The Curious Role of Natural Kind Terms

Abstract: *The semantics of natural kind terms has traditionally been seen as a problem of reference. This has led to some to worry over the ontological commitments we might take up by using them. Kripke and Putnam have suggested that their meaning begins with rigid designation, with any further implications emerging after much empirical study. I part ways with this assumption about reference and instead offer an account that focuses on the contribution that these terms make to the inferential roles of different sorts of sentences, in keeping with the work of Brandom and Sellars. I note that natural kind terms play an odd array of grammatical roles, both as subject and as parts of predicates, and explain why this dual role contributes something pragmatically significant to explanations of natural phenomena.*

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I

The meaning of natural kind terms is a philosophical problem with a classically beguiling character. On the one hand, our ancestors used analogues of many of our modern expressions thousands of years ago, yet we generally insist that the contemporary scientific community has the last word on what they imply. Many philosophers take questions about the semantics of natural kind terms as extensions of, perhaps even mere footnotes to, the ancient debate over universals and particulars. My aim here, however, is to say something about how we should approach the semantics of such expressions - their meta-semantics if you like - and so I will set aside worries about metaphysics for the moment; natural kinds are what they are and nothing else. What I would like to investigate is what those words mean when we use them and why we should have words like them in a language like ours. We cannot hope to exhaust such a topic here, so I will strive to offer a novel take on some crucial issues that any complete semantics for natural kind terms must confront. It is difficult to mention natural kind terms in the present context without reference to the work of Kripke and Putnam, but I will reserve comment for the most part here, having written on their views elsewhere.

Natural kind terms and other type-terms present certain headaches for those who seek a naturalistic semantics, for their presence is often cited as evidence for the positing of real universals. At the very least, most philosophers would like to avoid all of the ontological commitments to anything besides particulars that they can. It is therefore troublesome that the appearance of a natural kind term as the subject of a declarative sentence, such as "The oxygen atom has 8 protons in its nucleus," would seem to refer not to any particular oxygen atom, but to some abstract or extraphysical object, the kind itself. A slew of difficulties in explaining reference and epistemic access to such objects makes that view unpalatable to many philosophers. The predominant approach in contemporary philosophy has been to seek methods to translate or assimilate talk about types to talk about classes of particulars. [See Quinton (1957

and 1973).] "The lion is warm-blooded" might be reworked as "For all x, if x is a member of L (the class of lions), then x is warm-blooded." They function, as Sellars put it, as distributive singular terms, distributing whatever the predicate implies to each member of the class individually. As the accounts grow more sophisticated, the intensions of type-terms are explained as sets of extensions assigned to possible worlds. Some criteria will have to be offered for saying just which particulars fall into the extension of the concept at any given possible world, but proponents of this view will label that an epistemic matter rather than a semantic one.

There is good reason to doubt that even a more sophisticated version of this approach will suffice. Consider some counterexamples:

(1) The lion (*Panthera leo*)is disappearing from the Serengeti Plain.[1]
(2) The domestic shorthair cat (i.e. housecats, *Felis domesticas*) has mutated during its time in domesticity.
(3) Ozone (O_3) is becoming the predominant pollutant in the air supply.

These sentences are alike in that we cannot explain their semantic content as the distribution of a property across the members of a class. These are cases of natural kind terms occurring as singular terms in the subject position of a sentence, and some have called these 'kind-referring' usages of those terms. No particular lion has the property of 'disappearinghood' and no particular ozone molecule is polluting the air supply in its own right. The semantics of natural kind terms cannot be straightforwardly explained strictly in terms of distributive reference as described above. In some cases, a surrogate might be available, such as:

(1') The number of lions alive on the Serengeti Plain is approaching zero.

Let us ignore the singular reference to an abstract object (the *number* of lions) for now. What the nominalist-as-semantic-theorist would suggest here is that while not every kind-referring locution can be explained as a singular term that distributes its reference across the class of its members, we may translate or paraphrase any remaining sentences into surrogates like (1'). (See Quine (1969a and 1969b).)

As a piece of semantic theory, this strategy does not seem promising. At first glance, the problem with such analogues would seem to be that there does not appear to be a consistent pattern by which we could institute a regular procedure for generating them. (I will suggest

deeper problems in a moment.) Figuring out (1') does not contribute to figuring out how to replace (2). (3) might look similar in that it seems to imply that there is more ozone in the atmosphere or that its concentration in the air supply is increasing, but neither of those is necessarily the case. (Ozone reacts with several other compounds and a depletion of any of them may make ozone pollution a problem without actually adding any ozone to the air.) If we are going to implement a strategy of paraphrasing away such occurrences of kind terms into putatively logically equivalent sentences, then the only way we could establish the legitimacy of such an approach would be to demonstrate the completeness of such a scheme. Since we have a boundless capacity for recombination of these expressions into novel sentences, the only hope for such a proof of completeness would be a recursive translation procedure based on the grammatical form of such sentences. As we see with these examples, there is no obvious candidate for this job.

