Poznań Studies in the Philosophy of the Sciences and the Humanities
1997, Vol. 51, pp. 149–163

Sylvain Bromberger

NATURAL KINDS AND QUESTIONS

1. Introduction

This paper is based on the tenet that reasoning about natural kinds is intimately linked to reasoning with questions. If right, it should be viewed as amplifying Jaakko Hintikka's rich contributions to our understanding of the central role that questions play in scientific thought.

The term *natural kind* is a philosopher's term. It was presumably used first by Venn in his work on induction and probability. But terms with similar connotations have been used by others. Mill in his treatises on logic (Mill 1875) writes of *Kinds* and of *Real Kinds*. Duhem (1914) writes about *classifications naturelles*. And one finds references to the same idea in many earlier philosophers concerned with issues of metaphysics, epistemology, or philosophy of natural history. Nor is the notion primarily a philosophic or scientific one. Recent work in cognitive science suggests that it is part of our innate intellectual endowment. It is certainly part of the common sense of many people. Thus a column in my daily newspaper *The Boston Globe,* once contained the following question and answer:

> Q. How many kinds of animals are there on earth, and at what rate are they disappearing?
> A. No one really knows how many types of animals there are or how many of those species are disappearing. *The World Book Encyclopedia* says scientists have classified almost a million animals ranging in size from the microscopic to the gargantuan. Each year hundreds of new animals are discovered. The more than 800,000 varieties of insects make up the largest group. There are about 21,000 kinds of fishes, 8,600 species of birds, 6,000 types of reptiles, 3,000 kinds of amphibians and 4,000 species of mammals.

In spite of its familiarity and the ease with which we rely on it, the notion that there are natural kinds is replete with problems that call for philosophic scrutiny. In what follows, I will first review some of these problems. Any adequate account of Natural Kinds should help us solve or dissolve them. I will then sketch a conjecture about what the notion that there are natural kinds comes to. The conjecture will put us in a position to revisit the problems from a different perspective, though I will postpone such a revisit for an occasion where much more space is available. I will also concentrate on what is implicit in the belief that there are natural kinds, and not on so-called natural kind terms, though I will finish with a brief comment about such terms, a family of lexical items that has received much attention in philosophic and linguistic literature.

2. *Some Classical Issues about the Notion of Natural Kinds*

A. *Methodological Issues and Rational Taxonomy*

Statements like the one quoted from *The Boston Globe* presume that animals – that is, individual animals – can be systematically and unequivocally sorted out into species, types, classes, varieties, and so on. But of course, like any set of individuals, they can be sorted in indefinitely many ways. There is a whole discipline, so-called systematics, devoted to the study of systems of classification and evaluation of such systems. It is based on the plausible view that some classifications are better, more effective, more convenient, more natural, perhaps closer to the facts for the purposes of natural history than others. But what are the features by which good classifications differ from bad ones? That turns out to be a deeply controversial and often divisive issue, as is attested by the literature on taxonomy in e.g., entomology, or the debates that surrounded Lavoisier's proposals on the classification of chemical substances, or the controversies that accompanied the transition from Linnean taxonomies to cladistic ones[1].

B. *Ontological Issues*

What is the ontological status of Natural Kinds? Are there so-called Real kinds, or are there only Nominal kinds? Note that the *Globe* reporter wrote of kinds and species and types as if they were part of the furniture of the world, as if the world contained not only individuals but also kinds, as if we come across not only new individuals but new kinds. But this cannot be literally true. We never actually come across a kind, but only across individuals: since kinds are not the sort of things that can have any causal efficacy, they cannot affect our senses, be seen, heard, felt, tasted, smelled, or be bumped into. But even so, talk about kinds does not come down to talk about individuals. For instance, the enumeration of kinds is crucially different from the enumeration of individuals since it is one thing to know (or to be ignorant about) the number of kinds of animals there are and an altogether different thing to know how many animals there are. Nor is the appearance and disappearance of kinds simply the appearance or disappearance of individuals. But if it is not literally true that Natural Kinds exist as entities over and above their members, how is it true, how is one to understand the claim that kinds in general exist, or even that some specific kind exists?

