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Natural Kinds and Natural Kind Terms

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Abstract

The aim of this article is to illustrate how a belief in the existence of kinds may be justified for the particular case of natural kinds: particularly noteworthy in this respect is the weight borne by scientific natural kinds (e.g., physical, chemical, and biological kinds) in (i) inductive arguments; (ii) the laws of nature; and (iii) causal explanations. It is argued that biological taxa are properly viewed as kinds as well, despite the fact that they have been by some alleged to be individuals. Since it turns out that the arguments associated with the standard Kripke/Putnam semantics for natural kind terms only establish the non-descriptiveness of natural kind terms and not their rigidity, the door is open to analyze these terms as denoting traditional predicate-extensions. Finally, special issues raised by physical and chemical kinds are considered briefly, in particular impurities, isotopes and the threat of incommensurability.

I. What are Natural Kinds?[1]

Kinds are categories or taxonomic classifications into which particular objects may be grouped on the basis of shared characteristics of some sort. *Natural* kinds are best construed, not so much as kinds found within *nature*, but rather as classifications that are in some sense not *arbitrary*, *heterogeneous*, or *gerry-mandered*.[2]

As commonly cited examples of natural kinds, the literature includes both classifications that are part of our ordinary vocabulary (e.g., *tiger*, *lemon*, and *salt*) as well as ones that are dealt with by various scientific disciplines, especially biology, physics, and chemistry (e.g., *Tyrannosaurus rex*, *Liliaceae*, *jadeite*, *planet*, *electron*, and *hydrogen*); but the taxonomic divisions presupposed for example in such disciplines as medicine, psychology, economics, or meteorology (e.g., *multiple sclerosis*, *schizophrenia*, *inflation*, and *hurricane*) may also turn out to be good candidates for natural kinds.

Beyond the relatively clear cases, however, there is a large and varied array of categories with respect to which there is some controversy: consider for example classifications which might be viewed as motivated by superstition or pseudo-science (e.g., *prophet*, *seer*, *angel*, *witch*, *ghost*, *demon*, *fairy*, *Sagittarius*, and the like); classifications that are politically charged (e.g.,

Aryan, *Jew*, etc.); classifications which were at one point part of respected science but later came to be discarded (e.g., *phlogiston*, *aether*, etc.); or classifications which bear some relativity to what is immediately accessible to our human perceptual apparatus (e.g., *sweet things*, *yellow things*, etc.).

Given this series of examples, one may arrive at the conclusion that the distinction before us is not *sharp*, but rather one of *degree*, with the result that perhaps kinds can ultimately be classified only into *more* or *less* natural ones along a spectrum of some sort, with clear cases on either side and a good bit of indeterminacy in the middle. Though *chair* is for example obviously a classification of objects that are man-made, it may, for all we know, come out, on this approach, as more natural than, say, *weed* or *shrub*, despite the fact that the latter two categories are exclusively composed of objects that are found in nature.

Finally, we should also be wary of attempts to provide an answer on *a priori* grounds, independently of a thorough investigation into the nature of kinds, to the question of whether ordinary or scientific taxonomic efforts will arrive at a single *unique* classification of particular objects into kinds, or whether instead a *pluralistic* attitude towards divisions into kinds is called for. Regardless of how this question is decided, it must of course be admitted that kinds form a hierarchy, so that each individual member of one kind (e.g., *human being*) may also simultaneously fall under many other kinds (e.g., *animal*, *living thing*, etc.).

II. The Special Features of Natural Kinds: Induction, Laws of Nature, Causal Explanation

How, then are natural kinds to be distinguished from non-natural kinds? And what motivates our belief in the existence of natural kinds in general and of certain specific natural kinds in particular? Those who take a *realist*, rather than a *conventionalist*, line on natural kinds, i.e., those who are of the opinion that the 'natural'/'non-natural' distinction points to a substantive contrast, are typically motivated in their belief in the existence of natural kinds by the role these kinds play in (i) induction and prediction; (ii) the laws of nature; and (iii) causal explanation.

