the cat-rat John Locke claims to have personally seen. Now, a mixture of the traits of two separate species may arise in any number of ways, but among the most commonly supposed causes of trait-mixing is sexual hybridism, that is, the mixture of two species' 'genetic' material (to speak anachronistically) through copulation. The possibility of sexual hybridism, though, carries with it implications for the ontology of species. In short, if boundaries may be crossed, then the picture of biological kinds as fixed and eternal cannot be maintained.

According to one common view, it is Aristotle who bequeathed to Western biological thought a conception of living kinds as rigidly and eternally fixed, and on this view the preoccupation with monsters in the early modern period is a result of thinkers using monsters, as Daston and Park put it, to "challenge natural kinds."³ Though Aristotle is not mentioned by name here, presumably it is against the Aristotelian tradition, broadly speaking, that the early modern challenge is thought to be made. Two important points must be made in response to this claim. First, even if there are early modern antecedents, strictly speaking 'natural kinds' were not on anyone's mind prior to J. S. Mill's introduction of this term in the 19th century. Second, anachronism aside, one of the most valuable contributions of Atran's work has been to show that biological kinds have never fit easily into some broader class of natural beings—in spite of the habit extending from Locke through Kripke of using, e.g., lead and cats as interchangeable examples of species or kind—as well as to show that the conception of biological kinds in the early modern period was not an ancient and entrenched inheritance, but a novel conceptual development.

In order to understand this development, it will be useful to briefly consider Aristotle's view of biological kinds, for in the emergence of the early modern view Aristotle is too often cast in altogether the wrong role. David Hull, for example, notoriously charged Aristotle with the responsibility for bringing about '2000 years of stasis' in western biological thinking (Hull 1965). If it had not been for the Stagirite's rigidity, the imp-

plants, hybridity is 'wondrous', but still a common enough phenomenon already for farmers in antiquity to be easily accommodated within this reality.

3. See Lorraine Daston and Katharine Park (1998).

lication seems to be, pre-Socratic ideas, most notably those of Empedocles, about the origins of more perfect life-forms from less perfect ones would have led much more quickly to a Darwin-like theory of natural selection.

But what rigidity? The common view is that Aristotle's essentialism consists in two fundamental and connected features. As Atran puts it (in the course of debunking it), these are (i) the eternal fixity of species, and (ii) the doctrine that "any individual necessarily comes to be what it is in virtue of its species-specific properties, that is, those properties which define the essence of the kind of being that individual is and which therefore make the individual the particular individual it is" (Atran 1991, p. 138). Many have presumed that Aristotle is constrained to support (i) and (ii) in virtue of his purported commitment to what is often called the 'typological species concept,' which, according to Ernst Mayr, "attempts to assign the variability of nature to a fixed number of basic types at various levels. It postulates that all members of a taxon reflect the same essential nature, or in other words that they conform to the same type. . . . Variation, consequently, is considered by the typologist as trivial and irrelevant" (Mayr 1969, p. 66). But to the extent that Aristotle sees species as 'fixed', he does not do so in virtue of a belief in underlying universals that would require such fixity, and to the extent that he believes that individuals come to be what they are by virtue of species-specific properties, he does not believe that this happens of necessity.

What is the textual evidence on which Hull bases his argument, which is in turn echoed in the presumption of Daston and Park that the early moderns inherited from antiquity, and ultimately rejected, a rigid doctrine of natural kinds? Aristotle provides the classic formulation of his concept of kind in the *De Anima*. Creatures, he says, or at least those "whose mode of generation is not spontaneous,"

produce others of their kind, animals producing animals and plants producing plants, in order that they may share, so far as their several natures allow, in the eternal and divine. That is the ideal for which all creatures strive, and which determines their behavior, so far as their behavior is natural. . . . But since mortal things cannot share continuously in the eternal and divine (because nothing that perishes can preserve its identity nor remain numerically one), they partake of eternity and divinity in the one way that is open to them, and with unequal success; achieving immortality not in themselves, but vicariously through their offspring, which, though distinct individuals, are one with them specifically. (*De Anima* 415a27–b9)

The phrase ‘with unequal success’ is telling here. What Aristotle is in fact concerned with is the functional and morphological analysis of kinds in their ecological context. There is, of course, a theory of ‘underlying’ natures for Aristotle, but in the end, Aristotle’s method is to determine kind membership by appeal to morphological aspect. As D. M. Balme puts it, Aristotle makes systematics first in zoology, and morphology first in systematics (Balme 1986, pp. 291–301). Natures develop, in Aristotle’s view, under certain natural conditions, but there is certainly nothing to ensure that an individual organism will necessarily come to be what it is simply in virtue of the inner working of its species-specific nature. It is true that for Aristotle all organisms would turn out as perfect copies of their fathers, who contribute the active principle to reproduction through the vehicle of the sperm, *if* the offspring did not also require the passive matter contributed by the mother’s menstrual blood in order to develop into a particular embodied substance, and if the development of the offspring were not also influenced by environmental factors.