Some people are actually willing to say that one must understand these claims literally. After all, there are not only individuals, but also sets of individuals, and natural kinds are but sets of individuals. One has to be a very finicky nominalist indeed, to deny the existence of sets. However, this attitude raises a problem of its own. So-called natural kinds may be sets, but they can't be just arbitrary sets. They presumably are special sets, sets that are distinct from random sets. Their members have been grouped by nature, so to say. But exactly what does that mean? What facts about the world, about nature, about reality, about God for that matter, does the distinction of sets into natural kinds and non-natural kinds (nominal kinds) register? Or – put differently – what sort of new fact about the world does the discovery of a new natural kind represent? How is it related to, how is it like, and how is it unlike the discovery of new individuals?

Of course some people think that such worries are misguided, are the price of unclear thinking which fails to acknowledge that so-called natural kinds are human intellectual artifacts. We, according to them, not nature, are the agents who parcel things into kinds. If there is a problem here at all, it is the problem of making clear to ourselves the ends for which we classify. Good classifications are not discovered but contrived. On such a view there are no right or wrong classifications, only more useful or less useful ones, and the ontological problem reduces to the methodological one.

Others rightly reply that no classification of natural objects can be convenient, or useful, unless it is grounded on facts about these objects, facts by virtue of which they fall into kinds that we may choose to acknowledge or not acknowledge, but which are not up to us to invent. A classification can be effective only if it, as the saying goes, "cuts nature at the joints". So this way of looking at things, this pragmatic descent, does not really dissolve the ontological issue.

C. Epistemological Issues

There are, to begin with, problems that are the obverse of the metaphysical problems and the issues in systematics. Thus the history of science is replete with claims that new species have been discovered. (Think of Darwin's trip on the *Beagle*.) But how is the claim that a new kind has been discovered ever warranted? When does evidence justify it, and how? What is the nature of the reasoning, of the inferences from observation to conclusions that justifies such claims or such beliefs? It obviously is not pure deductive reasoning from observational premises. Nor is it simple induction by enumeration. Nor does it seem, offhand, to be induction to the best explanation (or if it is, explanation of what?).

The problem about evidence arises in other contexts brought to our attention initially by Nelson Goodman (1965) but about which there now exists an enormous literature. When we infer from observed cases to unobserved ones we rely on classifications of individuals into something like natural kinds. So suppose that I observe that some elephant has a heart with four cavities, and suppose that I classify objects into sets, one of which contains my elephant, the elephants in the Bronx Zoo, the snakes in South America and the flies in New Jersey, and suppose that I call the members of that set *shmiers*. It would clearly be a mistake to infer from the fact that one or more shmiers has a heart with four cavities that all shmiers do. Shmiers don't make up a kind across which inductive projections are licensed. On the other hand, if I classify things so that there is a class that contains all and only elephants, then the inference, though not conclusive, will be at least rational, plausible. Or, to take an example with a more respectable Goodmanesque philosophic lineage, suppose that I define *emphire* as the class of all things that are either emeralds and have been observed by some human being before March 3, 2000, or are sapphires, but have not been observed before March 3, 2000. All the emphires observed so far have been green. So have all the emeralds observed so far. In fact every emphire observed so far has been an emerald and vice versa. Yet the induction to the conclusion that all emphires are green is unwarranted, whereas the induction to the conclusion that all emeralds are green is warranted. Even the inference that all emphires are grue (green if observed before March 3, 2000, blue otherwise) seems abnormal. What is the difference between the species called emphire and the species called emeralds that underlies and generates this difference? What is there about natural kinds that licenses projection from individual members to further individual members?

D. Semantic Issues

The notion of natural kinds has come up in contemporary philosophic literature in relation to a set of problems raised initially by Saul Kripke (1980) and Hilary Putnam (1975), but about which there now exists a vast literature and innumerable doctoral dissertations. There is a view in semantics, traced usually to the German mathematician Frege (1893), according to which singular terms, i.e., names (and descriptions) do their linguistic job by virtue of being attached, on the one hand, to something called a *sense* (*Sinn*) and on the other hand to something called an extension or *denotation* (*Bedeutung*). The extension is the set of things to which the name applies. Thus the extension of the word 'dog' is the set of all dogs that have, do, and will exist. The sense of the name is something more subtle and not easily characterized, but roughly it is that which speakers know about the word by virtue of which they can recognize members of its extensions, that learnable fact tied to the phonological (or orthographic) and syntactic features of a sign by virtue of which the sign is used to refer to members of its specific extension. Some hold that English and other languages (possibly all natural languages) contain so-called natural kind terms, that is, terms whose extensions by semantic necessity make up natural kinds. Those who hold this view must thus believe that the senses of natural kind terms share features by virtue of which their bearers qualify as natural kind terms. It becomes a task of semantics to characterize that feature. Kripke and Putnam have advanced powerful arguments that cast deep doubts on this view. They deny that names of natural kinds have Fregean senses. They hold that such names are *rigid designators* and get their extension, not through a semantic content, but by being tacked directly and deliberately to some member of the extension in a sort of baptism. The word *water*, for instance, on this view, has its extension because something like the following happened: someone at some time pointed to a sample of water and said "This stuff is going to be called *water*", or words to that effect, and thereby initiated the convention that all samples standing in the relation of being "the same substance" to this sample may be referred to by utterances of the sound *water*.

