

BIOLOGICAL SPECIES¹

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Abstract: In the 1970s, the position that species are natural kinds characterized by essences came to be challenged, and was replaced by the view that species are individuals. To date, this remains the dominant position, at least among biologists, despite influential arguments that species can be construed as homeostatic property cluster kinds (employing a revised notion of essence). Recent philosophical discussions have broadened the scope by articulating a neo-Aristotelian essentialism for species, developing a post-essentialist account of human nature, and scrutinizing temporal persistence conditions for species in the light of species de-extinction efforts. Yet most such current discussions concerning species have not relied on the notion of an essence, which also parallels recent accounts of natural kinds in the philosophy of science.

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Anti-essentialism has been particularly vivid in the case of biological species. Like in many other specific cases, e.g., gender or race (see Mallon, this volume and Rosario, this volume), what one always needs to bear in mind is that—given the background of particular philosophical debates—“essentialism” and “anti-essentialism” mean something specific to the case and context at hand. This made the ascription or rejection of essences meaningful for a case like species. My survey of the nexus of essentialism and biological species starts with a primer on biological systematics, which is important to understand how species are individuated. Then I address the question of whether an individual is essentially a member of its species and whether a species essentially belongs to its higher taxa. Section 3 features the central debate, which led to the prominence of anti-essentialism about species and the position that species are not natural kinds but individuals, despite the more recent position that a revised notion of essence is applicable to biological species and other biological kinds. The final section looks at literature and new philosophical topics from the last decade, including a neo-Aristotelian essentialism about species, a post-essentialism about human nature (an issue relevant to humans as a species), and considerations about the temporal persistence conditions of species stemming from species de-extinction efforts. A noteworthy trend is that both these discussions about species persistence and recent philosophy of science accounts of natural kinds in general could have been conducted—and usually were conducted—without relying on the notion of essence, possibly on the grounds that the label “essence” retains problematic connotations.

1. A Primer on Contemporary Biological Systematics

Species are grouped into higher taxa, such as genera, families, orders, and kingdoms. It is still common to assign a Linnean rank to each higher taxon, although different taxa of the same rank (e.g., a bird family, a primate family, and an herbaceous plant family) can differ significantly in

the number of species they contain and even in their evolutionary age. During the 1960s and 1970s, biological systematics (also called taxonomy) witnessed a dispute between three schools of classifying species into higher taxa (Hull 1988). According to *numerical taxonomy* (also called phenetics), only the overall phenotypic similarity between species matters. This was based on the philosophical orientation that biological taxonomy is nothing but a convenient way to store information, and should be a practice that can be conducted independently of presupposing substantial theories (e.g., from evolutionary biology). In contrast, the longstanding approach of *evolutionary systematics* used to classify in terms of common phylogenetic ancestry, while also recognizing morphological change as resulting in different evolutionary grades that can count as distinct taxa. Finally, the *phylogenetic systematics* (also called cladistics) proposed by Willi Hennig in 1950 classifies exclusively in terms of common ancestry (Hennig 1966). Only the splitting of a phylogenetic lineage into separate species, resulting in different branches (clades) of the phylogenetic tree, can make for new taxa, while evolutionary change along a lineage that does not split is of no taxonomic relevance. A complete branch of the tree of life, consisting of an ancestral species (called a stem species) and *all* of its descendants is called a *monophyletic group*; and such monophyletic groups are the only taxonomic groups that phylogenetic systematics recognizes as genuine taxa. For example, the traditional Linnean taxon of fish (Pisces)—although a distinct evolutionary grade for evolutionary taxonomy—is not monophyletic, as the most recent common ancestor of fish also has as its descendants all the land-living vertebrates, which the alleged taxon fish fails to include. Since the 1980s, phylogenetic systematics has become the only accepted approach, so contemporary systematics defines higher taxa as monophyletic groups in terms of common ancestry, and Pisces and some other Linnean taxa are no longer recognized.