First, natural kinds are often said to be particularly well-suited, in comparison to other sorts of taxonomic classifications, to the task of grounding legitimate *inductive inferences* concerning the members of the kind in question. Thus, from the premise that all observed samples of copper in the past have been found to conduct electricity we can legitimately infer that the next observed sample of copper will conduct electricity, presumably at least in part because samples of copper form a genuine natural kind and their capacity to conduct electricity is uniformly associated with samples of this kind of metal; thus, in the language of Goodman, we may say that the predicate, 'conducts electricity', '*projects*' with respect to members of this natural kind and the presence of this

feature may be legitimately extrapolated with respect to future samples of the same kind.

In contrast, classifications of objects that are intuitively gerry-mandered (e.g., *objects that are currently in my visual field*) perform rather poorly from the point of view of licensing inductive inferences over as-of-yet unobserved members of these groupings. What is deficient about classifications of this sort is precisely, as it is sometimes put, that their members lack any other common characteristics (or at least ones that are not themselves gerry-mandered) besides the feature by means of which they are categorized under a common heading (namely, *currently being in my visual field*). John Stuart Mill for example illustrated this shortcoming of intuitively heterogeneous classifications by means of the kind, *white thing*, which he considered to be a phony kind:

> White things are not distinguished by any common properties, except whiteness; or if they are, it is only by such as are in some way connected with whiteness. But a hundred generations have not exhausted the common properties of animals, of plants, of sulphur or phosphorus; nor do we suppose them to be exhaustible, but proceed to new observations and experiments, in the full confidence of discovering new properties, which were by no means implied by those we previously knew. (Mill 122)[3]

Secondly, the suggestion is frequently made that natural kinds distinguish themselves by figuring in *laws of nature*. Despite the fact that for example the classification of pieces of furniture under the heading, 'chair', captures highly useful uniformities of some sort, it is highly unlikely that any scientific law will require appeal to the category, *chair*, in particular, as opposed to that of *material object* (or *body*) in general. In contrast, classifications like *copper* or *emerald* do figure in universally quantified statements of the form, 'All pieces of copper conduct electricity' or 'All emeralds are green', which may plausibly be viewed as expressing laws or nomological generalizations, though ones of a much higher degree of specificity than, say, Newton's First Law, according to which *bodies* in general are said to continue at rest or in uniform motion in a straight line unless acted upon by an impressed force.[4]

Thirdly, and no doubt connectedly, natural kinds have been recognized by philosophers and scientists for their prominent role in *explanation*, especially *causal* explanation.[5] A realist about natural kinds like Putnam for example will point to the connections he sees between our taxonomic activity and the causal features of the world, to account for the *successful* results to which our explanatory and predictive practices lead; it is this convergence between our categorizations and the actual causal features of the world which, in the mind of the realist, underlies the important contribution made by our natural kind classifications to inductive reasoning and the formulation of scientific laws, as is emphasized for example in the following passage from Kornblith, who endorses Boyd's account of natural kinds as homeostatic property clusters:

> Inductive inferences can only work, short of divine intervention, if there is something in nature binding together the properties which we use to identify kinds. Our inductive inferences in science have worked remarkably well, and, moreover, we have succeeded in identifying the ways in which the observable properties which draw kinds to our attention are bound together in nature. In light of these successes, we can hardly go on to doubt the existence of the very kinds which serve to explain how such successes were even possible. (42)

For the conventionalist, on the other hand, the world is more accurately characterized in terms of degrees of similarity and difference, rather than 'chasms or gaps' between particular objects; insofar as any such boundaries among objects are recognized, their origin, in the mind of the conventionalist, is ultimately to be traced to the nominal essences recognized by particular conceptual schemes. Given this picture, however, it seems incumbent upon the conventionalist to provide some alternative explanation, in place of the causal avenues that are open to the realist, for why classifications in terms of natural kinds, such as *copper*, lead to the explanatory and predictive successes that are noticeably absent from intuitively gerry-mandered classifications like *objects currently in my visual field*.[6]

III. Biological Taxa

The question should be raised as to whether biological species, and possibly the higher taxa as well, are even properly viewed as kinds at all; for it has been alleged by some that they are in fact *individuals*, i.e., segments of the phylogenetic tree, concrete spatiotemporally located chunks within the total genealogical nexus of life on Earth. Individual organisms, on this view, are *parts* of species, rather than *members* or *instances* of them. The position alluded to here is also known as the '*Species-as-Individuals*' thesis (SAI), and has been advocated most prominently by Michael Ghiselin and David Hull (see especially Ghiselin, 'On the Psychologism'; *Triumph of the Darwinian Method*; 'Radical Solution'; 'Species Concepts'; Hull, 'Are Species Really Individuals?'; 'Matter of Individuality').[7]