Kripke and Putnam's way of picturing things may free us from the problems raised by the theory that names of kinds have a sense that share a distinctive feature, but only at the price of a new problem, namely, that of determining what constitutes *being the same substance*, or, in the case of animals, *being of the same species*. And that problem is as recalcitrant as the problem raised by the Fregean assumption. In short, Kripke and Putnam do not deny that natural kind terms themselves constitute some sort of natural kind, that is, they still hold that the extensions of some terms constitute natural kinds and that this is something that must be known (or at least believed) by anyone who can be said to understand the term, but they leave us in the dark about the content of that knowledge (or belief). I shall come back to this issue in the last section.

3. A Different Approach to the Notion of Natural Kind

Whatever the problems that burden the notion of natural kind, the presumption that the world contains such kinds is unquestionably a very deeply ingrained presumption, so deeply ingrained, in fact, as to suggest that it not only springs from our native cognitive endowment, but that it does so in a way that shapes how we learn about the world, think about it, cope with it, and talk about it. We should therefore not be surprised that it is at once transparent, utterly compelling, and yet elusive.

In what follows I want to sketch a theory about what the presumption that the world contains natural kinds comes to. Note that I speak here of a presumption. I don't propose to show that there are natural kinds. I don't know whether there are. But I think that much of our intellectual commerce with the world is inescapably based on the presumption that there probably are. We approach the world and inquire about it with expectations built on that presumption. Science would be impossible without it. But what is its content?

I have spoken of a presumption, as if there were a single one. But the analysis I am about to propose assumes that belief in natural kinds is actually constituted of a family of presumptions in which more complex ones rely on simpler ones, but in which simpler ones do not require commitment to the more complex ones. I will therefore divide the discussion as if the presumption implicated different levels of commitment, and speak of *levels* of that presumption.

I. THE FIRST LEVEL OF THE PRESUMPTION: The world contains sets of objects that stand as exact models to each other.

The word *model* has many meanings in contemporary English. I use it here in a sense on which I have relied before (Bromberger 1992, p. 178). Examples of the sort of things I have in mind are familiar: small models of real airplanes, plastic models of DNA molecules, models of the Eiffel tower, maps of territories, and so on. What makes some of these things models of others? The fact that we can find out things about the object modeled by investigating the object that serves as model. Thus counting the number of engines of a model airplane will tell us the number of engines of the actual airplane, counting the twists on the DNA model will tell us the number on an actual molecule, computing the ratio of height to that of the base of a mock-up of the Eiffel tower will tell us what that relation is in the case of the real Eiffel tower.

The relevant notion of a model on which I rely is thus the following: *M is a model of O relative to a quadruple* $<Q_m, Q_o, P, A>$ *if and only if (a) M and O are numerically distinct, (b) in that quadruple* Q_m *is a non-empty set of questions about M,* Q_o *is a non-empty set of questions about O, P pairs members of* Q_m *with members of* Q_o*, and A is an algorithm that translates answers to any member of* Q_m *into answers to the member of* Q_o *paired with it by P, and translates correct answers to the former into correct answers to the latter.*

This notion of a model is obviously a relational notion. Nothing is intrinsically a model. More importantly, it is a relativised notion. No two objects stand or fail to stand in the relation of model to modelee *tout court*. They may stand in that relation relative to some quadruple and not relative to other quadruples. In short, it is built on a three-term relation (actually a six-term relation), not merely a two-term one.

To fix ideas, think of a map, which is a form of model under this definition. A question in Q_m for the relevant quadruple might be "What is the distance between dots *a* and *b* on the map?" and in the corresponding Q_o "What is the distance between city *A* and city *B* in the territory?" where the pairing is provided by the mapping conventions and the algorithm by the scale. Other questions about the map will not enter into any such quadruples, for instance, "What is the chemical composition of the paper?" or "What is the name of the publisher printed at the bottom?"