Although nowadays there is only one account of what constitutes a *higher* taxon, there are

actually many different species concepts in use. Biologist Richard Mayden (1997) distinguished 22 different species concepts, and more recently philosopher John Wilkins (2018) provided his count of 28 conceptions as part of his detailed historical and philosophical discussion. Since these concepts rely on different conditions of what constitutes a species, the plurality of species concepts will have metaphysical implications in some of the following sections. To illustrate the motivation for using one species concept, which at the same time has drawbacks over other species concepts, it suffices to mention only some of the concepts as examples. The so-called *biological species concept* defines a species as a group of (potentially) interbreeding natural populations that are reproductively isolated from other such groups (Dobzhansky 1935; Mayr 1942). Given that interbreeding is a major mechanism of gene flow within a species, one major theoretical advantage is that the biological species concept ties into causal explanations of how speciation occurs. If two populations become geographically isolated, diverge genetically and phenotypically, and eventually lose the ability to interbreed and exchange genes, then these populations are now two different species. The biological species concept has also been historically instrumental in understanding the distribution of malaria, by means of being able to distinguish different species of *Anopheles* mosquitos (some of which transmit malaria to humans). At the same time, this species concept faces well-known theoretical problems. One oddity is that when each of two geographically adjacent populations can interbreed, organisms of this species on different parts of the globe need not have the ability to even potentially interbreed. More problematic is that even proponents of the biological species concept admit that hybridization is quite common in plants and some animals—and hybridization is by definition an instance of interbreeding between different species. Finally, interbreeding consists in sexual reproduction, so that for (the vast number of) asexual species the biological species concept is utterly inapplicable and another species concept must be used.

Another widely used concept is the *ecological species concept* (Simpson 1961; Van Valen 1976). It defines a species as a lineage (or a closely related set of lineages) that occupies an adaptive zone (ecological niche) minimally different from any other lineage in its range and that evolves separately from all lineages outside its range. The ecological species concept is beneficial in tracking the evolutionary adaptation of populations to local ecological conditions, and it may be able to distinguish two populations as different species even when they are potentially able to interbreed. There are also different variants of the *phylogenetic species concept* (Cracraft 1983; Hennig 1966; Mishler and Brandon 1987). And the *phenetic species concept* and the *morphological species concept*—both construing species in terms of phenotypic similarity—are still relevant today, not as theoretical accounts of what constitutes a species, but as tools for classifying species in practice (Wilkins 2018).

Whereas some decades ago some deemed their preferred species concept as the only important or fundamental one, nowadays the vast majority of biologists and philosophers are pluralists about species concepts (but see Barker 2019; de Queiroz 1999), where biologists may also make joint use of several species concepts as part of their work (Bzovy 2017). Not only are there several ontological processes that generate overall biodiversity (Ereshefsky 1992), but there are different epistemic purposes and scientific aims, each of which may require a distinct species concept (Kitcher 1984). We have seen that while the biological species concept is a useful tool for explaining speciation, it is ill-suited for classifying asexual organisms. Different species concepts entail not only different conditions of what constitutes a species but can also result in different boundaries between species and different counts of the number of species in a habitat. This can have major practical implications; for instance, while one species concept counts the Alabama sturgeon as a distinct species, which is critically endangered, another species concept would consider the Alabama sturgeon as a mere part of a species, which as a species is not

endangered and thus not worthy of protective measures. Because of this, it is often recognized that various non-epistemic aims, such as conservation purposes or the medical aim of preventing malaria transmission, can legitimately be used when choosing a species concept and delineating what species there are (Conix 2019; Ludwig 2016).

2. Essentialist Statements Involving Species

Although most of the debates among biologists and philosophers concerning essentialism have centered on the question of whether species are natural kinds with essences (to which I turn in the next section), there are other essentialist statements involving species that one can investigate for their truth or falsity. These have only been occasionally considered, and in this section, I follow the book-length discussion by Joseph LaPorte (2004), among others. As tigers (*Panthera tigris*) are mammals, one may wonder whether the species *Panthera tigris* is *essentially* mammalian, or at least whether it *necessarily* belongs to the taxon Mammalia (see Torza, this volume and Correia, this volume). Likewise, one may ask whether Tony the Tiger is *necessarily* a tiger. Regarding the latter issue, the answer arguably is no. LaPorte (1997) as well as Okasha (2002) point out that this answer is at odds with the assumption found from ancient philosophy to modern analytic metaphysics (e.g., Wiggins 1980) that a person is essentially a human being and that any organism belongs necessarily to its species (see also Marabello, this volume). A clear way to arrive at Laporte's and Okasha's claim is if one adopts the orthodox account of phylogenetic systematics, according to which upon an ancestral species Δ splitting into two lineages T and Φ , species Δ thereby becomes extinct (ceases to exist) and two new species T and Φ originate (LaPorte 2004: Ch. 2, Sect. II.2.a). And if Tony the Tiger belongs to lineage T, he is only contingently a member of species T. For the existence of T as a species hinges on the branching event that consists in some lineage Φ branching off. Had this contingent event not

happened, species Δ would still persist to the present and be the lineage that contains Tony.