A monster, for Aristotle, is not an abrupt rupture in the order of nature, but is only a case of *steresis* or ‘falling short’—and indeed, every organism falls short of the reproductive ideal to some extent, since organisms are never exact copies of their fathers. It is against this background that Aristotle can claim that women are monsters of sorts—they fall short of the reproductive ideal, indeed somewhat more so than men, but there is nothing exceptional about this. For Aristotle, in an important sense monstrosity is the norm. We might say that for him teratology is just the way one accounts for the diversity of individuals across a kind: every individual falls short of exact duplication of its father; fathers achieve eternity ‘with unequal success’. A very poor stab at eternity would be one in which environmental or maternal influences bring about a creature that not only does not bear the particular traits of the father, but does not even appear to bear the typical traits of the kind to which the parents belong. The kind to which the parents belong is itself, in any case, only “a universal that represents a . . . possibility for the future course of optimal individual development” (Atran 1991, p. 193). This universal does not have any real being of its own, but is only the derivative or ‘secondary’ substance through which particular primary substances may be cognized.

As Atran explains, the species is a naturally occurring “empirical ‘necessity’—part of nature’s ontological fold—that is nevertheless conditional upon an ideal constellation of material circumstances that may never, in fact, obtain” (*ibid.*, p. 138). Thus there is nothing guaranteeing that like will consistently—let alone eternally!—beget like, even if, for Aristotle, sexual reproduction amounts to a sort of approximation of eternity for mortal, sublunar corporeal substances. Indeed, if we consider Aristotle’s

more general account of the relationship between particular primary substances and secondary substances, it is remarkable that he can continue to be considered a rigid fixist about species. For him, secondary substance such as humanity or bovinity has its reality only derivatively from the existence of actual humans or cows. Whether or not this metaphysical picture constitutes a thorough reversal of the Platonic theory of forms, as is sometimes claimed, it is clear that for Aristotle there is no eternal, fixed standard against which an individual can be compared for the determination of its qualification for membership in an unchanging kind. The eternity in Aristotle's account of sexual reproduction is eternity only in so far as finite corporeal substances are capable of it. Which is to say: not much. Nature only approximates eternity, and environmental circumstances might very well bring it about that, in the case of some species or other, it does so rather poorly.

Aristotle, like any small child, recognizes the relevant ways in which an entity can be, or fail to be, a member of a biological kind, and recognizes how these differ from the ways a thing can be, or fail to be, an olive press. But this recognition does not, in spite of Hull's excoriation of Aristotle for the 'stasis' he brought about, amount to a belief in the fixity of kinds, the impossibility of cross-species fertility, or transmutation as a result of environmental change. The eternal species reification, against which the early modern preoccupation with monsters was supposedly a revolt, has a quite different pedigree.

4. Genesis and the Early Modern Legacy of Biblical Zoology

Daston is certainly correct in pointing out the importance of the idea of an Adamic language for early modern taxonomy. Yet if the modern species fixists would invoke scripture in support of their view, and would insist that their view is the only scripturally correct one, still, fixism does not seem to come automatically from Genesis.

There are three significant passages that would serve to solidify fixist doctrine in later Christian thought—those describing the Creation, Adam's naming of the animals, and Noah's ark. Significantly, God creates plant life as early as Genesis 1:11, then moves on to the creation of celestial bodies. He finally returns to terrestrial life at Genesis 1:20, and only then properly begins his zoological endeavor:

And God said, Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly above the earth in the open firmament of heaven. And God created great whales, and every living creature that moveth, which the waters brought forth abundantly, after their kind, and every winged fowl after his kind:

and God saw that it was good. And God blessed them saying, Be fruitful, and multiply, and fill the waters in the seas, and let fowl multiply the earth. And the evening and the morning were the fifth day. And God said, Let the earth bring forth the living creature after his kind, cattle, and creeping thing, and beast of the earth after his kind: and it was so. And God made the beast of the earth after his kind, and cattle after their kind, and every thing that creepeth upon the earth after his kind: and God saw that it was good.

The naming ceremony then begins at Genesis 2:19: “And out of the ground the Lord God formed every beast of the field, and every fowl of the air; and brought them unto Adam to see what he would call them: and whatsoever Adam called every living creature, that was the name thereof.” Ordinarily, to name is not to reify, but rather to pick out, or to attempt to pick out, something that is already there. But Adam’s naming ceremony, in the scriptural tradition, was different, for with his prelapsarian acuity he was able to zap right in to the essences of the creatures God brought before him and to name them accordingly. Their names were not arbitrary sounds meant to stand in for dogs or cats, as we now take words such as ‘dog’ or ‘cat’ to be; rather, they were *the* names of the things *themselves*. The animals Adam was thought to have named would come to exhaustively fill out the list of animals that there *are*.

Finally, God’s instructions to Noah concerning animals occur at Genesis 6:19–20: “And of every living thing of all flesh, two of every sort shalt thou bring into the ark, to keep them alive with thee; they shall be male and female. Of fowls after their kind, and of cattle after their kind, of every creeping thing of the earth after his kind, two of every sort shall come unto thee, to keep them alive.” Plants, sea creatures, and creeping things are not named at all. The latter are taken, unnamed, onto the ark during the flood, while presumably the plants and certainly the marine life do not need to be saved by Noah, as they can simply ride the flood out. Creeping things are a residual class—the things Adam did not get around to naming—, while sea creatures and plants appear in their own way to constitute their own ontological domains: the flood, which was meant to wipe the living world clean, is the natural habitat of the sea creatures; plants are created two whole days before the creation of all the animals, and seem to occupy an entirely different part of the Creation, itself as different from the creation of the animals as the creation of the lights in the firmament on the fourth day is from both of these.