An *exact* model is defined as follows: *M is an exact model of O if and only if, in the quadruples relative to which they are models, (a) members of* Q_m *are paired by P only with members of* Q_o *with which they are identical but for the replacement of references to M in* Q_m *by references to O in* Q_o*, and (b) A matches answers to each that are identical but for a similar replacement of references.*

So, for instance, any sphere S_1 is an exact model of any identical sphere S_2 relative to a quadruple that includes in Q_m "What is the radius of S_1?", "What is the circumference of S_1?", "What is the area of S_1?", and that includes in the paired Q_o the same questions but with S_2 mentioned instead of S_1, and that has as *A* the equality function.

So the first level of the presumption comes down to this: *Objects in the world fall into sets of indefinite size whose members are exact models of each other relative to some known or discoverable sets of questions.*

That is a bit abstract, so let us look at two examples that support the presumption.

Samples of mercury are exact models of each other relative to the questions "What is the boiling point of *m*?" (356.6°C), "What is the freezing point of *m*?" (–38.87°C), "What is the molecular weight of *m*?" (200.6).

Utterances of the expression *Massachusetts Institute of Technology* are exact models of each other relative to the questions "How many words does it contain?", "What does it refer to?", "What are the morphemic constituents of each word?", "What is its constituent structure?".

The first level of the presumption may not seem very weighty, but it is not a tautology. Is it a necessary truth? That is a complex issue which cannot be considered without delving into the nature of the relevant modalities. It does not seem to be a necessary truth under most construals. But even if it is not a necessary truth, its import for science is not that of a hypothesis to be confirmed or disconfirmed. As a hypothesis it is rather thin and dull. Its import is that of a ground for inquiries or what a Kantian might pompously call a Postulate of Pure Erotetic Empirical Reason. If there are sets of objects that stand as exact models of each other in nature (artifacts are less interesting), we should want to know what they are, or we should at least want to know as many of them as possible, and perhaps how they came to be. Satisfying such a want is not a simple matter. One does not discover such sets by simply looking at things: one has to equip oneself with questions. Take, as a case in point, the first of our examples. The discovery that there are samples of matter that are exact models of each other in these specific respects could not have been made before the erotetic notions of temperature, of boiling point, and of molecular weight had been established, and that happened rather late in our conceptual history and required enormous preparation.

In what follows, I will use the expression *Projectible Questions for the kind K* to refer to the questions that make some set *K* a confirming instance of this first-level presumption. I shall call such confirming instances "Minimal Natural Kinds". The first presumption can therefore be restated as follows: *The world contains minimal natural kinds.*

II. THE SECOND LEVEL OF THE PRESUMPTION: The world contains sets of objects that constitute Quasi-Natural Kinds.

A quasi-natural kind is a minimal natural kind *N* of which the following is also true: *There is a non-empty set of questions Q_w: (a) Whose presuppositions are satisfied by every member of N; (b) To which different (though not necessarily all) members of N bear different answers, i.e., Q_w is not a set of projectible questions for N; (c) Whose right answer – for each member – is the object of a sound why-question; (d) At least one answer to that why-question in each case follows from common nomological principles, instantiated by contingencies peculiar to the case, but of a sort applicable to all.*

Let us refer to such questions as *w-projectible questions over the kind.*

To make this more concrete, let us again consider samples of mercury. They constituted a minimal natural kind by virtue of the question and common answer pairs: "What is the boiling point of *m*? 356.6 °C"; "What is the freezing point of *m*? –38.87 °C"; "What is the molecular weight of *m*? 200.6." And they furthermore constitute a quasi-natural kind by virtue of the *w*-projectible questions such as the following, askable of each sample (but not always supporting the same answer for each sample): "What was its temperature on July 4, 1987 at noon?" That question is *w*-projectible because its right answers for each sample are individually themselves the topic of a sound why-question "Why was the temperature *T* on July 4, 1987?", one of whose answers satisfies (d) above if we assume, as seems plausible, that the temperature can be accounted for in each case by appeal to the same appropriate thermodynamical theory and "boundary conditions" of the sort selected by these principles, e.g., details about the degrees of freedom of the particles in the sample and distributions of energy among these degrees of freedom.