This conclusion about an organism not essentially belonging to its species also holds if one doesn't adopt the extinction upon splitting convention, while relying on the biological species concept that focuses on the potential to interbreed or alternatively the ecological species concept that pertains to occupying the same ecological niche (LaPorte 2004: Ch. 2, Sect. II.2.b; Okasha 2002). These properties for species identity are contingently possessed by an organism. For instance, the potential to interbreed can change if other organisms were to change their mate recognition behavior, and the potential of flowers to interbreed is even dependent on changes in their pollinators. Imagine a large population Δ from which a splinter group becomes geographically isolated. Assuming that the members of the splinter group either lose the ability to interbreed with the members of the larger population Δ (or alternatively come to adapt to a new ecological niche), the splinter group would form a separate species T. (Species Δ would not thereby become extinct, and contain ancestral as well as contemporary members.) In this scenario, Tony the Tiger actually belongs to species T. But this could have been different. Had the loss of interbreeding (or the adaptation to a different ecological niche) by the overall splinter group containing Tony not happened, there would only be species Δ and Tony would instead belong to Δ . So Tony the Tiger is not necessarily—and thus not essentially—a tiger.

What about the quite different question of whether the species *Panthera tigris* necessarily belongs to the taxon Mammalia, or to the taxon Animalia? Now LaPorte (2004: Ch. 2, Sect. II.1) claims that a species (or a higher taxon) *necessarily* belongs to a more encompassing taxon to which it actually belongs. We have seen that phylogenetic systematics (as the only currently accepted approach) only recognizes higher taxa that are monophyletic groups (clades), consisting of an ancestral species and all its descendants. Consequently, mammals are those organisms that descended from species *G*—this historical ancestry could be considered as the essence that

defines mammals (see also Robertson Ishii, this volume). There are possible worlds where the tree of life has a different branching structure, with some branches (clades) missing, including tigers or even mammals not existing. Still, every possible world that contains tigers—which actually descended from ancestral species *G*—also contains their ancestor *G*. LaPorte's reasoning is that whatever organisms descended from *G* in such a possible world (e.g., tigers) count as mammals, hence his tenet that the species *Panthera tigris* necessarily is a mammalian species (and necessarily an animal species).

However, Margarida Hermida (2022) has more recently argued that LaPorte is wrong on this issue and that all tigers are merely *contingently* mammals and animals. Interestingly, her argument is based on the situation that any particular tiger contingently belongs to the tiger species—which as we have seen even LaPorte grants. Hermida argues that individual tigers could have been non-mammals if they were present in a possible world where mammals did not exist at all. The reason is that a particular tiger (such as Tony the Tiger) exists in a possible world whenever his ancestors are present in this world as well, while the organisms that form species *G* (and found the clade Mammalia) in the actual world need not belong to *this species* in the possible world, in which case she contends that this world has no mammals (in contrast to LaPorte's assumption that the counterfactual descendants of *G* in every case count as mammals). To my mind, these discussions exhibit a potential ambiguity: for the most part, LaPorte (2004) focuses on the *taxon* *Panthera tigris* when claiming it to be necessarily a mammalian species, while Hermida (2022) convincingly argues that all *individual* tigers are contingently mammals. Does a necessity still hold for a biological taxon as such (even if it doesn't hold for any individual member of the taxon)? I am not sure that is the case either, at least if organisms forming ancestral groups that found taxa in the actual world can belong to different species in possible worlds. Even the very type specimen that is the individual used to anchor a species

name does not necessarily belong to its species—LaPorte (2003) diagnoses this as an instance of the contingent a priori.

In spite of endorsing the origin essentialist claim that mammals are defined by deriving from ancestral species *G*, LaPorte (2004: Ch. 3) argues that such essences are *not discovered*, in contrast to the vision popularized by Kripke and Putnam (see also Mallozzi, this volume). This obtains in cases of scientists finding that what they took to be a kind does not actually make up a natural kind, where the finding entails having to *choose* among different options of how to align the traditional natural kind term with one of the genuinely existing natural kinds—or to choose to discard the term. (LaPorte's discussion also covers chemical kinds, so that his tenet that essences are not discovered does not hinge on the historical essences that characterize biological taxa.) A good example is rodents. Rabbits were once considered to be rodents, but it turned out that rabbits form a lineage that branched off before the origin of all the other rodents. This separate rabbit lineage then acquiring characteristics that are not found among the other rodents was one reason to taxonomically exclude the rabbits from the rodents altogether—resulting in one account of what the ancestral group *H* is that is the most recent ancestor of all rodents. But in principle, one could also have decided that the rodents are the more encompassing monophyletic group that includes rabbits (in addition to the descendants of *H* that we now consider rodents). This would have resulted in a different group *H'* being the ancestor that figures in the essence defining rodents. More interestingly, in the 1990s evidence emerged that suggested Guinea pigs are more closely related to seals, horses, and primates than they are to mice and rats. If this is the true phylogeny,² then mice, rats, and Guinea pigs as paradigmatic rodents do not form a monophyletic group—unless one makes the in principle possible choice that rodents also include seals, horses, and primates. If one eschews this counterintuitive option, one has to make a further decision about which of what were considered to be paradigmatic rodents are actually rodents