It is clear that the most phenomenally salient living beings in the Old Testament are the beasts of the field and forest, and the fowl. These are the creatures provided, as it were, with reserved cabins on the ark. The creep-

ing things are stowed indiscriminately, while the plants and the sea creatures are exempted altogether from the effects of God's wrath. Such luxurious accommodations come with a heavy price, though. For it is the species with the reserved cabins—the species named by Adam—that would be expected subsequently to keep to themselves.

If the tone in which early modern natural historians and philologists alike invoked Adam's knowledge of the animals was, as we will see, consistently optimistic, one prominent strain of theology had it that such knowledge is, for fallen man, hopelessly beyond recovery. Thus Martin Luther writes in his commentary on Genesis 1:26:

Even this small part of the divine image we have lost, so much so that we do not even have insight into the fullness of joy and bliss which Adam derived from his contemplation of all the animal creatures. All our faculties today are leprous, indeed dull and utterly dead. Who can conceive of that part, as it were, of the divine nature, that Adam and Eve had insight into all the dispositions of all animals, into their characters and all their powers. What kind of a reign would it have been if they had not had this knowledge? Among the saints there is evident in this life some knowledge of God. Its source is the Word and the Holy Spirit. But the knowledge of nature—that we should know all the qualities of trees and herbs, and the dispositions of all the beasts—is utterly beyond repair in this life. (Luther 1968, 66)

For Luther, the unattainability of knowledge of the essences with which God imbued animal species at the creation is no ground for presuming that species are not real. If it had not been for the Fall, knowledge of other creatures would have endured throughout the generations descended from Adam.

In spite of the epistemic gap the Fall brought about, Luther is nonetheless certain that God caringly created each kind according to its nature. Gone for him is the universal, naturalistic, and necessary *stereis* that Aristotle posited to account for diversity. In this connection, Luther has reason to denounce those who would agree with Aristotle that a woman is a man deformed. Aristotle, Luther maintains, declares that a woman is a monster of sorts.⁴ “But let themselves be monsters and sons of monsters—these

4. The extent to which Aristotle actually believes this has been debated extensively in recent scholarship. We cannot summarize all of this scholarship here, and will be content to note two of the more interesting recent contributions: Deslauriers (1998); Mayhew (2004). Both of these authors acknowledge the important theoretical, as opposed to merely pejorative, role of *stereis* in Aristotle's account of sexual reproduction, and of its conse-

men who make malicious statements and ridicule a creature of God in which God himself took delight as in a most excellent work.”

Now, Luther is hardly known for his defense of women’s equality, so it is worth asking why this point of Aristotle’s biology in particular managed to bring out whatever latent feminism the minister had in him. In his commentary on Genesis, Luther emphasizes that among the animals that preceded Eve in the order of Creation, Adam could not possibly find his helpmeet, and that it was for this reason that the female human was made. Eve was his “associate in generation and in the conservation of the species” [*socia generationis et conservationis speciei*]. He describes Adam among the animals, before the creation of Eve, as ‘tentatus’, and it is not altogether clear whether this means that he is merely being ‘tested’, or whether rather he is ‘tempted’ to find his helpmeet among the nonhuman species available. In any case, God prevents any such awkward pairings by forming a woman out of Adam’s own rib. In forming Eve, God ensures that future humans will be generated in the manner of the beasts, as opposed to being forged from mud: “Neither did God wish for [Adam’s] descendants to be born in the same way as Adam, namely, from the earth. Rather, he wanted man to have generation just as the other beasts have it [*voluit, ut haberet generationem, qualem aliae bestiae habent*].” After this moment, the criterion of species membership, for both men and beasts, is clear: “Whatever living thing is generated, is generated from the male and the female, in such a way that it is brought into the world by the female [*sic ut per foeminam edatur in lucem*]” (Luther 1968, 66).

“[H]e who formed man from a clod,” Luther goes on, “today creates men from the blood of the parents.” Luther thus takes Aristotle to task for what he sees as the Greek philosopher’s belief that the origins of species can be accounted for in purely naturalistic terms by appeal to proper climatic and material circumstances: “Thus does Aristotle talk nonsense for nothing,” Luther writes, “when he says that man and the sun generate man. For if heat alone fostered bodies, nevertheless the cause of generation is quite other. Namely, the cause is the *verbum Dei*, which decrees: “*Iam sanguis tuus fiat masculus, fiat foemella*” (ibid.). In sum, for Luther, the sexual reproduction of species, and the permanence of species guaranteed thereby, is an article of faith, revealed in scripture, and it is a sign of one’s pagan orientation to suggest that species could have any other origin. To be a human is to have been reproduced by a male and female human, which is also the mode of generation of the animals that do not participate in spiritual life. Even if knowledge of the essences of other species has been lost as a re-

quences for the metaphysical status of women, without for that reason failing to acknowledge that in the end this account is not independent of broader cultural attitudes.

sult of the Fall, we at least know by revelation, Luther thinks, what it is to be a member of a species: it is to receive species essence from a male and a female in the process of generation. Each species has been sustained through sexual reproduction since the Creation, and there has been no transformation or branching of lineages through hybridism, adaptation, etc.