My skepticism about such a strategy is not rooted in doubts about the truth of such surrogate sentences or the possibility of figuring out a surrogate for each kind-referring sentence we come across. I can think of no good *a priori* reasons to put such bounds on our ingenuity. The real problem with such a proposal is that it seems to be theoretically defunct. We asked what explanation could be given for the content of a certain sort of locution and the nominalist-as-semantic-theorist said that they could be done away with in favor of those surrogates. This would be an acceptable strategy if we were talking about mere idioms that appeared in regular ways in every token instance, like the word 'sake' in 'for the sake of x' and 'for x's sake.' But singular term usages of natural kind terms appear to operate just like other compositional subsentential elements, suggesting that there are innumerably many sentences we could form with them. If so, then a sentence-by-sentence replacement is dubious not only because of the volume of material involved, but because we owe the same sort of analysis for such expressions that we do any other category of subsentential expressions. Asserting that we could figure out a surrogate in every case is not an answer to such a call for explanation, even if it is true. What I

aim to show is that there is just such an explanation available to someone who adopts the approach to semantics the I will endorse in this paper.

One final point should be made before I move on to my account. One intuition that might come to some readers is that the kind-referring usage described above is an archaic form disappearing from common usage. Its successor might be bare plurals (i.e. 'lions' instead of 'the lion'), which seems to present fewer ontological entanglements. Whether or not there are real kinds, there are surely sets of lions. However, this advantage is illusory, as the semantics of bare plural usages of kind terms present similarly intractable sentences. Bare plurals do not cash out directly as distributive terms in many cases, (e.g. "Lions hunt as a pride" - not if they are cut off from the pride or live in the zoo they don't) and they present the same variety of grammatical forms as the singular term usages of kind terms described above, appearing both as kind-referring singular terms and object-referring singular terms. For this reason, as well as the literature suggesting that bare plurals require a semantics of their own (see Carlson (1977 and 1995)), I do not think we can simply substitute bare plurals for kind-referring singular term usages of kind terms. For the time being, I will concentrate on the singular term usages on the assumption that much of what I say will accommodate them (with a few adjustments) down the road.

I would like to suggest that we take a very different approach to the semantics of natural kind terms, one in which semantics answers to pragmatics. Contemporary philosophers often infer from the assumption that language bears some intimate connection with the world to the view that this connection must consist in word-world relations between word types or tokens and the things they represent - objects, events, states of affairs, etc. Correspondence theories of truth are a classic example of this; sentences have the property of truth when they represent a state of affairs that obtains, in some suitably loaded sense of 'represent.' But pragmatism has offered philosophers the alternative of saying that our account of that connection with the world might be cashed out in terms of performance and the pragmatic significance of speech acts rather than in terms like representation. To borrow Wittgenstein's metaphor, we look at them in terms of

their practical role, like 'pieces' in a 'game'. Taking language as the medium of this conceptual process, several authors have suggested that it is the linguistic expression of judgment to which we must look in assessing the pragmatic significance of a piece of language in order to give such an account of semantics. Some go on to argue that the best way to approach this is to start with good inference, particularly good material inference. (See Brandom (1987 and 1994), Grover, Camp and Belnap (1975), Lance and O'Leary-Hawthorne (1997), Rosenberg (1974) and Sellars (1963, 1980).) An account of semantics along these lines begins with an analysis of the inferential role of an expression. We ask what the inferential proprieties of sentences are and then look at how different categories of subsentential expressions affect those proprieties when we compose sentences with them.

On this view I am endorsing, an understanding of what we can and should do with natural kind terms will suffice as a semantic account so long as we can articulate the pragmatic significance of such expressions in terms of their inferential proprieties and concomitant commitments that they confer upon us. Such an account would come in the form of a normative pragmatic analysis - an investigation of what sorts of things we are committed to and entitled to do in virtue of the assertion of some claim made with the piece of the language to be analyzed. Those commitments and entitlements may include inferential moves in a very broad sense, encompassing 'entry' moves like observation reports and 'exit' moves like actions in accordance with intentions as well as moves from one assertion to another.

Of course, inferential moves can only be made with complete sentences (or an implication of them). One cannot infer from a word to another word, or from an observation to a word, but only to and from assertions of sentences that include such words. So an account of subsentential expressions must address how those expressions contribute to or play a role in the sentences in which they occur. A semantic analysis of a category of expressions will proceed by taking the syntactically significant categories of expressions of the language and searching for ways in which occurrences of those word-types, or subsets of those word-types, affect the pragmatic significance of the sentences in which they appear. For instance, Brandom (1987 and

1994, Ch.6) demonstrates the inferential contribution of singular terms in terms of the distinctive way in which we may perform substitution inferences with them.

Natural kind terms, a subset of the sortal terms with a few mass terms thrown in, are such a class of expressions whose pragmatic significance can be understood in substitutional terms, as I shall demonstrate, and whose greater role in the language game is generally taken to be in the area of explanations of natural phenomena. For the time being, I will not offer a deeper account of which terms are the natural kind terms. My concern is with explicating their inferential role, and a suitable defense of some set of necessary and sufficient conditions for 'naturalness' would be a substantial undertaking in itself. In return for this indulgence on the reader's part, I will make my examples as mundane as possible. If there is no genuine difference between the explanations we give in the natural sciences and those we give in other theories, then there may be no distinction to be made between natural and non-natural kind terms. I suspect that there is such a distinction, but I will not argue that case here.

II

Natural kind terms, and sortal terms in general, bear a conspicuous disanalogy to other categories of expressions in our language. Their role as subsentential expressions actually bifurcates into a pair of distinct compositional roles. Offering the sort of pragmatist account I have described obliges us to account for both of them in turn.