(and which are not). The need for such scientific choices bolsters LaPorte's contention that the essences of at least some natural kinds are not just discovered, and that the reference of the corresponding natural kind term is not pre-determined by prior language use plus the natural kind structure of the world (see also Brigandt 2013; LaPorte 1996).

3. Species as Natural Kinds vs. Species as Individuals

The vast majority of discussions on species and essentialism have turned on the question of whether a species is a natural kind or an individual. Around the same time that the rise of the causal theory of reference for natural kind terms featured tigers and lemons as examples of natural kinds (Kripke 1980; Putnam 1975; see Tahko, this volume), biologist Michael Ghiselin (1974) and philosopher of biology David Hull (1978) argued that a species is not a class or kind, but instead an individual. This novel perspective on the metaphysics of species had been preceded by the charge that for too long biological taxonomy had been governed by *essentialism*, which is at odds with modern evolutionary theory (Hull 1965). Essentialism about species came to be viewed as effectively identical to what previously had been dubbed *typological thinking*, as opposed to population thinking (Mayr 1959).³ Population thinking emphasizes genetic and phenotypic variation within populations because natural selection acts on phenotypic differences between individuals and genetic variation makes gradual evolutionary change possible. From this perspective, individual organisms and their properties are primary. The properties of species such as most common phenotypic traits or quantitative trait averages are merely derivative of the properties of individuals, and subject to evolutionary change. Sober (1980) articulates the contrary typological thinking (or essentialism about species) as the adoption of a natural state model for explaining variation, analogous to Aristotelean physics. This way of thinking postulates the existence of a natural phenotypic state of a species (grounded in the species'

essence), where deviations from this natural state are seen as being due to intervening (e.g., environmental) forces. This provides a way to nominally acknowledge the readily observable within-species variation, while taking variation to be of no scientific significance—unlike the species essence that has explanatory impact. Such a natural state model about species is clearly inconsistent with Darwinian evolutionary theory. As a result, many evolutionary biologists were critical of such a form of essentialist thinking, which formed the background for subsequent discussions of the specific ontological status of species.

The new argument against the traditional construal of species as classes or kinds pointed out that each species is a particular object, not a universal (Ghiselin 1974; Hull 1978, 1989). A species is a spatiotemporally restricted object, which comes into being at a certain point in time, exists extended in time at certain regions of space, and may become extinct. The most compelling objection to species as kinds is that defining a species in terms of necessary or sufficient properties or an essence consisting of shared molecular, physiological, or anatomical traits is impossible (see Dumsday, this volume). Not only is there significant variation among the members of a species at any one point in history, but the very opportunity of subsequent evolutionary change—and of in principle unlimited evolutionary transformation—makes it moot to point to certain phenotypic traits as defining this species. And, *pace* Kitts and Kitts (1979), invoking some genetic traits as the species' essence will not fare any better (see also Mallon, this volume, Rosario, this volume and Stoljar, this volume). In contrast, the species-as-individuals (SAI) thesis was upheld as doing justice to the nature of species as units of evolutionary transformation. On this approach, the species *Panthera tigris* is an individual, which is made up of various organisms as its physical parts (as opposed to organisms being members of a class). Analogous to how an organism is made up of cells (including different cell types), variation and differences among these parts are very well possible. And an individual is a concrete object,

coming into being at a certain point in time and existing during a particular period of history. Most importantly, an individual can undergo substantial change over time, without ceasing to be this individual.⁴ The species-as-individuals thesis also meshes with the fact that biological species are denoted by proper names. Soon after its formulation, it became the dominant metaphysical position among biologists and philosophers of biology. Apart from species, higher taxa often came to be construed as individuals as opposed to kinds (Jenner 2006).⁵