Very briefly, according to the proponents of SAI, species have the following characteristics: (i) they may change over time; (ii) they belong to a particular spatiotemporal phase in the development of life on Earth; (iii) their constituents stand in causal relations to one another; (iv) they are not suitable to appear in scientific laws; (v) they do not have essences; and (vi) expressions used to refer to them exhibit name-like behavior. Those who subscribe to SAI interpret these considerations as supporting the view that species belong to the ontological category of individuals, rather than to competing categories.

Due to the potentially confusing nature of the term, 'individual', however, it is not entirely clear what the competing ontological categories are from which SAI intends to exclude species. Based on the considerations cited above, involving spatiotemporal location, historicity, change over time, and causal connectedness, SAI is most straightforwardly interpreted in the following way: on the one hand, we are encouraged not to view species as *abstract* entities or as the sort of entities that have *members* or *instances* (e.g., *universals* or *sets*); on the other hand, we are encouraged to regard species as entities that are both *concrete* and have *parts*. Given this construal, the potentially confusing term, 'individual', as it is used by the advocates of SAI, is best interpreted as denoting *concrete particular wholes*, as contrasting with *abstract* entities, in particular *sets* or *universals*.

Without really entering into the difficult debate over the nature of species, I want to take up at least briefly some of the metaphysical and semantic points raised by (i) to (vi). On the most general level, it should be pointed out that, unless potentially controversial additional premises are granted, none of the considerations we have come across so far directly settle the question of whether species belong to the ontological category of *kinds*: for it is itself far from obvious how kinds should be classified ontologically with respect to the options cited above.

(i) change over time; (ii) historicity; (iii) cohesiveness.

Next, as has been noted by several writers, there is some justification for viewing the dispute over SAI as being at least in part *terminological*.[8] This assessment especially suggests itself with respect to features (i) to (iii). For we may nevertheless describe species as apparently changeable, historical and cohesive entities, even if they turn out to be abstract entities of some kind, by tracing the trait in question to features of the organisms that constitute them: in this way, for example, when we attribute a given characteristic to a species, e.g., that it evolves, becomes extinct or forms a cohesive unit, our ascriptions may be understood in terms of states of affairs involving the organisms belonging to the species, namely, that these organisms adapt to their environment, are wiped out, or are subject to such evolutionary processes as gene flow, and the like. In order to establish that anything metaphysically substantive is at stake in this particular manifestation of the dispute over the nature of species, we would need to be convinced by the supporters of SAI that a genuine loss of expressive power results from the sort of maneuver just indicated.

(iv) absence of laws

Due to the importance assigned, as noted above, to the way in which natural kinds figure in our inductive practices, the laws of nature and causal explanation, the opponents of SAI should certainly take the

suggestion that generalizations concerning biological taxa may lack the character of scientific laws very seriously. The main reasons for thinking that biological generalizations like 'All robins' eggs are greenish-blue' should not count as laws are that these are apparently (a) *not exceptionless*; (b) do not sustain *counterfactual reasoning*; and (c) are not sufficiently *universal* in their domain of application.

However, as has been argued by Lange, it is debatable whether these considerations really establish their intended conclusion. (a) It is open to doubt whether any area of science can furnish us with exceptionless nomological generalizations, even those domains from which uncontroversial candidates for proper scientific laws tend to be drawn, e.g., physics and chemistry. (b) It seems to all the world that generalizations proposed in the special branches of biology, when properly qualified by *ceteris paribus* clauses, do sustain counterfactual reasoning. (c) And, thirdly, it is by no means obvious that all proper candidates for scientific laws are in fact prohibited, on the basis of purely formal considerations, from referring to particular regions of spacetime or their occupants (e.g., the Big Bang, the center of the universe, or the moon).