On the one hand, they appear in what look like predicates, e.g. "Simba is *a lion*." This "is" is certainly not the "is" of identity, for even if we believe in some universal for lionkind, a particular lion is not identical with it. But Gupta (1980) gives us good reason to believe that such uses of sortal terms or "common nouns" cannot be analyzed as predicates are, for sortal terms add rules of identity in addition to rules of application. Sentences of the form "...is a K" express claims that commit us to the existence of an object and imply criteria for asserting an object's identity with itself and its identity over time. Ordinary predicates could not do so; only by taking "...is red" to indicate a commitment to a "red-thing" could they do so, but "thing" itself is so broad a concept in its applicability that it does not sort and so offers no criteria at all.

Roughly speaking, genuine predicates allow us to assign properties to objects, while sortal terms play a role in saying that something is an object as well as assigning properties. Natural kind terms are not simply parts of predicates like property terms, but expressions whose occurrence in assertions confers an additional category of commitments upon us. Thus, we could not translate "x is a K" with "x has K-hood" where "K-hood" names the property of being a member of the kind, like "humanity" or "rabbithood." Such a translation cannot carry with it all of the inferential commitments of the original locution because nothing about the concepts expressed by predicates tells us what counts as the same object, whether at an instant or over time. So we must distinguish between genuine predicates and sortal terms that apparently occur as parts of predicates. Let us call usage of natural kind terms in these apparently predicative grammatical roles *attributive* usages of natural kind terms to distinguish them from genuine predicates. In addition to these attributive usages of natural kind terms, there will also be singular term usages of natural kind terms like, "The lion is warm-blooded" mentioned above. If we were right to reject the attempt at a systematic reduction of the singular term usages to attributive usages, then natural kind terms (and sortal terms in general) would seem to have an irreducibly dual role in semantics, unlike any other category of expressions.

One might argue quixotically that there are really two distinct expressions to what we call a natural kind term that just happen to have the same noises and inscriptions associated with them in every single case. These two expressions could then be linked to one another by a series of rules associated with each pairing. "Lion" as the expression occurs in "Simba is a lion" and "The lion is warm-blooded" would actually be two distinct semantic types that we were bound to use together in certain ways. For instance, these two sentences imply "Simba is warm-blooded." But each expression-type would have its own distinct rules of material inference, along with rules of inference linking the two expressions. A monolithic division between expressions that occur in the subject position and those that occur in predicates makes for a simpler set of semantic categories, but does so at the cost of explaining these inferential connections by a slew of ad hoc rules linking expressions from the two categories without uncovering why such

expressions should be linked to one another at all. That the two usages bear such an intimate relation cannot be a mere historical accident and separating them in this way does nothing to explain that relation. What we now seek is an account that articulates what is inferentially distinctive about natural kind terms as a semantic category. Our mission in the rest of this paper will be to show how the dual grammatical roles described here enable us to make some important inferential moves in the explanatory process of the natural sciences.

III

I take it to be uncontroversial that the distinctive practical task that cannot proceed without natural kind terms is the explanation of natural phenomena. In explaining how and why the world is how it is and does what it does, we take up commitments to some set of Ks (however many our theories require) and to claims that they behave in certain ways with a lawlike regularity. Natural kind terms can occur in sentences that have nothing to do with the explanation of natural phenomena ("Daddy, I want a lion for my birthday!"), but scientific explanation of natural phenomena cannot proceed without such terms. This is not to assert that every law of nature involves even an implicit appeal to a natural kind term (though I suspect this is the case), nor that every scientific explanation requires appeal to a law of nature. I only wish to make the more modest assumption that every explanatory theory in the natural sciences will include some natural kind terms and that they will bear a distinct relation to laws that is brought to light in certain sorts of theoretical explanation. For now, we are only worried about cases where natural kind terms actually *do* show up. Such an account must make explicit how each usage of natural kind terms - as singular terms and as attributive expressions - plays a role in explanatory discourse and then suggest how the two usages would be inferentially linked to each other in a way that is salient to the demands of that discourse.

I will not attempt to offer a full theory of scientific explanation here. We will only be concerned with how natural kind terms figure in the articulation of inferential practices within any scientific explanatory project, such as observation and prediction, and the inferential role they play in what should intuitively strike us as sufficient explanations in some of those theories.

In inferential terms, the theoretical claims doing the explanatory work should serve as licenses for us to infer to the claims that we wish to explain. One of the characteristic ways in which we go about doing this is by generating predictions and I believe we have good reason to believe that attributive usages of natural kind terms are important elements in an articulation of the inferential workings of some parts of such a process.

An explanatory discourse will have to include some set of claims tied to observation, and science is clearly no exception. Observation claims allow us to make claims about particulars in a way that will license further theoretical consequences and thereby make use of its descriptive and predictive resources. This allows us to consider particulars with regard to properties that are salient to theoretical generalizations. In a sense, observation claims are how we get particulars 'into' the context of theoretical consideration. Scientific discourse is distinguished from other explanatory discourses by the sort of practical consequences we get 'out of' it in the form of predictions and the degree of confidence we have in those predictions. Certain further claims about the future events and behavior of particulars will therefore have to be licensed by the claims that we use to bring the particulars 'into' theoretical consideration.