When Luther criticizes Aristotle for describing women as monstrous, this is because the Protestant reformer wishes to abolish the Greek philosopher's understanding of male and female as occupying different points on a continuum, as on the model of Aristotelian *steresis*, and instead to emphasize their equality at least to the extent that they are equally part of the scheme God laid out at the Creation for the perpetual reproduction of kinds. What Luther overlooks, of course, is that monstrosity for Aristotle is mere deformity, and deformity is but a result of falling short of perfect reproduction, reproduction in number as well as kind, of the father. For Luther, in contrast, a monster could only be produced by crossing the boundaries of the human species, whereas women, for him, are fully human and indeed fully necessary for the transmission of humanity from one generation to the next. It is this rigid tethering of species membership to reproductive lineage that gives us the early modern preoccupation with monsters not as mere misfirings or fallings-short of an abstract ideal of reproduction, but rather as violations of the rigid boundaries between kinds that had been fixed by God at the Creation.

Luther, on the basis of his reading of scripture, emphasized the reality and permanence of species, while also arguing that as a result of the Fall we are forever cut off from knowledge of species essences. Many 16th-century naturalists would agree with Luther as concerns the ontology of species, but would insist that the Adamic grasp of essences was recoverable, and indeed would be recovered by their own research.⁵ To cite one of many examples, in his *Neu Kreutterbuch* of 1577 Hieronymus Bock writes that

It is however clear and undeniable that Adam, as the first-created, did not only clearly and correctly understand all of Earth's creation through the pouring in [to him] of divine power and wisdom, but also named every creature with its correct name.⁶

5. For more thorough treatment of the Adamic language in the 17th century, see Katz (1981); Aarsleff (1982).

6. Bock (1577, Preface, no page numbers). "[D]as ist aber offenbar und unlegbar das Adam als der Erstgeschaffen alle Geschöpff auff Erden durch eingiessung Göttlicher krafft und weisheit nit allein recht und wol erkandt sond' auch ein jedes mit seinem rechten namen . . . genennt hat."

A similar view of zoology is offered in the Epistle Dedicatory of the 1658 edition of Edward Topsell's *History of Four-Footed Beasts*. This work, the author claims, is "like to another Paradise, where the Beasts, as they were brought to Adam, are again described by their Natures" (Topsell 1658). There is a remarkable though little remarked similarity between reflections such as this last from an herbarium, on the one hand, and those we find in texts on the biblical languages on the other. Thus, in his Hebrew grammar, Simon Sturtevant, describing the first parents as the "most learned & rare Linguists," writes that:

The beasts journey amaine vpon the flower fragrant floore of the greene grasse; and there they thus assemble with all kinds of hearbs and trees alreadie in the Garden: first, on their parts to sweare submissiue allegiance, and loyall subiection to him and his heires for euer, and also to receiue fit names of memorable notation, to wit, their Hebrew appellatiue titles, according to their nature & condition . . . Adam (wisely contemplating the creatures interiour formes, & prudently foreseeing the forenamed future proprieties) proceedeth to impose most apt significant names. (Sturtevant 1602, pp. 4–6)

If there is a long tradition, extending at least back to the Patristic authors, of portraying Adam as the ultimate philosopher, in the early modern period he comes to be seen more precisely as the ultimate *natural* philosopher, whose philosophical acuity consists in the ability to discern the natures of natural things—that is, of those creatures that are explicitly mentioned in the Biblical account of Creation.

5. Species Fixism and the Role of the Botanists Reconsidered

In light of the discussion in the previous section, it is worth reconsidering Atran and Daston's respective accounts of the origins of species fixism in early modern botany. Both scholars take the early modern species concept to have emerged out of new scientific practices among those engaged in the project of classification, out of an 'applied metaphysics', in Daston's terms. In Atran's view, the first steps towards a systematic global classification of biological kinds came in the 16th century when botanists such as Andrea Cesalpino sought to fix the species as an eternally self-perpetuating entity. As a consequence of the effort to develop a comprehensive and universal system of classification in the early modern period, it was, as Atran has argued,

necessary to fix a criterion for the species even in advance of future discoveries. Without such a criterion there could be no principled

justification for uniting basic-level sorts originating in different climes within the same genus. Such a criterion must, therefore, establish that morphological characters *usually* perceived to be constant are, in fact, those that *ought to be* constant according to God's eternal plan. (Atran 1991, p. 142)

In 1571 the Italian botanist writes that "Eternity can only arise from the eternal: since the proper work of the vegetative soul is to engender its like, which makes for the eternity of the species, it is necessary that its substance not be corruptible. The reason for the eternal lies neither in corruptible existences taken individually, nor in their totality" (Cesalpino 1571, p. II vii; cited in Atran 1991, p. 139). Species must, in other words, be understood independently of ecological context, and as not subject to transmutation as a result of any ecological change; the species essence must be conceived as reliably transmitted from one generation to the next through sexual reproduction. Variation in a population under new ecological circumstances must now be conceived as intraspecific phenotypic drift rather than as transformation of one species into another. A creature's species essence is determined exhaustively by who its parents are. "[F]or like everywhere engenders like," as Cesalpino puts it, "according to nature and of the same species" (Cesalpino 1583, p. 26; cited in Atran 1991, p. 142). Nearly two centuries later, Linnaeus would put it even more unambiguously: "The law of nature is constant, indeed supremely so, so that like is always generated from like, nor will fierce eagles ever generate a docile dove."⁷

Whereas for traditional biology, including that of Aristotle, the primary interest had always been in determining and grouping species according to morphological aspect and ecological proclivity, natural history after Cesalpino, and then more clearly after Linnaeus, gradually came to focus on determining species' genealogically-related affinities (Atran 1991, p. 80). For Cesalpino, essence is communicated through reproduction, through like's begetting of like, and it is this process that ensures the eternity of species, rather than merely approximating to eternity, as was the case for Aristotle:

Eternity can only arise from the eternal: since the proper work of the vegetative soul is to engender its like, which makes for the eternity of species, it is necessary that its substance not be corruptible. The reason for the eternal lies neither in corruptible existences

7. Linnaeus (1757, p. 26). "Constans, immo constantissima, naturae lex est, quod similes procreentur a similibus, nec imbellem feroces progenerent aquilae columbam."

taken individually, nor in their totality. (Cesalpino 1571, p. II viii; cited in Atran 1991, p. 139)

On Atran's view, Cesalpino's metaphysics of plant kinds is a consequence of certain exigencies in the project of systematic classification. Plant kinds came to be seen as fixed, and plant essences as reliably and unchangingly transmitted from one generation to the next, in a way that was no longer concerned with the kind's ecological context, in large part because conceiving them in this way was useful to the project at hand. Though she has very different concerns than Atran, Daston also asserts that early modern botanical name-fixing was a consequence of an unwitting endeavor in applied metaphysics. We have already seen Daston's account of early modern botany as the project of reversing the unfortunate consequences of Babel, and of thus, ideally, returning to the utopian state of affairs in which Adam was able to perceive the essences of living kinds directly and to call them by their true names. Of course, these botanists overlooked the fact, easily verifiable by a quick reading of Genesis, that Adam did not, as we have seen, name the plants, but only the animals.⁸ And Atran has perhaps overlooked the fact that the species concept that takes shape in Cesalpino's work on plants is there in some form in Luther's account of humans and animals several decades earlier, that is, in the work of an author with no particular interest in developing a global system of the classification of living kinds, but only in interpreting the Old Testament.

Luther's ontology of species agreed with that of the systematists, but his account of our knowledge of species was wholly at odds with theirs. In the 17th century, though, some naturalists came to agree with Luther that species essences are both (i) fixed for all time, and (ii) as a result of our inherent ignorance, essentially unknowable. Thus for the pious natural philosopher John Ray, the number of species was fixed once and for all, and variation within a species, much as for today's 'creation scientists', can never lead to transmutation:

8. This is certainly not to say that early modern naturalists were intentionally misreading scripture, but only that a certain deep-seated theoretical distinction between plants and animals was overlooked by many of them, often in consequence of an overriding interest in the former. Certainly, no naturalist ever falsely claimed that Adam in fact named the plants, and that in this sense early modern botany directly continues the Adamic project; rather what happens is that plants come to stand in for the living world in general, and what is said of them is assumed *mutatis mutandis* to be applicable in other domains such as zoology, even though at precisely the same time reflections about the entities of interest to zoology are taking place far outside the bounds of natural philosophy, in the tradition of scriptural commentary.

[D]ifferences that issue from the same seed, be it in an isolated plant or in an entire species, are accidental and not the signs of a specific character. . . . The same is true of the animal world . . . the number of species in nature is certain and determined: *God rested on the sixth day, interrupting his great work*—that is, the creation of new species.

Though species are eternal, for Ray, their essences are unknowable:

The correct and philosophical division of any genus is by essential differences. But the essences of things are unknown to us. Thus, in place of these essential characters, characteristic accidents should be used [that] join together plants that are similar, and agree in primary parts, or in total external aspect, and which separate those that differ in these respects. . . . The essences of things are wholly unknown to us. Since all our knowledge derives from sensation, we know nothing of things that are outside us except through the power that they have to affect our senses in some particular way, and by the mediation of these impressions to cause a particular image to arise in the intellect. If the essences of things are immaterial forms, it is admitted by everyone that these are not encountered in any sensible means. (Ray 1696a, p. 30f)

But the Lutheran ontology and epistemology of animal kinds would prove a difficult pair of beliefs to sustain together. If essences cannot be known, then one might reasonably protest that we have no good reason to think there are such things.

One of the most important weapons in the arsenals of nominalists, and later of materialists, in arguing against the reality—and *a fortiori* the fixity—of species, would be the purported empirical evidence for species transmutation, whether in the course of an individual organism's life or as a consequence of sexual hybridism. In general, a thinker's position on the possibility of hybridism serves as a good index of his position on the reality of universals. Thus Ray believes that species are 'ideas' in the divine mind, and denies any true transmutation, but only intraspecific phenotypic drift. He maintains that biological kinds:

are not transmutable, and the forms and essences of these are either certain specific principles, that is, certain very small particles of matter, distinct from all others, and naturally indivisible, or certain specific seminal reasons enclosed by means of an appropriate vehicle. (Ray 1696b, ch. 6; cited in Atran 1991, p. 164)

In contrast, many who prefer to ‘lay notions by’ and focus on particulars, in contrast, are more inclined to recognize the possibility of true transmutation. In the *Novum Organon*, Francis Bacon notes that there are natural beings “which appear to be composed of two species, or to be the rudiments between one and the other.” He offers as examples of these “Moss, which is something between putrescence and a plant,” and “Flying Fishes, between fishes and birds,” and, finally, “Bats, between birds and quadrupeds.” He goes on to suggest that sometimes these transitional individuals may emerge by way of degeneration: “plants,” he writes, “sometimes degenerate to the point of changing into other plants” (Bacon 1870, p. 283). And in the *Sylva sylvarum*, Bacon indicates that, while reason recoils from the prospect of bleeding across species lines, nonetheless empirically we are forced to acknowledge that it happens. And significantly, the kingdom of nature from which the clearest evidence comes is the vegetable, and not the animal:

The rule is certain, that plants for want of culture degenerate to be baser in the same kind; and sometimes so far as to change into another kind . . . This work of the transmutation of plants into one another, is *inter magnalia naturae*; for the transmutation of species is, in the vulgar philosophy, pronounced impossible: and certainly it is a thing of difficulty, and requireth deep search into nature; but seeing there appear some manifest instances of it, the opinion of impossibility is to be rejected, and the means thereof to be found out. We see, that in living creatures, that come of putrefaction, there is much transmutation of one into another; as caterpillars turn into flies, &c. And it should seem probable, that whatsoever creature, having life, is generated without seed, that creature will change out of one species into another. (Bacon 1854, p. 142f)

We have already seen from Ray the explicit claim that species essences are held fixed in place through the transmission of seeds or essence-bearing particles from generation to generation through the process of sexual reproduction. Bacon’s tack is not to deny that a preexisting seed or principle would ensure continuity of species, but rather to emphasize that in those cases where there is no such preexisting principle, transmutation is undeniable. Margaret Cavendish, similarly, who does not believe “that all natural things are produced by the way of seeds or eggs,” observes “that there are productions of and from creatures of quite different kinds; as for example, that vegetables can and do breed animals, and animals, minerals and vegetables, and so forth: Neither do I so much wonder at this, because I observe that all creatures of nature are produced but out of one matter,

which is common to all” (Cavendish 2001, p. 66f). To acknowledge, then, that a creature could be generated *de novo* from a new and fortuitous arrangement of existing matter, rather than from some preexisting principle, is tantamount to acknowledging the reality of species transmutation. After all, the transmutation of excrement into flies is clearly as much of a change as the transmutation of one species of plant into another species of plant.

While some, such as Bacon and Cavendish, could distinguish between those higher creatures that reproduce through the transmission of a preexisting principle, and those lower creatures that emerge from inorganic matter, the central tenet of Cartesian embryology was that *all* reproduction is a thermomechanical process like any other, that fetuses develop through a series of what Descartes calls ‘minor causes’ at work in the raw materials of the uterus. Nicolas Malebranche sharply saw the consequences of such an account of embryology for the ontological problem of species. In *The Search after Truth* of 1676, he notes that Cartesian embryology is adequate to account for reproduction in general but wholly unable “to explain why a mare does not give birth to a calf, or a chicken lay an egg containing a partridge or some bird of a new species” (Malebranche 1962, p. 243).

And indeed, for some such as Locke, who adopted a broadly Cartesian view of reproduction to accompany his thoroughgoing nominalism, this is exactly what started happening. “I demand,” Locke asks,

what are the alterations that may, or may not, be in a horse or lead, without making either of them to be another species? In determining the species of things by our abstract ideas, this is easy to resolve: but if any one will regulate himself herein, by supposed real essences, he will I suppose be at a loss; and he will never be able to know when any thing precisely ceases to be of the species of horse or lead. (Locke [1690] 1975, p. 13)

The unknowability of essences, for Locke, is also, simultaneously, a compelling reason to hold to the possibility of species transmutation. Locke speaks in the *Essay* of creatures that “have shapes like ours, but are hairy, and want Language, and Reason. . . . If it be asked,” Locke reasons, “whether these be all Men, or no, all of humane Species; ‘tis plain, the Question refers only to the nominal Essence: For those of them to whom the definition of the Word Man, or the complex Idea signified by that Name, agrees are Men, and the other not. But if the Enquiry be made concerning the supposed real Essence; and whether the internal Constitution and Forme of these several Creatures be specifically different, it is wholly impossible for us to answer” (Locke [1690] 1975, p. 450f). Elsewhere in

the same work, Locke again attempts to draw empirical evidence in favor of his nominalism from what he takes to be the common natural phenomenon of cross-species reproduction. “I once saw a Creature,” he maintains,

that was the Issue of a Cat and a Rat, and had the plain Marks of both about it; wherein Nature appear'd to have followed the Pattern of neither sort alone, but to have jumbled them both together. To which, he that shall add the monstrous Productions, that are so frequently to be met with in Nature, will find it hard, even in the race of Animals to determine by the Pedigree of what Species every Animal's issue is; and be at a loss about the real Essence, which he thinks certainly conveyed by Generation, and has alone a right to the specifick name. (Locke [1690] 1975, p. 451f)

Here Locke offers us a paradigmatic statement of his nominalism, and he takes the apparent fluidity of species boundaries as evidence for the truth of this theory. For Locke, important empirical evidence for the non-reality of species, or at least purported empirical evidence, is what he takes to be the common phenomenon of cross-species reproduction or hybridism. For him, one potential hybrid is that between humans and apes; “if History lie not,” he writes, “Women have conceived by Drills; and what real Species, by that measure, such a Production will be in Nature, will be a new Question” (Locke [1690] 1975, p. 451f).