(v) lack of essences

There can be little doubt that broadly Darwinian assumptions create a generally hostile environment for essentialism about biological species. This biological reality ought to make philosophers working at some remove from the practice of evolutionary biology reluctant to persevere in their Aristotelian habit of ascribing essences to species on *a priori* grounds. Rather, the metaphysically cautious stance to adopt would seem to be one which allows that empirical findings either already have, or at least may, disprove essentialism about biological species.[9]

Note, however, that the truth of SAI does not immediately follow from the admission that species lack essences. For this step would require an additional premise, namely, that something could not be a natural kind unless it had an essence; and the status of this further premise at the very least deserves to be discussed. At the same time, even if the absence of species-essences cannot be taken to establish immediately that biological taxa therefore ought to be viewed as individuals rather than kinds, we should nevertheless concede to the supporter of SAI that the philosophical landscape has thereby changed substantially: for once the traditional tie between natural kinds and essences has been severed in the face of empirical considerations from evolutionary biology, essentialism now also can play no part implicitly or explicitly in any of the considerations leading up to our commitment to the existence of natural kinds. And those who are engaged in an analysis of induction, the laws of nature or causal explanation must be mindful of such potential conflicts created by the invocation of essentialist assumptions.[10]

(vi) REFERENCE TO SPECIES

Finally, species terms of course may well behave in certain respects *like* proper names, even if they are not in fact proper names and the entities they refer to do not belong to the same ontological category as the referents of proper names. In particular, it may well be the case that species terms have in common with proper names the semantic properties of direct reference and rigidity, even if species terms function as *general* terms (i.e., expressions which purport to apply to many entities simultaneously, e.g., 'red') while proper names function as *singular* terms (i.e., expressions which purport to apply to a single entity only, e.g., 'Earth'). In their classical treatment of the semantics of natural kind terms, Kripke and Putnam in fact classify expressions denoting species as general terms (Kripke, 'Identity and Necessity'; *Naming and Necessity*; Putnam, 'The Meaning of Meaning'); but they nevertheless ascribe the semantic properties of direct reference and rigid designation to these expressions. For this reason, in order for supporters of SAI to count the apparently name-like behavior of species terms as a consideration in favor of their position, an additional argument would have to be available to the effect that only expressions which are proper names can act semantically as directly referential rigid designators.

To conclude, then, the preceding discussion of biological species seems to me to have established that, despite SAI's assertion to the contrary, the considerations advanced in (i) to (vi) by themselves do not rule out the thesis that biological taxa are after all paradigmatic of natural kinds. Observation (v) is, however, quite significant, in that it forces the Species-as-Kinds view to abandon the traditional connection between natural kinds and essentialism in the face of empirical evidence from evolutionary biology.

IV. The Semantics of Natural Kind Terms

The arguments of the preceding section have not yet settled the question of what the ontological category of natural-kind-term denotations is. In what follows, I will let the semantic behavior of natural kind terms guide us in approaching this ontological question.

According to the standard Kripke/Putnam approach to the semantics of natural kind terms, terms like 'water' are like proper names in that they have the following features: (i) they are *rigid designators* (i.e., they refer to the very same object or objects in every possible circumstance in which they refer at all); (ii) they are *non-descriptive* (i.e., they are not synonymous with a description or a cluster of descriptions associated with them by competent speakers of the language); (iii) they initially acquire their extension by means of an ostensive baptism or a descriptive

stipulation, which is subsequently passed on from speaker to speaker via a *causal mechanism* of some sort; and (iv) apparent identity-statements involving rigid designators like 'Water is H_2O' are *necessarily* true (if true at all), but their truth is often knowable only *a posteriori*. A natural kind term like 'water', on this analysis, directly designates a natural kind, membership in which is determined by the presence of a presumed underlying common nature or essence, e.g., being composed of two parts hydrogen and one part oxygen, which may or may not be known to competent users of the term and which is open to discovery through science.

The central arguments given by Kripke and Putnam in favor of their analysis of natural kind terms are helpfully divided in Salmon into those of a modal, epistemological and semantic variety. Suppose then that the traditional descriptivist picture is correct and a natural-kind-denoting general term such as 'tiger' is in fact synonymous with a description consisting of the sort of qualitative information a competent speaker of the language commonly associates with tigers, e.g., that they are four-legged, meat-eating, cat-like animals with a tawny yellow coat and black stripes. Then, following the traditional descriptivist picture, one would expect a sentence like 'Something is a tiger just in case it is a four-legged, meat-eating, cat-like animal with a tawny yellow coat and black stripes' to come out as *analytic*, i.e., as necessarily true and knowable *a priori*; in addition, whether an object belongs in the extension of the term, 'tiger', on this analysis, is determined solely by whether it exhibits the sorts of characteristics just cited.