These aspects of scientific discourse are accommodated by the attributive usage of natural kind terms discussed above, or at least could be accomplished with nothing but attributive usages. We become entitled to such claims involving attributive usages of kind terms by inferring from some other observation claims or even by acquiring the ability to observe some distinctions non-inferentially. (Let us call these 'attributive K-sentences.') For instance, the observation claim "x turns litmus paper red" would allow us to infer to the claim "x is an acid" and further observations might entitle us to the claim, "x passes tests A, B and C for the presence of chlorine ions." All of this would amount to evidence for the attributive K-sentence "x *is hydrochloric acid*." Entitlement to this claim allows us to attribute further things to the subject, such as, "x *contains free* H_3O^+ *and* Cl^- *ions*", "x *will react vigorously with glucose at STP*," "x *has a pH of less than 7*."

The explanatory importance of some of those attributions is their practical cash-value as predictions of what will or would happen under certain conditions. These allow us to predict or even plan future events in which those regularities become significant. Thus, attributive K-sentences serve a role in a theoretical discourse by linking observation claims, which may themselves be other attributive K-sentences, to theoretical contexts and licensing further theoretical claims that serve more immediate practical interests. We move from claims about what we *see* to claims about what we want to say that a thing *is*, which can then allow us to move to claims about what we can *expect*. Attributive K-sentences thus serve as nodes in an observation/prediction calculus that is essential to connecting scientific discourse to the world and generating practical consequences that make the entire discourse significant.

What I want to suggest is that natural kind terms commit us to *nomic bundles* - bundles of laws with common subsentential parts - so formulated because we attribute a theoretical salience to a coalescence of regularities in the physical world. Here, I must introduce the notion of a *substitution frame*. A frame will be a subsentential expression that combines with singular terms to make a well-formed sentence. We could substitute one singular term for another in such a frame while preserving the syntax of the resulting sentence, and some such substitutions will actually count as good inferences. For example, "...is red," "...is an electron" and "…is taller than…" would all be substitution frames, and moves like the one from "Cicero spoke out against Catiline" to "Tully spoke out against Catiline" count as good inferences, given the identity of Cicero and Tully. One might also think of inferences whereby we make a new attributive claim of the same subject as substitution inferences, albeit ones where we actually replace the substitution frame, rather than the singular term, e.g. "Flynn is a bachelor" entails "Flynn is male." As Brandom (1994, Ch. 6) points out, the curious dissimilarity between the singular terms and substitutional frames is that substitutions of singular terms (Cicero for Tully) always operate symmetrically in extensional contexts, while substitutions of substitution frames ("...is red" for "...is colored") generally function asymmetrically. One cannot infer from something's being colored to its being red.

If we have a series of generalizations of the form "All Ks are Fs," or perhaps "All Ks are G," then our nomic bundle will include a series of substitution frames of the forms "...is an F" and "...is G." These sentences can be understood in the sort of distributive terms that everyone since Frege has suggested: "All Ks are Fs" is logically equivalent to "For all x, if x is a K, x is F." Some of these will have the added status of combining to make lawlike statements with the right natural kind terms, e.g. combining "Electron" with "...has a charge of $1.6x10^{-19}$ coulombs." We will call these *nomic* substitution frames. To commit ourselves to the claim that our theory should include a kind term is to commit ourselves to the salience of a cluster of regularities in the physical world that entitle us to those lawlike claims. Given that part of our explanatory task in formulating a theory is finding how regularities bear upon one another, we would want to find cases where regularities coincided in a lawlike fashion, and attributive K-sentences serve as a way to claim that an object or an event is theoretically salient and license moves to further claims of practical significance. (See Lange (1993 and 1995) for more on this view of laws as inference licenses.)

Natural kind terms thus serve the role of sorting that which we can attribute to particulars and kinds into classes of co-applicability and thus license inferences involving such attributions. This is not to say that the attributive expressions and predicates in that class mean the same thing; "...is warm-blooded" and "...is a vertebrate" are both applicable to the lion and to particular lions, but they are certainly not synonymous or logically equivalent. Rather, they are the frames for which such substitution-inferences are licensed in every case that we are licensed to assert a K-sentence. They are the frames that apply to all the lions, or electrons, or H_2O molecules, etc. The theoretical process of gathering evidence to determine those classes of co-applicability will be subject to the usual constraints of simplicity and parsimony. We want the smallest set of kind terms that will do the most theoretical work. Thus, gerrymandered artificial kind terms like "molybdenum or an ecosystem" are not undesirable additions because they fail to meet this demand for classes of co-applicability, but because they do not give us interesting sets of laws that we would not otherwise have. We know that sortal terms group objects, but they

will also group together predicates and attributive expressions into those that apply universally to the sortal term's class and those that do not. That co-applicability will be salient to the practical aims taken up in providing the theory and introduces an important sort of inference license to our discourse. It licenses us to substitute singular terms such as proper names into the nomic substitution frames associated with a kind, giving us license to infer to theoretically interesting claims. It will also license some moves that are not universal for all Ks, such as "…bears live young" or "…is four-legged" which are true for some or most lions. Managing the exceptions to these generalizations is a part of grasping notions of kind, though explicating the epistemic grounds for these exceptions is probably too large a topic to be addressed here.

Thus, we have a way of taking the general lawlike claims from a theory and having them apply to particular objects and events via a substitutional procedure employing only the attributive usage of natural kind terms. These classes of co-applicability also suggest what we commit ourselves to in saying that two things are of the same kind. To say "a is a K" and "b is a K" introduces a certain equivalence relation between the two of them; not one of numerical identity where we can substitute "a" for "b" and vice versa in every extensional context, but a symmetrical substitution license across the class of substitution frames included in the relevant nomic bundle. That is, the same laws apply to objects of a kind and kind terms mark out the applicability of a set of laws. All of this is accomplished, or can be accomplished, solely with the attributive usage of natural kind terms.