Traditionally, hybridism was thought to be possible in sufficiently similar creatures. Thus, a claim to the possibility of hybrid offspring in early biology may give us insight into a perception of similarity, and into taxonomic links that may otherwise have remained unelaborated. Thus in the 12th century, in his *De animalibus*, Albertus Magnus identifies the ‘hybrid’ as any quadruped that is dual-genused, and maintains this is possible “for animals which have the same gestation period, an appropriately sized uterus, and are not very far apart as to shape” (Albert the Great 1999, Book 22, p. 1511). For Aristotle similarly, as we might expect, given our revisionist sketch of his view of the species category, hybridism is generally obstructed only as a result of the “gestation-periods of man, sheep, dog, and ox, which are wildly different, and none of these animals can possibly be formed except in its own proper period” (GA 769b 24–6). Tellingly, however, Aristotle also mentions earlier in the *De generatione animalium* a version of the old adage, *Ex Africa semper aliquid novi*, neither affirming nor denying that the ever new kinds supposedly generated in Libya are so as a result of rampant cross-species fertility: “One says that the proverb pertaining to Libya, according to which Libya always produces something new, owes to the animals of different families uniting: as water is scarce, they meet in the small number of places that have sources,

and they couple, even if they are not of the same species” (GA 746b6–11; see also HA 606b19). Where Aristotle denies the possibility of hybrids, it is not because kinds naturally and necessarily keep to themselves, but only for ‘mechanical’ reasons having to do with disparate gestation periods, etc.

In the 17th century, some adopted the view that continuity of species membership could be guaranteed only by preexisting seeds from which future organisms would unfold, while acknowledging that where a fetus develops strictly *de novo*, it’s species membership can be no more metaphysically well-founded than that of spontaneously generated flies or eels arising, as Aristotle put it, from nothing more than the right combination of heat and moisture. Some, such as Bacon and Cavendish, thus took the view that lower life forms that do not unfold from seeds are capable of transmutation and cross-fertility; as Bacon explains elsewhere in the *Sylva sylvarum*: “For it is the seed, and the nature of it, which locketh and boundeth in the creature, that it doth not expatiate. So as we may well conclude, that seeing the earth of itself doth put forth plants without seed, therefore plants may well have a transmigration of species” (Bacon 1854, p. 142f). For higher organisms, in contrast, continuity of species is secured by the fact that these are not generated out of inorganic matter, but rather from seeds. Roughly speaking, the distinction between higher and lower maps fairly smoothly onto a basic division between living kinds familiar to us from Genesis, between those animals that Adam got around to christening, and those that were left to slither namelessly.

6. Must Like Always Generate Like? Modern Taxonomy and the Metaphysics of Sexual Generation

We noted early on that in the plant world, there are no monsters except to the extent that a plant is perceived as partaking of animal nature. Monsters pose distinctly conceptual problems, as opposed to simply being signs of moral corruption or harbingers of the apocalypse, where there is some particular conceptual need to keep species boundaries fixed and uncrossable. This is why Aristotle, who, as we have seen, understands species in terms of their ecological context and morphological aspect, and who understands monsters naturalistically—indeed understands *every* creature as monstrous to the extent that none is ever an exact reproduction of its father—is also not troubled by the prospect of hybridism. Species fixism, we have seen, is sometimes described as a product of the distinctly modern taxonomical project spearheaded largely by the German botanists. And yet, it is animals, and *not* plants, that most early modern naturalists are intent on saving from the prospect of transmutation through hybridism or otherwise, and that the nominalists and materialists are intent on subjecting to such a fate. Why is this? Here, I believe we will not find the

answer by looking at the stated claims of early modern zoology, but must instead return to the traditional Christian anthropological scheme in which animals, and decidedly not plants, have been understood. Again, in Genesis, only brutes and fowl are taken on the ark: not fish, nor plants, and insects are evidently allowed on, but without having earlier been named—that is, on one interpretation, without having had their species essences fixed by Adam. And into the 17th century, it remains the case that the transmission of species essence through sexual reproduction is vigilantly guarded only for brutes and fowl, while the other creatures are permitted to reproduce after their own manner.

Atran's account of the development of systematic taxonomy in botany is rich and thought-provoking, but again, in order to understand the full range of concerns that entered into early modern reflections on the status of animal species, we would do well not to extend too quickly the implications of early modern botany to early modern zoology. In Atran's view, scholars are wrong to trace the cognition of life-forms—especially plant life-forms—to their assumed social functions. For example, one influential study (Witkowski, Brown and Chase 1981) maintains that life-form concepts such as 'tree' and 'herb' develop originally, not from perceptions of differences in size or gross morphology of plants, but from extensions of such functional concepts as 'wood' and 'weed'; but for Atran, the evaluation of life-forms is not invariably based upon an evaluation of functional factors. Children do not learn the concept 'wood-use' along with the concept 'tree'. Instead, they pick out, name, and place into taxonomies just what they find phenomenally compelling.

But Atran's point overlooks the obvious fact that, notwithstanding evidence as to the cross-cultural, pretheoretical ways in which life-forms are cognized, in the Western tradition animals and plants are put to very different theoretical uses. To the extent that plants are, to borrow Lévi-Strauss's oft-borrowed phrase, 'good to think with', they are so principally to the extent that they make it into a human culture's gardens, kitchens, or medicine cabinets. Animals, in contrast, as Thomas of Chobham reminds us, are *themselves* good to think with, whether we see much of them or not. It is worth noting in this connection that a good number of the animals that made it into Gesner's *De Quadripedibus*, as also in the medieval bestiaries, were charismatic megafauna—not to mention unicorns⁹—preserved in Africa but unknown in post-Ice Age Europe other than through the moral fables told about them.