On the basis of the modal, epistemological, and semantic arguments, the traditional descriptivist analysis can be shown to be inadequate for the purposes of capturing the semantic behavior of natural-kind-denoting general terms. For it is neither sufficient for something's being a tiger that it be superficially similar to the entities we have been calling 'tigers' in all the ways listed above: for example, something might turn out to be four-legged, meat-eating, cat-like, etc., and yet turn out to be a robot. Nor is it necessary that the entities we call 'tigers' really have the features we have been ascribing to them: for example, due to some mass-hallucination perhaps, it might turn out that these animals in fact lack some or even all of the characteristics we have been ascribing to them. Thus, contrary to the traditional descriptivist picture, a natural-kind-denoting general term like 'tiger' evidently is not used by speakers of the language in such a way that it is either necessarily true or knowable *a priori* that something falls into the extension of the term just in case it satisfies the descriptive information commonly associated with the term.

While Kripke's and Putnam's central arguments are no doubt quite forceful as directed against the traditional descriptivist approach, it should be noted that, in the absence of further potentially controversial

premises, we can conclude from these arguments only that natural-kind-denoting general terms are *non-descriptive*, i.e., that they denote *directly*, and not via the mediation of the sort of descriptive material commonly associated by speakers with the term in question.[11] What is left open by the modal, epistemological, and semantic arguments, however, is whether natural kind terms are in fact rigid (i.e., whether they apply to the same entity or entities in every possible circumstances in which they denote anything at all) and to what category their denotations belong.[12]

Nevertheless, the non-descriptiveness of natural-kind-denoting general terms by itself is already sufficient to mark off natural-kind-denoting general terms like 'water' from their non-natural-kind-denoting counterparts, namely, terms like 'bachelor', 'hunter', or 'janitor'. For the Kripke/Putnam account replaces the purely semantic mechanism by which natural-kind-denoting general terms are said to determine their extensions according to the traditional descriptivist picture with a very different mechanism: natural kind term extensions are determined, rather, by reference to *actual-world samples* in conjunction with an appeal to a *same-kind relation* of some sort, the details of which need not be known to competent users of the term. In contrast, it would be quite bizarre to propose that the extension of a term like 'janitor' in every possible world includes whatever bears the relevant same-kind relation to actual-world janitors, while allowing that it might come as a complete surprise to us what sorts of features members of the extension of the term might turn out to share.

As the thesis that natural-kind-denoting general terms are non-descriptive is neutral with respect to the question of whether these expressions are rigid and what the ontological category of their denotations is, we should not take it as having been settled that natural-kind-denoting general terms must be analyzed as denoting the same abstract non-set-like entity (such as a property) in every possible world in which they denote anything at all, while their extensions may vary from world to world. Unless further arguments are provided to close off the alternatives, other candidates for the role of natural kind term denotations should thus be regarded as live options as well, in particular that natural kind terms denote (1) sets, (2) wholes, or (3) pluralities.[13] Since we cannot attempt to treat this difficult question properly in the present context, I will mention only in passing that there are reasons for opting against the first two choices; for it follows from both of these candidate analyses that natural-kind-denoting expressions function implicitly as *singular* terms, rather than general terms.[14] Thus, once the requirement of rigidity is abandoned, the central arguments presented by the Kripke/Putnam approach appear to be at least compatible with the possibility that natural kind term denotations are simply traditional predicate-extensions.