It was not until the turn of the century that a new vision of natural kinds was articulated that also attempted to capture species and other kinds studied by biology and other special sciences. This is Richard Boyd's (1999a, 1999b) notion of natural kinds as homeostatic property cluster (HPC) kinds. The first important ingredient is to replace the idea that a natural kind is defined by necessary and sufficient conditions by mere *correlations* among properties. An HPC kind is a cluster of properties—properties which kind members tend to share, but need not universally share. The presence of variation within a species thereby becomes no genuine obstacle for construing this species as an HPC kind. (Wilson et al. 2007 call this the “intrinsic heterogeneity” of HPC kinds.) Based on his realism about natural kinds, Boyd views this clustering of properties across kind instances not just as a function of some language game, but something qualifies as an HPC kind only to the extent to which there is some real mechanism that accounts for the clustering, which Boyd dubs a “homeostatic” mechanism.

The second important move is to point out that traditional discussions of natural kinds (at least tacitly) assumed that the essences defining a kind are intrinsic properties of kind members, such as microstructure or genes (see Torza, this volume and Griffith, this volume). But there is no reason to exclude *relational* properties as also being constitutive of some kinds (Boyd 1999a; Griffiths 1999; Okasha 2002; see Tahko, this volume). Historical relations of ancestry are important to species as evolutionary entities (and more generally to other historical kinds;

Godman 2021; Millikan 1999; see Robertson Ishii, this volume). We learned in Section 1 that a higher taxon is simply a monophyletic group (a clade), the identity of which consists in common ancestry from some ancestral group of organisms G . And being descended from G is not an intrinsic, but a relational property. While common ancestry as a relation defines which organisms are members of this higher taxon as a natural kind, this is fully consistent with genetic, phenotypic, and other intrinsic properties of organisms significantly diverging within the taxon, and is thus compatible with evolutionary change.

And while common ancestry and the forming of phylogenetic lineages likewise matter to species, some species concepts feature further relational properties. In Section 1 we encountered the so-called biological species concept, which defines a species as a group of potentially interbreeding natural populations (which are reproductively isolated from other such groups). “Being able to interbreed with” is not an intrinsic property of a particular organism, but a relation between organisms that also hinges on the internal features of (and genetic compatibility with) potential mates. Since interbreeding leads to gene flow within the species, any novel genetic variant (e.g., a mutation) introduced in one subpopulation can spread across the species. In this sense, the interbreeding relation does yield a certain cohesion of the species (Wilson et al. 2007). But this genetic and phenotypic cohesion is fully compatible with the ongoing evolutionary change of this species. Likewise, the ecological species concept focuses on an organism occupying the same adaptive zone as others, again a relational property. This yields phenotypic adaptation to the same ecological niche, while fully permitting evolutionary change (where even the ecological niche can gradually change).⁶ Pointing to species concepts including relational properties therein is part and parcel of the naturalism guiding the HPC approach (Brigandt 2009). A theory of natural kinds has to capture kinds as studied in biology, and it is ultimately an empirical question of what constitutes the ontological character of a given species (see also

Mallon, this volume).

Proponents of the notion of HPC kinds have used the notion of an “essence” for what determines the identity of such a kind, often by viewing the homeostatic mechanism underlying the property clustering as the essence, which is explanatorily more fundamental than the clustering (Boyd 1999a; Griffiths 1999; see also Godman et al. 2020). At the same time, it has been emphasized that such essences need not be traditional (e.g., microstructural) essences at all (see Griffiths, this volume). An HPC kind essence can include relational and other non-intrinsic properties. The essence can also be complex, consisting of many properties or be multiply realized. Such an essence may also change across time, e.g., what physically constitutes the ability to interbreed or the sharing of an ecological niche may be subject to change.⁷

Based on the introduction of the HPC kinds approach many philosophers have come to agree that species (and higher taxa) can be considered natural kinds after all, and even a few biologists have adopted the HPC approach (Assis 2011; Franz 2005; Rieppel 2005, 2009; Wagner 2014). It has also been suggested that a species can be both a natural kind and an individual and that these ontological categories do not exclude each other (Boyd 1999a; Brigandt 2009; LaPorte 2004; Okasha 2002; Rieppel 2007, 2013). From this perspective, the kinds vs. individuals question is less important than the features that make diverse organisms belong to one species and that account for the species’ persistence and *identity* across time. Still, the species-as-individuals thesis remains the dominant position among biologists. Some philosophers also continue to maintain that species as evolutionary entities can only be individuals, and cannot possess essences or be natural kinds (Ereshefsky 2007, 2010).⁸ Ironically, in the history of metaphysics, the category of an individual has likewise been characterized by an essence (Okasha 2002; see also Marabello, this volume), where an individual’s essence accounts for why the individual’s parts are not just a heap of objects but form a unified whole and how the