But the suitability of animals as a source of salutary moral lessons un-

9. For a judicious treatment of the enduring importance of unicorns in late-17th-century natural philosophy, see Ariew (1998).

doubtedly arises in the first place from a perceived likeness to humans that is, in the end, rooted in a shared history of evolution. They share our plights as mortal corporeal substances that have offspring, i.e., that literally, if not perfectly, reproduce themselves. It is precisely with respect to those living beings in which this feature is not easily observable that seedless generation is allowed by many early modern authors, and in which, relatedly, authors such as Bacon and Cavendish are more ready to concede the possibility of species transmutation. While of course early modern botanists were aware of the mechanics of plant reproduction from seeds and spores, as Bacon reminds us phenomenally plants simply do not seem to be the sort of entity for which it makes sense to speak of parent and offspring.

This phenomenal difference between plants and animals is crucial for our understanding of the concept of ‘monster’ as it was invoked in early modern natural philosophy. In order to be identified as a monster, a creature must be identified as different with respect to species essence from at least one of its parents. What is generally reported in the *Philosophical Transactions* is not simply the sighting of a monster of indeterminate age, but the witnessing of a monstrous *birth* to some particular parents or others. A monster, in short, can only be one in relation to its parents, and at that level of the scale where there is no meaningful application of the concepts of ‘parent’ and ‘offspring’, there is also no logical possibility for the identification of an aberrant individual. Like Grendel, every monster has a mother (as well as a father), one who need not love it, but who must at least be recognizable as its progenitor.

For Dan Sperber (at least in his early work), approaching the question of monsters from the perspective of cognitive anthropology, to recognize that a creature is deviant is already to recognize that it *is* a deviant something-or-other, and even if it requires special treatment in ritual, or moral condemnation, this does not mean that it presents distinctly cognitive problems for any given system of classification. Sperber emphasizes that the way animals are classified need not necessarily be based, as it is in scientific biology, on lineage. What counts as a monster has everything to do with the class of creatures to which it is compared, and a creature’s parents are only the most obvious comparison class in a taxonomic system that sees ancestry as the sole criterion for species membership. Thus Sperber argues that

the notion of a species in folk taxonomies need not be defined by the only criterion acceptable to modern zoological thinking: the reproduction of like by like. The natural mode of reproduction, certainly well observed in all societies for the greater part of their

fauna, may be the object of a generalisation which, however important, remains external to the principle of taxonomic classification. (Sperber 1986, 152)

The way a being is classified, in other words, is not exclusively determined by consideration of who its parents were—Sperber notes for example that in French folk taxonomy mules constitute their own ‘species’, even though everyone knows full well they are the product of a horse and a donkey. The mule is not, on this way of thinking, a ‘misfiring’ of nature, it is not a sorry excuse for a horse, nor yet a bad representative of the donkey-kind. It has the mule essence, fully and properly, and this independently of its ancestry. To cite another example, from Bulmer and Tyler’s famous work on taxonomy among the Karam of New Guinea, the Karam “believe that metamorphoses sometimes occur between taxa, each of which also reproduces after its kind, which suggests that they do not see separate ancestry and reproductive isolation as necessary features of the units they distinguish” (Bulmer and Tyler 1968, p. 335).

In his *Philosophy of Symbolic Forms*, Ernst Cassirer notes that what distinguishes the modern conception of biological genera and species, as opposed to ‘primitive’ schemes for carving up nature such as that of the Karam, “derives not from simple sensation, from the material content of our visual and tactile impressions, but from the form of their causal coordination and connection, hence from acts of causal inference” (Cassirer 1925, p. 180). In his treatise *On the Different Races of Men*, Kant explains similarly: “In the animal kingdom, the natural classification into genera and species is based on the common law of reproduction, and the unity of the genera is nothing than a unity of the generative power, *valid for a certain number of animals*” (Kant [1775] 1964, italics added; cited in Cassirer 1925, p. 180). It is only when the biological world is carved up into kinds thought to pass along species essences through the causal chain of sexual reproduction that animal species come to be seen as fixed and eternal. It is only on such a view of species, moreover, that anomalous creatures appearing to blend traits of more than one species at once begin to appear as ruptures in an otherwise rational system. Such a view of species is one that first emerges in a certain way of thinking about animals, and not plants: a way of thinking that is rooted in the tradition of Christian anthropology, and of which Luther’s Old Testament exegesis is one significant instance. In this tradition, animals are of interest principally as a mirror held up to humanity, rather than in their own right. This mirroring effect is made possible by certain phenomenally salient respects in which animals really are like human beings, and plants are not.

The early modern preoccupation with monsters, in turn, is not, as

Daston and Park have argued, a challenge to some ancient, rigid doctrine of natural kinds, but rather an unavoidable consequence of a system of classification of animals based, in Kant's terms, on the common law of reproduction. This law appears to have its origins much more in Genesis and the tradition of scriptural commentary than in Aristotle, on whom it has commonly been blamed, and it appears to be valid, as Kant notes, only for a certain number of animals. Monsters can arise only where this law is perceived to hold: what is monstrous arises from a monstrous *birth*, and not from a spore or a bubble of slime. The preoccupation with monsters was not, in Cassirer's sense, 'primitive': not based on visual impressions, nor yet on affective factors such as 'wonder', but on the apparent rupture the creature signaled in the causal coordination of nature, that is, in the system of sexual reproduction of higher biological kinds.

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