V. Incommensurability and Indeterminacy: Physical and Chemical Kinds

The following two prominent objections, among others, were raised early on against the Kripke/Putnam approach to natural kind terms and have enjoyed an afterlife of sorts since then. First, it was pointed that our natural kind terms seem to denote substances of varying degrees of uniformity, due in part to the phenomenon of *impurities* as well as to the natural occurrence of *isotopes*. Thus, Zemach (120) for example observes that much of what we in practice refer to as 'water' is in fact not pure H_2O, but contains traces of many other elements: heavy water, mineral water, salt water and distilled water are all commonly labeled 'water', as were, at least at one point in time, tears, urine, sweat, saliva, and the like, despite the fact that the substances in question obviously lack a uniform chemical composition. Considerations of this kind seem to suggest that the extension of terms like 'water' may in fact be more heterogeneous than implied by the Kripke/Putnam analysis of natural kind terms.[15]

Secondly, a number of writers have emphasized that such apparent natural kind terms as 'mass', 'force', 'motion', 'species', and possibly even 'phlogiston', are tied through their *theoretical* content to particular scientific traditions in physics, chemistry, biology, and the like. As a result, such terms may in fact be more susceptible to the possibility of meaning-change and the sort of incommensurability that is brought on by scientific revolutions than the Kripke/Putnam approach initially let on. The resulting alleged lack of stability in the semantic behavior of natural kind terms would in turn lend itself more naturally to a *descriptivist* approach to their meaning.[16]

Both of these lines of criticism have received ample discussion in the literature and defenses of the Kripke/Putnam approach in response to them are available. Thus, the presence of impurities and isotopes among natural kind term denotations may be interpreted as indicating simply that we often do not immediately succeed in singling out genuine divisions among natural kinds: even though we of course intend there to be a perfect match between a certain portion of our vocabulary and the actual varieties of objects we encounter in ordinary life and in the laboratory, our attempts at classifying the phenomena around us are rarely if ever completely free of any indeterminacy or from the need to revise our conceptual or linguistic apparatus to some extent somewhere down the line.

In response to the second criticism, it has been suggested for example that theoretical terms should be analyzed as implicitly *context-dependent* (Kitcher, 'Theories') or as only *partially denoting* a physical quantity singled out by a later theory (Field; see also LaPorte, 'Chemical Kind Term Reference'; 'Essential Membership'; *Natural Kinds*). Similarly, Boyd ('Realism, Conventionality'), like Field, also appeals to the apparatus of

approximate truth to justify a realist conception of scientific progress in the face of challenges raised by the constructivist. Finally, even Kuhn himself (see, e.g., 'Commensurability'), in later work came to advocate a much less radical and much more localized version of the incommensurability thesis than was originally suggested by his earlier writings (especially *Structure of Scientific Revolutions*). This more moderate version of Kuhn's position certainly allows for, and in fact predicts, a fair amount of stability in the taxonomic categories utilized by successive theories.

Short Biography

Kathrin Koslicki was born in Munich, Germany, where she spent the first eighteen years of her life. After a year of studying philosophy and classical philology at the University of Tübingen, Germany, Koslicki completed her undergraduate work at SUNY Stony Brook in 1990; she received her Ph.D. from MIT in 1995, and spent the next decade or so teaching at the University of New Orleans, USC, the University of Florida, and Tufts University. She joined the University of Colorado, Boulder, in 2007. Her interests in philosophy lie mainly in metaphysics, the philosophy of language, and Ancient Greek philosophy, particularly Aristotle. In her monograph, *The Structure of Objects* (Oxford University Press, 2008), she defends a structure-based, neo-Aristotelian theory of parts and wholes. Her work has also appeared, among other things, in *History of Philosophy Quarterly*, *Synthese*, *Noûs*, *Mind and Language*, *Philosophical Studies*, *The Journal of Philosophy*, *Philosophy and Phenomenological Research*, and *Dialectica*.

Notes

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[1] A more detailed version of what follows can be found in Chapter 8 of Koslicki's *Structure of Objects*, on which the current entry is based.

[2] According to Ian Hacking, John Stuart Mill introduced the expression, 'Kind' (with a capital 'k'), into English philosophy in his *A System of Logic* in 1843; in 1866, John Venn coined the phrase 'natural kind' in his *The Logic of Chance*; Russell reintroduced it into English philosophy in 1948 in *Human Knowledge: Its Scope and Limits* (see Hacking, 'Tradition of Natural Kinds' for further discussion of the history of kinds).