Our reasons for wanting a bundle of lawlike claims with common subsentential parts will also be tied to our explanatory obligations. Imagine for a moment how we might 'break up' that bundle without losing the lawlike claims that we use in scientific explanation. There is nothing logically inconsistent in suggesting that we could have each of the lawlike claims in our bundle expressed without any common natural kind terms. Each lawlike claim can have its own formulation with a unique K-term and evidential criteria for spotting instances of the kind. So for instance, we now make numerous lawlike claims about electrons; "An electron has a charge of 1.6×10^{-19} coulombs", "An electron has a mass of 9.1×10^{-28}g", etc. We might rewrite each of

these claims as a 'lonely' lawlike claim not attached to a bundle with any others by introducing a unique sortal term for each generalization; "A K_1 has a charge of $1.6x10^{-19}$ coulombs" and "A K_2 has a mass of $9.1x10^{-28}$g", etc. where we make no claims about the similarity of K_1s to K_2s, etc.

The pragmatists among us will point out that among our 'lonely' K-terms, many will have exactly the same evidential criteria as others, rendering any distinction between them otiose. But we must also see that such a proliferation of 'lonely' lawlike claims actually strips us of explanatory possibilities. They might give us an empirically adequate observation/prediction calculus, but they would fail to unify those claims in a way that licenses us to make interesting and fruitful inferential moves between the different attributions of various properties. This also flies in the face of the grounds we could offer to confirm such putative laws. One generally cannot confirm a law in isolation, both because one must often lean on other laws to interpret empirical data and because a large part of the grounds we have for rejecting or accepting a given lawlike claim is its coherence with a complete system of laws in a scientific theory. Breaking up the bundle does not seem to be a viable possibility after all.

The very notion of a bundle may send shivers down the spines of some philosophers, for it sounds like a veiled attempt to smuggle in the sort of 'cluster concept' view that Kripke (1972) argued against so persuasively. [See also Putnam (1962, 1973 and 1977).] I have no wish to resurrect that dinosaur, so let me say why I am not committing myself to such a position. The cluster concept view suggested that the meaning of a proper name or a kind term was some cluster of descriptions and its reference could be fixed by a stipulation of such descriptions associated with the term at the time of its introduction. Kripke pointed out that we might find that all such descriptions should be revised and that the cluster view cannot accommodate such revisions. Note that Kripke's claim is that a cluster of descriptions cannot play a specific role - fixing the reference and giving the meaning - not that there will be no such clusters of descriptions associated with the term. My claim here is only that the semantics of a natural kind term in its attributive usage can be made explicit in terms of substitution inferences made with *some* cluster of substitution frames (the analogue of descriptions in my account).

On my view, we are not committed to saying that which frames are in the bundle/cluster is determined by the introduction of the term, nor that the bundle of nomic substitution frames makes denotational facts about the kind term something we know *a priori*. To say that the cluster of descriptions or substitution frames fixes the reference of the term is an additional claim that does not necessarily follow from the account I have given. Though every natural kind term will have such a bundle, what belongs in it will be a matter determined by evidence and coherence with other theoretical commitments, not mere public stipulation.

IV

Having said what inferential role attributive usages of natural kind terms play, we can now turn to a discussion of singular term usages of natural kind terms. When talking about physical phenomena and making observation claims and predictions, we generally want those claims to have the practical force that they do in light of what the kinds of things involved would do in any possible world similar enough to our own that it would fall into the purview of our theories. Since it is not their accidental historical occurrence that interests us, but their occurrence as instances of a type we find theoretically important, we often speak of physical regularities with singular terms to emphasize that we are abstracting or idealizing away from the details of the actual world (e.g. "The lion is warm-blooded"). This is undoubtedly how we *do* make use of natural kind terms as singular terms to talk about types, but those inclined towards a stingy nominalist ontology will be eager to eliminate such type-talk. As we have seen, we could get by with only the attributive usages of natural kind terms and conditionals in most cases. What we would need to provide is a sort of explanatory role that could only be filled by a natural kind term appearing as a singular term.

Resurrecting the strategies from section I without appealing to classes, claims of the form:

(6) The K is Φ.

could be replaced by claims of the form:

(7) For all x, if x is a K, then x is Φ.

This would not eliminate or translate away all of our kind terms, but it would provide a surrogate that would do all the work we have so far identified. If we have the logical vocabulary to make claims of the form of (7), and we certainly do, then we can make explicit all of our theoretical commitments expressed in the form of (6) without the use of natural kind terms as singular terms.

As an initial step towards deflating this objection, let me say something about the adequacy and the non-spookiness of singular term usage of natural kind terms. Brandom (1988 and 1994, Ch. 6) argues that the distinctive feature of singular terms that makes them semantically significant parts of our language is the symmetric substitution-inference commitments we take up with them. This symmetry establishes equivalence classes of expressions for which substitution inferences would be good ones. In the case of particulars and their naming expressions, the explication of those substitution licenses takes the form of identity claims. But it would be an error to think that this was the only sort of substitution-inferential commitment we could take up and the only sort of equivalence class we could have. Attributive kind-claims differ from identity claims in that they allow substitution inferences into a specific set of substitution frames, rather than issuing us a fully general substitution license for a pair of singular terms. Rather than telling us that two terms are intersubstitutable in all and only the same set of frames, the nomic bundle surrounding an attributive K-sentence tells us what the acceptable set of frames would be for substitution inference. The function played here is still one of licensing substitution inferences, though it is a restricted license whose boundaries we must spell out explicitly through the discourse surrounding theoretical inquiry.