individual can persist through changes (Witt 2011). While the proponents of species as HPC kinds have pointed to properties and processes figuring in species concepts as what makes a species a unified whole, philosophers favoring the species-as-individuals thesis have only emphasized evolutionary transformation but (curiously) never addressed the obvious question of what conditions would account for the identity of any such species-individual across evolutionary time (see also Scarpati, this volume).

Beyond ontological issues, another imbalance between the two sides of the individual or kind debate is that only proponents of species as natural kinds have made points of *epistemological* significance. The very motivation for the HPC account of natural kinds is that scientists rely on natural kinds because knowledge of genuine kinds permits scientific inferences and explanations (Boyd 1999b), something also echoed by other and more recent accounts of natural kinds in philosophy of science. Reliable inferences can be made to the extent to which similarities exist among kind members and different properties associated with the kinds are correlated. And to the extent to which knowledge about a natural kind includes underlying mechanisms and other causal relations, scientific explanations become possible. Philosophical attention to scientific aims matters as even in the domain of evolutionary biology and systematics different kinds are used for different specific scientific purposes, which can have implications for the nature of each such kind, e.g., regarding the relevance of intrinsic or of relational properties (Brigandt 2009; see also Bolker 2013). A naturalistic approach needs to capture the diversity of kinds found in the special sciences and the different ways they figure in scientific reasoning. In contrast, philosophers of science upholding the species-as-individuals position have been comparatively silent on matters of scientific theorizing and practice.

4. From the Death of Species Essences to the Rebirth of Species?

Among philosophers, debates about species being natural kinds or individuals have been revived by Michael Devitt's (2008) call for a strong role for intrinsic properties within a species essence, on the grounds that the relational properties (e.g., ability to interbreed) used by species concepts are insufficient to identify a particular species taxon as that taxon (rather than another species). Predictably, critical responses to such an intrinsicism have been raised (Barker 2010; Ereshefsky 2010; Godman and Papineau 2020; Slater 2013). Very recently, Christopher Austin (2019) has put forward a construal of species as natural kinds with (purely) intrinsic essences. What makes his contribution highly original is the use of a neo-Aristotelian framework, in terms of the members of a given species sharing the *disposition* to develop in a certain fashion. The intrinsic essence consists in an organism's developmental modules. Importantly, Austin avoids any claim that the disposition would consist in developing one (species-typical) phenotype. Instead, he relies on the disposition to generate a restricted but whole range of phenotypic outcomes that are *possible* for this species' members. From this perspective, developmental modules yield a natural kind with the capacity to produce various phenotypic manifestations (including non-actual ones), depending on the environmental and other circumstances of individual organisms. Austin's neo-Aristotelian account has a hylomorphic component, in that the form consisting in a species-wide goal-directed disposition can across individual organisms be multiply realized in matter.

While a philosophical focus on dispositions holds great promise to understand theorizing in evolutionary biology that employs explanations capturing the possible and impossible (Austin and Nuño de la Rosa 2021; Brigandt 2015; Brigandt et al. 2023), in my view, it is less obvious that this is suitable for specifically construing species as natural kinds with intrinsic essences.⁹

Austin (2019: Ch. 2) explicitly separates the question of what makes an organism a member of a species (answered in terms of an intrinsic essence) from the question of what makes a taxon a species as opposed to some other category (answered in terms of species concepts, including relational properties). But this cuts off a metaphysical account that is supposed to be of the nature of *species* from all traditional considerations (discussed in Section 3) that delineate different species and provide the basis for a species' historical cohesion combined with the potential for evolutionary change. A more cautious neo-Aristotelian and teleological essentialism (than Austin's) was previously put forward by Denis Walsh (2006), which focuses on the natures of individual organisms, not the natures of species.