[3] Of course, as inhabitants of a post-Kripkean era, we may wonder whether Mill correctly judged *white thing* to be a phony kind, since some features that all white things have in common appear to be non-analytically connected with their whiteness, e.g., that they emit or absorb light in a particular fashion.

[4] The connection between natural kinds and laws of nature is for example explicitly endorsed in Fodor 506; Putnam, 'Analytic and the Synthetic' 53 (page number comes from the reprinted version in Putnam, *Mind, Language and Reality*); as well as Churchland.

[5] See for example the classical account of the semantics of natural kind terms in Putnam 1975. For a similarly realist line on the role of natural kinds in causal explanation in terms of homeostatic property-clusters, see Boyd, 'How to Be a Moral Realist'; 'Realism,

Conventionality'; 'Realism, Anti-Foundationalism'; 'Constructivism'. For a skeptical voice concerning the usefulness of the notion of natural kinds, see Quine's classical paper, 'Natural Kinds'.

[6] Locke (on some readings) denies that genuine boundaries among particular objects exist, independently of the nominal essences in terms of which we conceive of them; the phrase, 'chasms or gaps', is borrowed from him. For interesting discussion, see Ayers.

[7] For discussion, see for example Crane; Dupré, 'Natural Kinds'; *Disorder of Things*; Ereshefsky; Kitcher, 'Species'; 'Against the Monism'; 'Ghostly Whispers'; 'Some Puzzles'; LaPorte, 'Essential Membership'; 'Rigidity and Kind'; *Natural Kinds*; Sober.

[8] See especially Kitcher, 'Species'; 'Against the Monism'; 'Ghostly Whispers'; 'Some Puzzles'; LaPorte, *Natural Kinds*.

[9] Alas, the Aristotelian custom still lives on; cases in point for example are Lowe; Wilkerson, 'Natural Kinds'; 'Species Essences'; *Natural Kinds*.

[10] My remarks above are only directed towards a particular type of essentialism concerning species, namely, the sort of view according to which species-essences consist in a set of characteristics that are shared by and essential to the members of the species in question. However, there are other sorts of essentialism about species which are not immediately touched by Darwinian considerations, e.g., the historical species-essences advocated in LaPorte, *Natural Kinds*. In analogy with Kripke's origin-essentialism for the referents of proper names, LaPorte holds that it is essential to a species that it originated in exactly the particular slot within the phylogenetic tree of life on Earth in which it in fact originated. This latter sort of view attributes an essential property directly to the species, rather than its members, and is fully compatible with the idea that particular organisms can fail to belong essentially to the species to which they in fact belong.

[11] My conclusions here essentially agree with those of Cook; Deutsch; Linsky; Salmon; Soames ch. 9–11.

[12] The essentialism presupposed by Kripke and Putnam would allow us to conclude that, whatever exactly the nature of natural kind term denotations turns out to be, at the very least the essences associated with these terms remain stable from world to world. Cook suggests that this sort of stability might be all that is needed to establish the rigidity of natural kind terms, independently of whether these terms are embedded within an extensionalist or intensionalist framework.

[13] I mean by 'plurality' here nothing more mysterious than traditional predicate-extensions: thus, according to the third candidate listed in the main text, natural kind terms like 'water' are to be understood as denoting simply *many* things simultaneously, i.e., any and all samples of water, without thereby denoting a *single* entity (e.g., a set or a whole) that is composed of these many things.

[14] I have argued that such a view should be avoided with respect to mass terms (see, e.g., Koslicki, 'Semantics of Mass-Predicates'; others have urged an analogous conclusion for plural count nouns (see, e.g., Higginbotham and Schein; Schein). The case of singular count nouns and adjectives is not really under dispute.

[15] For discussion of these and related points, see for example Aune; Donnellan; Johnston; LaPorte, 'Chemical Kind Term Reference'; *Natural Kinds*; Mellor; Zemach.

[16] For relevant literature, see for example Boyd, 'How to Be a Moral Realist'; 'Realism, Conventionality'; 'Realism, Anti-Foundationalism'; Enç; Field; Hacking, 'Working in a New World'; Kitcher, 'Theories'; Kuhn, 'Commensurability'; LaPorte, 'Chemical Kind Term Reference'; 'Essential Membership'; *Natural Kinds*; Lewis; Nola; Papineau; Sankey; Shapere.

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