In short: *A class of objects that constitutes a minimal natural kind also constitutes a Quasi-Natural Kind relative to a set $<Q_p/A_p; Q_w>$ -- in which the Q_i/A_i's are non-empty sets of questions paired with their true answers -- if and only if it is the largest set of objects for which those in Q_p are projectible, and those in Q_w are w-projectible.*

The presumption that there are quasi-natural kinds, like the presumption that there are minimal natural kinds, does not represent a necessary truth. And its import for science too is that of a regulative principle of inquiry. If there are quasi-natural kinds, we want to know what they are, or we may want to discover as many of them as possible, and we may want to know how they came to be.

Here too, it is worth noting that the discovery of quasi-natural kinds requires much more than mere observation of things: it too may require the conception of new questions. But it may require even deeper reconceptualizations. The presumption entails that the world sustains a distinction between brute facts and explainable facts, or, more exactly, between facts that are legitimate objects of sound why-questions and those that are not. The discovery of quasi-natural kinds may require a relocation of the division between these two kinds of facts.

To see what is involved here, think of Lavoisier after he had performed the experiments that convinced him that water is a compound of Hydrogen and Oxygen. Suppose that at that point he has raised the question "Why is water a compound of Hydrogen and Oxygen?" There would have been something blatantly nonsensical about that question, something calling for a rhetorical "Why should water not be composed of Hydrogen and Oxygen?" Every fact is not necessarily the topic of a sound why-question. At the time, the question "Why do Hydrogen and Oxygen combine at all?" would have seemed equally hopeless. So the status of a why-question can change from pointless to significant as new knowledge is acquired.

But how can one tell whether a fact is – or could become – the topic of a sound why-question? Often one simply can't. I have argued elsewhere (Bromberger 1992, pp. 145 ff.) that why-questions can put one in the very peculiar predicament of not only not knowing the answer and not knowing how to find the answer and not being able to come up with a non-objectionable answer but of not even knowing what one needs to know in order to know whether the question has an answer at all. Why-questions are very different from other questions in this respect[2]. In the case of other wh-questions one need only establish whether their presuppositions are true to establish whether they have an answer, and their presuppositions are inferable from non-elliptic formulations. Thus neither "What is the age of the King of the U.S.?" nor "What is the square root of the King of the Belgians?" has an answer. The first suffers from failure of referential presupposition (there is no King of the U.S), the second from failure of attributive presupposition (the King of the Belgians is not the sort of thing that has a square root). Why-questions can have referential presuppositions inferable from non-elliptic formulations. They can also have propositional presuppositions inferable from non-elliptic formulations ("Why does hydrogen combine with oxygen?" has the propositional presupposition that hydrogen combines with oxygen.). But they have no attributive presuppositions inferable from non-elliptic formulations. Nor is the truth of their referential and attributive presuppositions sufficient to guarantee that they have a true answer. This is due to the fact that why-questions are governed by assumptions of a special sort, to the effect, (roughly) that one condition (at least) is unsatisfied from a set of conditions that are jointly sufficient and individually necessary for some contrary of the propositional presupposition to obtain. But there is no way to infer from mere knowledge of the propositional presupposition, whether the assumption is true, and what its content might be in a case at hand. There may not be such a set of jointly necessary and individually sufficient conditions in the case at hand, or there may be more than one such set, and there is no way of knowing in advance (that is,

from mere understanding of the question) which ones, if any, can fail to be satisfied (Bromberger 1992, pp. 75 ff.).

III. THE THIRD LEVEL OF THE PRESUMPTION: The world contains biological kinds.

A biological kind, for present purposes, is *a non-empty set which: (a) includes a subset whose members constitute a quasi-natural kind as defined above. Let us call that subset the "stereotypical core" of the biological kind; (b) also includes the preponderance of any of its members' descendants; (c) if Q is a projectible question for the stereotypical core, but Q is not projectible across all the descendants, then Q is at least w-projectible across both the stereotypical core and all the descendants.*

A biological kind is thus the union of a stereotypical core and the descendants of that core[3]. Note that the definition is designed to accommodate not only stereotypical tigers, but also the exceptional albino and three-legged ones that are descendants of stereotypical ones.