Looking beyond the restricted topic of species, on the one hand, the last decade has seen a reinvigorated and ongoing interest in natural kinds among philosophers of science (Ludwig 2017, 2018). On the other hand, these accounts do *not* rely on the notion of an essence (Franklin-Hall 2015; Khalidi 2013; Magnus 2012; Slater 2015; see also Griffith, this volume). These new accounts of what natural kinds are also do not adopt Boyd's prominent identification of natural kinds with homeostatic property clusters, on the grounds that many kinds in biology and other special sciences (possibly even species) need not have an underlying homeostatic mechanism (see Brown, this volume). But they still continue Boyd's naturalistic project of attempting to philosophically capture the diversity of kinds found in the special sciences. Given this recent proposal of actually different accounts of which properties make for a natural kind combined with the recognition that across science there are different types of kinds, some have also suggested that we should abandon the search for the one unique theory of natural kinds and that the mere statement that something is a natural kind—without further details about this kind—is not very informative (Brigandt 2022; Ludwig 2018).

The motivation for many contemporary philosophers of science having turned away from

the label “essence” appears to be that the notion tends to suggest outdated tenets or obscures several philosophical issues that are better clarified in different terms. This perspective also aligns with Maria Kronfeldner’s (2018) post-essentialist treatment of *human nature*—a notion traditionally related to the idea that the human species has an essence. She argues that the (“essentialist”) tradition promised to offer *three* things through one human nature (see also Mallon, this volume and Griffith, this volume): a classificatory nature (what makes humans members of their species), a descriptive nature (the properties of human beings studied in biology, cognitive science, and social science), and an explanatory nature (in terms of developmental resources of humans that are biologically or socially inherited). Kronfeldner convincingly argues that a single account of human nature is inadequate to accomplish all three tasks and tends to yield a problematic picture of at least some of us. Instead, as part of a pluralist approach to human nature, she develops three separate accounts, yielding the classificatory, descriptive, and explanatory nature, respectively. An analogous point may well be made about species essences. If a natural kind’s essence is to provide membership conditions for kind members and ground a causal or mechanistic explanation of the kind’s characteristic properties—as has often been assumed—while possibly also encompassing the kind’s characteristic properties or property cluster, then ambiguously many different intrinsic and relational properties have to be stuffed into the essence of a complex biological kind such as a species. While advocating for three concepts of human nature, Kronfeldner (2018) vigorously eschews any normative conception of human nature that would claim some human biological, cognitive, or behavioral traits to be normal or ideal while considering deviations as abnormal or inferior. Such problematic but practically inevitable connotations would also have to be kept in mind when assigning an essence to the human species (see also Ritchie, this volume, Rosario, this volume, Stoljar, this volume and Tannenbaum & Glesakos, this volume).

A novel metaphysical question about species stems from scientific efforts toward the *de-extinction of species*. One motivation is to enhance species conservation programs by restoring a species that has recently gone extinct, for instance, through back-breeding (breeding and interbreeding of extant species to generate organisms similar to past instances). More fanciful are speculations about recreating long-extinct species such as the woolly mammoth, possibly through somatic cell nuclear transfer or by using DNA partially preserved in permafrost. While such scientific efforts face serious if not unsurmountable *practical* obstacles, philosophers have offered *conceptual* reasons concerning the metaphysical impossibility or possibility of de-extinction (Finkelman 2018; Piotrowska 2018; Siipi and Finkelman 2017). The very possibility of restoring a species that hitherto was extinct hinges on the persistence and spatiotemporal identity conditions of a species. At the same time, such philosophical discussions of what could count as the same species as represented by past organisms have been conducted without using the notion of a species essence. To a first approximation, the species concept adopted impacts the potential for the de-extinction or rebirth of species (Finkelman 2018). If one used a phenetic or morphological species concept, which construes belonging to the same species in terms of phenotypic similarity, then any newly created organism that is sufficiently similar would fully count as a member of the species that was considered extinct. And the same would hold for a genetic species concept. However, the more commonly used species concepts do not just provide operational criteria for distinguishing species but a more substantive account of the nature of species. And they typically view a species as some phylogenetic lineage of organisms linked by reproduction, combined with additional considerations of what counts as a splitting of a lineage into different species (e.g., not being able to interbreed any longer or occupying different ecological niches). The requirement of a continuous lineage imposes serious challenges to the idea of de-extinction being conceptually coherent at all. Philosophers have recently been

exploring ways in which the notion of “reproduction” could be construed and have been evaluating whether certain biological techniques pursued (e.g., somatic cell nuclear transfer) would then count as a reproductive link to ancestral organisms (Piotrowska 2018). The conceptual possibility of the species as such still being extinct while having presently existing members has also been considered (Siipi and Finkelman 2017).