Singular term usages like "The lion is warm-blooded" allow us to state explicitly which frames belong to the kind term's bundle. While it would be possible to do all this with sentences of the form of (7), there is nothing logically illicit about the substitution inferences we are employing here. The difference between names and sortal terms here is simply that the sortal term establishes an equivalence class that may have names for more than one particular and we associate a specific set of substitution frames with it, rather than a general license to substitute

into any frame in which a member of the equivalence class occurs. For example, "Simba" and "Leo" might belong to the equivalence class associated with the kind term "lion" and we might be committed to the claim "Simba lives in the Washington Zoo," but that does not make the substitution inference to "Leo lives in the Washington Zoo" a good one because that substitution frame is not associated with the sortal term that established that equivalence class. Leo may live in the wild and still be a lion.

So we have two sorts of substitution-inferences that might be made here. First, from the claim "Simba is a lion" and "Leo is a lion," we know that we will be licensed to make substitution-inferences involving some set of frames, Γ, associated with the natural kind term "lion". Thus, where $F \varepsilon \Gamma$ and F_{Simba}, we are licensed to infer and assert F_{Leo}. So it goes for the attributive usages. In the case of kind-referring usages, we will find that those singular terms are symmetrically substitutable across all extensional contexts, as are all singular terms. So, given "The lion is F" and "Lions are Φ s" (i.e.$\forall x(Lx <--> \Phi x)$), we will be licensed to infer and assert "The Φ is F."

So if there is nothing spooky or illicit about singular term usage of natural kind terms, what could we say in its favor? One point to be made about singular term usage of natural kind terms is that it makes possible a similar sort of substitution inference with kind-referring sentences. The critic of singular term usage of natural kind terms suggested that we could and should eliminate all such locutions in favor of quantifiers and conditionals. But this limits us to distributive referential assertions, i.e. attributions of a property to each member of a class. This works well for generalizations like "The lion is warm-blooded" but they fail to account for claims like "The lion is disappearing from the Serengeti Plain." Certain uses of natural kind terms as singular terms simply do not cash out into terms of a distribution of properties to each member of the kind. By having singular term usage of natural kind terms, we allow ourselves a series of substitution inferences between such kind-referring sentences and laws of nature pertaining to the kind that might otherwise be expressed as quantified conditionals.

Not all kind-referring claims could even purport to be laws of nature. Many of them report entirely accidental empirical facts that would not be the case even in possible worlds that share all of our laws of nature. Why is this important to scientific discourse? We should remember that scientific investigation does begin with such accidental facts and does incorporate them along the way. In many cases, they present explanatory challenges that test the mettle of those theories. Our claim about the ozone pollution in (3) is not an attribution of pollutancy to each individual ozone particle, yet it does tell us something about the environment that chemists and other scientists have an obligation to explain. With only distributive and attributive usages of natural kind terms, such claims would be impossible and such empirical data would be left out of the scope of our theories.

The trouble with a language with strictly attributive usages of natural kind terms is that we are only left with the means to talk about theoretically salient regularities that affect members of the kind individually and in the same measure (e.g. being warm-blooded, having three oxygen atoms, etc.). We dole properties out, one lion or electron or ozone molecule at a time, but never speak of the whole. But not all the facts about the world that we want to explain with a scientific discourse are of such a form that we can attribute something to each member of the relevant class individually across even a small set of the nomologically possible worlds.[2] We have many claims about each possible world that need to be explained by the lawlike claims, along with some accidental details, we make even though the claims themselves are accidental, e.g. we want to know why the domestic shorthair mutated in domesticity despite the fact that it did not necessarily have to do so.

Some theoretically salient regularities involve what we might call the 'totality' of the kind. It may seem odd to speak of the mass of a kind in this way, for we like to imagine our particulars and the referents of our singular terms as tidy medium-sized drygoods. I do not wish to engage the mereology (every collection of things is a thing) vs. minimalism (there are only elementary particles, or some such category) debate in metaphysics here. However, these sorts of mass reference do not reduce out in any simple way when we are talking about kinds, even

when we are only concerned with the kind as it shows up in the actual world. Their role as symmetrically substitutable expressions will also become important in certain sorts of explanation, as we shall see in section V.

The ways in which we speak of the totality will also bear some relation to the explanatory aims of the theories in which they appear. Though we accept reports like "The lion is disappearing from the Serengeti" we do not recognize a report like "The lion weighs 2 million kilograms" even if it is true that this is the sum weight of all the lions in the world. It also seems uncomfortable to attribute 'disappearinghood' to a sum, even though we can see how it reports a certain sort of information and does so in a non-idiomatic way. Which properties we may attribute to the totality of a kind in these ways is typically a matter that is settled by the sorts of properties that are relevant to the sorts of explanations we hope to give with them, so there is no rough and ready way to say in advance just which predicates we should permit. (See Carlson, et al (1995, pp. 63-102) for more on this point.)