The notion of descendant required for this definition is simply the notion captured by Frege's classical definition. Thus if P stands for the relation of parenthood then b is an ancestor of a if and only if

$$(\forall A)(a \in A \;\&\; (\forall y)(\forall x)(x \in A \;\&\; yPx :\rightarrow y \in A)) \rightarrow b \in A))$$

This notion of descendant raises an intriguing possibility. It is built on the relation of parenthood. But we know that ancestor-like relations (ancestrals) can be built on other relations. Frege, for instance, defined the set of natural numbers by means of an ancestral-like relation built on the notion of successor. Could the presumption that there are biological kinds be extended along similar lines?

More explicitly, parenthood is a causal relation. Roughly, a and b are parents of c if a and b are causally and biologically responsible for c's earthly existence. Could there be other causal relations whose Fregean ancestral plays a similar role in shaping our curiosity about the world?

IV. THE FOURTH AND FINAL LEVEL OF THE PRESUMPTION: The world contains CATEGORIES that are the domain of descriptive and explanatory laws.

A category is simply a set of distinct quasi-natural kinds that are all relativized to the same projectible, *w*-projectible, and individuating questions. So, for instance, samples of mercury form a category with samples of gold, water, iron, hydrochloric acid, and other substances. More specifically, as we noted before, samples of mercury form a quasi-natural kind by virtue of the questions "What is its boiling point?", "What is its molecular weight?", "What is its freezing point?" and so on, for which they all get the same answers. But samples of (pure) water are also subject to these questions and they too all share the same answers. Of course, the answers are different for water and for mercury. The same similarities and differences apply to samples of gold, iron, hydrochloric acid, and other chemical substances. That is how chemical substances therefore constitute a category. More specifically then, *A set of quasi-natural kinds forms a category relative to a set* $<Q_p, Q_w>$ *if and only if it is the largest set of quasi-natural kinds for each of whose members the questions in* Q_p *are projectible and those in* Q_w *are w-projectible.*

When is a category the domain of a descriptive law and of an explanatory law?

To see what is involved here, we must first return to projectible questions. A set of projectible questions characteristic of a category (the Q_p in the definition above) constitute the dimensions of a space. In the case of our example of chemical substances the space is defined by the questions "What is its boiling point?", "What is its freezing point?", "What is its molecular weight?", and so on. The spaces that concern us are spaces defined by such projectible questions.

The points of such a space are tuples whose members are possible answers to the defining questions. Some of these points correspond to actual substances, some don't. So, for instance, in the case of our example, the point where the answer to "What is the boiling point?" is 356 °C, that to "What is the freezing point?" is -38.87 °C and that to "What is the molecular weight?" is 200.6 corresponds to mercury, the point where the answer to "What is the boiling point?" is 2807 °C, that to "What is the freezing point?" is 1064 °C and that to "What is the molecular weight?" is 197 corresponds to gold. Each of the other substances is located in this fashion at a corresponding point. On the other hand, most of the points defined by arbitrary answers to these questions do not correspond to any substance at all. Returning then to our question, *A category is the domain of a descriptive law if there is a law that is the locus of all the members of that category, i.e., a law that partitions the points of the space into two subsets, those whose points are answers for actual attested or attestable cases and those whose elements don't add up to a description of any actual cases. A category is the domain of explanatory laws when every quasi-natural kind in it has w-projectible questions whose answers depend on the same explanatory principles.*

We can now summarize all this succinctly: *Natural kinds are quasi-natural kinds that are members of categories which are themselves the domain of descriptive and explanatory laws.* And the presumption that there are natural kinds thus also implicates the presumptions that there is more than one and that there are descriptive and explanatory laws.

The discovery of natural kinds is a many faceted enterprise. Elsewhere I listed some of the tasks required for their discovery:

> Observation of phenomena is only the most obvious among them. Questions, answers that fit them, concepts with which to embed them into laws, expressions with which to process them, must be thought of; those that are projectible across significant numbers and varieties of things must be recognized; .... regularities must be spotted, canonical usages that guard against the misleading associations of the current vernacular must be introduced, etc. Since, in the performance of these tasks, conceptual and terminological creativity plays an enormous part, one might be tempted to conclude that scientists, rather than facts about the world, are responsible for the existence of categorial spaces in which laws operate. But that is hardly plausible. Surveyors label and map the territory; they sometimes divide it; but they do not create it. Gloves are human creations, but it does not follow from this that the hands they are designed for are also human creations, or that the shape of those hands springs from the glovemaker's mind. (Bromberger 1992, pp. 199–200.)