Taking stock, recent insightful discussions about what metaphysically would count as a species’ continued existence (under counterfactual modifications) did not have the need to employ the notion of an *essence*, and may be based on reasons for avoiding a historically loaded or contextually specified notion of essentialism. To a significant extent, this also holds for the recent enthusiasm about natural kinds among naturalistic philosophers of science. And even though the late Richard Boyd was happy to use the notion of essence as part of his theory, from the outset he also argued that while retaining some realism about kinds, social constructivists were right in many respects (Boyd 1999b). On his “bicameralism” thesis, something is a natural kind not only in virtue of the structure of reality but also in virtue of such structures fulfilling the inferential and explanatory demands of a disciplinary matrix. And such demands are up to our human interests and purposes. Subsequently, it has been acknowledged that the naturalness of a kind is relative to a scientific domain (Khalidi 2013; Magnus 2012) or scientists’ aims, interests, and norms (Franklin-Hall 2015; Slater 2015). The choosing of one species concept over another—and thus the metaphysical conditions determining a species’ identity—is likewise contingent on scientists’ interests. Section 1 already indicated that conservation, medical, and other *non-epistemic purposes* can play an important role in species concept choice (Brigandt 2022; Conix 2019; Ludwig 2016; for an analogous case see Brown, this volume). So if one chooses to construe species as having essences, chances are that such essences are co-determined by human values (see also Vaidya & Wallner, this volume).

Notes

- 1 I thank the participants of the Routledge Handbook of Essence Workshop for their comments on a synopsis of my essay. I am particularly indebted to Kathrin Koslicki and Mike Raven for their detailed comments on a draft of this chapter. The work on this essay was supported by the Social Sciences and Humanities Research Council of Canada (Insight Grant 435-2016-0500) and the Canada Research Chairs Program (CRC-2018-00052).
- 2 Since 2005 substantial evidence has been accumulating that guinea pigs are actually more closely related to rats, mice, and other rodents, so that the traditional taxon considered to be rodents can be retained.
- 3 Such a lumping together of Platonic types and Aristotelean essences immediately suggests carelessness about the views of Aristotle and other historical figures (Lennox 2001). But it has also been revealed that even pre-Darwinian taxonomists, including Linnaeus, were not essentialists (Amundson 2005; Brigandt 2021; Wilkins 2013; Winsor 2003).
- 4 Brogaard (2004) suggests that the failure to distinguish between a three-dimensional (endurantist) and a four-dimensional (perdurantist) account of species has led to some of the issues debated, e.g., whether species can be construed as mereological sums. Among the species-as-individuals proponents, Hull (1989: 187) merely states that a species name refers “both to a spatiotemporally extended lineage and to a time-slice of that lineage.” Rieppel (2008, 2013) favors a four-dimensional interpretation.
- 5 Likewise, homologues came occasionally to be viewed as individuals (Ereshefsky 2009; Grant and Kluge 2004). A homologue is the same character (bodily part) across all the organisms making up a species or higher taxon. Traditionally, the relation of homology

- (character x in one species is homologous to y in another species) was considered an equivalence relation, in line with these characters forming a kind.
- 6 While some have objected to using the HPC account for biological taxa on the grounds that “whatever is ‘homeostatic’ cannot, by definition, evolve” (Kluge 2003: 234), this takes Boyd’s label “homeostatic” mechanism too literally. While common ancestry and interbreeding account for some cohesion among the members of a taxon, they do not prevent evolutionary change.
 - 7 Although Boyd (1999a) is not fully clear on whether the essence of an HPC kind is the property cluster or the homeostatic mechanism accounting for the clustering (or both), he explicitly views the property cluster as well as the homeostatic mechanism as subject to change. While the HPC account of natural kinds recovered a notion of essentialism compatible with evolutionary theory, based on the field of evolutionary developmental biology there have also been arguments that a sort of typology (or typological thinking) can legitimately be used in evolutionary contexts (Amundson 2005; Austin 2017; Brigandt 2007, 2021; Lewens 2009; Love 2009; Walsh 2006).
 - 8 While biologist Olivier Rieppel (2006) pointed out that phylogenetic systematists (including those viewing species as individuals) are committed to essentialism in the form of origin essentialism, philosopher Marc Ereshefsky (2007) responded that since “qualitative essentialism” and origin essentialism are two types of essentialism, the proponents of the species-as-individuals thesis (committed to origin essentialism) are not committed to essentialism at all. The blatancy of this non-sequitur illustrates how some preferring the SAI position have been less reconciliatory than those HPC proponents who acknowledge that species can at the same time be individuals and kinds.
 - 9 For problems with dispositions in other scientific contexts, see Lam, this volume.

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