The point to be made here is that the empirical information introduced into a theoretical discourse may include interesting but contingent patterns of phenomena in the world as well as evidence that confirms lawlike generalizations. Although the claims we could make about such patterns might not be lawlike, they might be explained as the consequence of a number of our lawlike claims and some further contingent empirical facts. All of this just points to the fairly uncontroversial point that kinds interact with one another in an environment. We might have regularities that pertain to how the interaction between members of the kind and their environment will tend to go, though those regularities will be states or events that no particular could possess as they do ordinary properties. Ozone's being a rising pollutant is just such a state - no substance is a pollutant in its own right, but only within an environment with a certain sort of chemical makeup. The mutation of the genetic profile of housecats may seem to be a claim about individual phenotypes or sets of phenotypes and their gross morphological effects, and thereby an attribution to particulars, but any mutation by any particular cat is incidental here. The claim's significance lies in the implication that the evolutionary development of the species

and our explanation of it will involve noting the change in conditions from the wild to domesticity. Having only attributive usages of natural kind terms in our languages leaves us unable to even introduce such claims and the explanatory burdens they bring with them into scientific discourse, which drastically impoverishes the range of things we can assert with our language and the variety of phenomena we can explain and understand. Thus, singular term usages of natural kind terms are not disposable artifacts of a clumsy surface grammar, but significant additions to the expressive resources of a language that aims to have explanatory discourse about the physical world.

V

It remains to be said how both of these roles for natural kind terms could be incorporated into the explanatory strategies of the natural sciences. There should be certain sorts of inferences that allow moves from one usage to the other if they are both aspects of the semantics of the terms, and those moves should do some sort of explanatory work. If not, we might legitimately say that there are two terms at work here. Suppose we have the following K-claims:

(8) The Canadian lynx (*Lynx canadensis*) is disappearing from the Hudson Bay region of North America.
(9) The Canadian lynx hunts other animals for food.
(10) The primary prey of the Canadian lynx is the snowshoe hare (*Lepus americanus*).

Sentences (8) and (10) make reference to kinds, but do not predicate something of every member of those kinds. No individual lynx is disappearing and not every hare is being eaten by a lynx, or will even be hunted by one in its lifetime. Sentence (9) might be cashed out in terms of attributive usages of natural kind terms; we are attributing to every lynx a disposition to hunt certain things to sustain itself, even if it lives in a zoo. Now, from these claims, we can infer to the claim:

(11) In the near future, the snowshoe hare will thrive in the Hudson Bay region.[3]

Given the background claim:

(12) The snowshoe hare in the Hudson Bay region feeds on plant species *X, Y* and *Z*.

we can infer to the claim:

(13) In the near future, plant species *X*, *Y* and *Z* will be depleted in the Hudson Bay Region.

Here we have a series of claims, some distributive and some genuinely kind-referring, that give us the workings of an explanation that would not have been possible with only attributive usages of natural kind terms. If we had to explain claims like (11) and (13), we might have to do so in part by employing the sort of reports and explanatory strategies described above. We could not say of various species of plants that they would be depleted in virtue of the sort of plants they are, much less that they would do so in virtue of the presence of animals that do not even consume them. The inference to (11) is not a matter of entailment and it is certainly defeasible given other sorts of evidential claims. But to say that an inference is defeasible is not to say that it is a bad inference, nor to show that the inference stands in need of further premises in the form of conditionals to make that defeasibility a matter of logical validity. In fact, the very evidence that defeats the inference might involve the same sort of natural kind term as singular term usage, e.g. if whatever is threatening the Canadian lynx has the same effect on the snowshoe hare, licensing us to make a claim analogous to (8) for the hares.[4]

The explanatory work being done here is a matter of explaining regularities that do not involve the possession of some property by a class of individuals by incorporating claims about such regularities into a discourse that includes the sort of lawlike claims discussed in section III. Here we take advantage of the ambiguity between singular term usages of natural kind terms that cash out in distributive terms and uses that refer to the totality of the kind to substitute back and forth between nomic and non-nomic substitution frames. By having natural kind terms appear as singular terms in nomic and non-nomic statements, we can understand these licenses in terms of substitutability rather than a congeries of one-off stipulations. This substitutability is characteristic of singular terms and it points towards the practical advantage of speaking of kinds as we speak of objects. Once we do so, we have the linguistic resources to unite distributive claims, claims about particulars, and claims about the totality of a kind under one inferential rubric.

Now, by invoking the notion that the singular and attributive usages of natural kind terms are inferentially linked here, I do not mean to suggest that there is a particular pattern of inferences directly from one usage to the other and that somehow this particular pattern constitutes theoretical explanation. That would seem to imply something like the logical relation between explanandum and explanans in Hempel's deductive-nomological model, but what I am suggesting is more modest and more flexible. Rather than a specific pattern of inferences, we have a number of usages and ways of adjusting and accommodating them to one another as simple recombinable compositional expressions, rather than as dissimilar sorts of sentences. The point is that if you can say "The lion..." in both distributive and singular usages, then you can say both "The lion is disappearing from the Serengeti" and "The lion is warm-blooded" in the same context. If so, you can make substitution inferences involving either sentence in the same way. This is why neither reading is a trivial addition to the grammar; the surrogate sentences for kind-referring usages might be logically equivalent and so might the quantified readings of distributive singular terms, but the language includes singular term or quasi-singular term usages for both so that both sorts of information may be expressed with the same set of terms. Their appearance as these sorts of terms creates a common procedure so that the inferential connections between the two can be expressed via simple substitution inferences, the basic building blocks of all inference in the inferentialist view. Both sorts of information are re-expressed in a common way to create a sort of 'border town' between the two different sorts of grammatical function, wherein both parties adjust a bit but end up contributing something to the larger picture.