4. A Word about so-called Natural Kind Terms

Much of the recent discussion about natural kinds has actually been discussion about so-called natural kind *terms* carried out in what Carnap called "the material mode." But are there such terms, are there terms whose meaning – however we think of meaning – implies that the corresponding extension makes up a natural kind? Are there terms whose understanding requires that competent users construe them as having a natural kind as extension?

The answer, it would seem, must be both "yes" and "no"; it depends on what part of the vocabulary one is talking about.

Any person's vocabulary, lexicon, can be divided into two distinct sets. Part of the vocabulary – let us call this *the native vocabulary* – is made up of words and morphemes acquired through exposure, under conditions of paucity of stimulus, with relatively little negative feedback, i.e., in the course of natural linguistic development. There is no reason to believe that the native vocabulary does or can include natural terms. It may, of course, turn out to contain terms whose extensions happen to constitute natural kinds relative to some set of questions, but that would be a coincidence, a rather amazing coincidence. Part of the vocabulary – at least in some cultures – consists of terms acquired not through mere exposure but through tutoring, instruction that, at least initially, requires prior mastery of a native vocabulary. Let us call that part of the vocabulary *nomenclature*. There is such a thing as scientific nomenclature. It is subject to explicit stipulations and deliberate conventions, it is codified in canonical texts and it is under the governance of experts and professional groups to whom others must defer. That part of the vocabulary does contain terms whose extension is presumed, by convention, to constitute natural kinds. Its terms are introduced at specific historical moments and with stipulations designed to give them that character. Terms in the nomenclature have a history of their own which is quite distinct from the history of the rest of the language. They evolve along lines and under conditions that have little to do with the way other words evolve. (Compare the history of such English words as 'shoulder' or 'meat' which go back to Indo-European origins and are acquired without definitions, and the history of the words 'atom' or 'mass' or 'heat' as used in physics and chemistry. The introduction of the latter can be dated fairly precisely, and was subject to explicit datable revisions acknowledged by professional organizations. Many such terms do not even belong to any particular language, are recorded as ideographs, have no phonology proper, occur in formulae that need not be translated to become accessible to speakers of different languages.)

Conflation of these two classes is due to at least two facts: a) Some phonological shapes of items in the native vocabulary have come to also encode items in the nomenclature. How and why such double assignment ever occurs are interesting questions to be left for another occasion. But by fixing on such an ambiguous phonetic shape while thinking that one is fixing on the term itself, one can easily come to overlook the shape's double life. b) Many items in the nomenclature can be taught and are taught. But the process by which they are taught is not always recognized as utterly different from the processes through which lexical items in the native vocabulary are acquired through natural development. By slighting the difference between these two processes one is easily led to disregard crucial differences among their end results.

Whether samples of water – where I am using the word as an item in the native vocabulary – constitute a natural kind was a matter to be discovered. It turns out that they don't, though a subset of them does. Whether samples of H_2O constitute a natural kind was never a matter open to discovery. That they are follows from the meaning of H_2O.

Massachusetts Institute of Technology

NOTES

1 For an important discussion of some of these problems and a useful bibliography see Dupré (1993).

2 Though not from all. "What is ..." questions, for instance, can share the same peculiarity.

3 This definition does not make allowance for the possibility of speciation. It represents therefore only a first approximation. The further conditions required to accommodate speciation can probably not be formulated at the present level of abstraction since they need to take into account the various – often conflicting – interests that regulate division into species and other taxa.

REFERENCES

Bromberger, S. (1992). *On What We Know We Don't Know: Explanation, Theory, Linguistics, and How Questions Shape Them.* Chicago: The University of Chicago Press and Stanford: CSLI.

Duhem, P. (1914). *La Théorie Physique: Son Objet, Sa Structure.* Paris: Marcel Rivière & Cie.

Dupré, J. (1993). *The Disorder of Things. Metaphysical Foundations of the Disunity of Science.* Cambridge: Harvard University Press.

Frege, G. (1893). Über Sinn und Bedeutung. *Zeitschrift für Philosophie und Philosophische Kritik* **100**, 25–50.

Goodman, N. (1965). *Facts, Fiction, and Forecast.* 2d ed. Indianapolis: Bobbs-Merrill.

Kripke, S. (1980). *Naming and Necessity.* Cambridge: Harvard University Press.

Mill, J.S. (1875). *System of Logic.* 8th ed. London: Longmans.

Putnam, H. (1975). The Meaning of 'Meaning'. *Philosophical Papers, ii: Mind. Language and Reality.* Cambridge: Cambridge University Press, 215–71.