To have at our disposal the sorts of K-sentences I have described is to assert that there is a theoretically salient cluster of regularities that we find in the world. Attributive usages allow us to talk about what sorts of regularities belong in that cluster and what we will count as a member of that kind. Nomic substitution frames are inferentially linked to such K-sentences. Singular term occurrences of natural kind terms allow us to make claims about how those theoretically salient clusters of regularities interact and relate to other regularities and

contingencies around them, including contingent features of the totality as well as features which apply to each member. But in order to be incorporated into scientific discourse, those singular term usages will have to bear some semantic link to the attributive usage, lest we have no way of establishing an inferential connection between them and the nomic claims that lie at the heart of this explanatory discourse.

The advantages of establishing that linkage by employing common subsentential expressions are twofold. First, it simplifies the structure of the inferential economy of a theory. Laws and other empirical claims can have a common substitution frame structure, as described earlier. This common structure allows us to articulate the commitments of a theory with a common method of substitution licenses into a specific set of frames for the most part, rather than primarily through sets of rules for material inference between sentences that do not bear any apparent syntactical or semantic similarity to one another. Rather than an enormous number of distinct rules, we have a set of common inferential procedures that carry over from one context to another. Given that there is some limit on how many rules of inference we can learn and understand, such common structures present a significant advantage.

Second, common subsentential parts allow us to formulate new claims and revise old ones more readily because we have simple compositional elements to work with. The upshot of this is that we have at our disposal a means of abstraction from particular lawlike and empirical claims; we can talk about Ks in novel and abstract ways because we recognize the term "K" as a semantically significant subsentential component that we can recombine with others. This is especially important when we remember that there are cases where we would want to have nested claims and anaphoric links between claims involving natural kind terms. Imagine the following narration to a wildlife documentary:

> (14) *The lion* is disappearing from the Serengeti Plain. *It* has been hunted by poachers, suffered through the worst droughts in memory, and been forced from *its* habitat by encroaching urban development. Unless concerted efforts are made, *they* will only number in the hundreds by the end of the decade. If *they* do not have game to hunt and room to roam, nothing conservationists do will save *them*.[5]

Each of the italicized expressions here is anaphorically linked to another. If it seemed difficult to imagine how we could separate singular and attributive usages of natural kind terms before, anaphora should make it clear that such a task is hopeless. We lose a fluency and flexibility of formulation and interpretation and a power to evaluate and reflect upon theoretical commitments without this. The more cumbersome discourse that would result is sharply at odds with the demand for a mercurial dialogue, constantly open to challenge and revision, that we implicitly accept in saying that we can explain events in the natural world and that our theory will answer to the evidence.

So following this train of thought leads us to a version of the pragmatism I espoused earlier; we carve out a notion of natural kind terms based on the sort of performances they facilitate rather than the positing of a relation of 'representation' between word types or tokens and further categories of posited or actual objects. Here, we have seen a slice of what may be articulated by such a method and just a hint of why it might explain what we really needed to figure out in the first place.

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Notes

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[1] Although I do not believe that it has appeared in print, Mark Lance tells me that this example originated with Joe Camp as a counterexample to a translation/reduction strategy offered by Wilfrid Sellars, much like those described above.

[2] The difficulty in explaining this in terms of distributive reference across a class of particulars might lead one to wonder whether we must say that the natural kind term here denotes something beyond particulars - an extraphysical universal, for instance. That suggestion seems unhelpful. If we say that the kind term denotes a universal here, we must still say that we associate certain properties with any instantiation of that universal and so with every member of the kind. This simply adds a step between the occurrence of a natural kind term as a singular term and the attribution of a property to each particular in the membership class across the nomologically possible worlds, when we wanted to get away from such attributions to particulars altogether.

[3] I add this "In the near future" caveat because predator/prey interactions tend to go in cycles. I should also acknowledge that this explanatory strategy is not without its critics in the biological community. As well as the cycles described here, other studies have suggested that there is a more complex interaction with several other species, while some evidence suggests that the population of a species will cycle on its own. Neither of these are incompatible with some version of this explanatory strategy, so I have offered only a fairly simple version of it. It is only the semantic aspects of such explanations that concern us in this case, so such disputes should not concern us. For more, see Starr and Taggart (1988).

[4] Biological kind terms give some philosophers and scientists worries, and some even go so far as to say that biological kinds are actually not kinds but individuals of some curious sort. [See Hull (1974) and Hull and Ruse (1989).] Nothing about the examples I am using really hinges on their using biological terms, though. Non-biological examples could replace them.

[5] Careful readers familiar with semantics and the question of generic expressions may also note that there is room in these sorts of contexts for bare plurals like "*Electrons* are attracted to positively charged particles." There certainly is, and they serve a variety of generic roles covering both singular and attributive usages. There is an ample literature on them, well

documented in Carlson, et al (1995). For now, I will not offer further comment on them, except to say that we would obviously want some consistent further story to tell about how their usage refines the expressive possibilities already laid out here.