CARVING NATURE AT THE JOINTS*

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This paper discusses a philosophical issue in taxonomy. At least one philosopher has suggested the taxonomic principle that scientific kinds are disjoint. An opposing position is defended here by marshalling examples of nondisjoint categories which belong to different, coexisting classification schemes. This denial of the disjointness principle can be recast as the claim that scientific classification is "interest-relative". But why would anyone have held that scientific categories are disjoint in the first place? It is argued that this assumption is needed in one attempt to derive essentialism. This shows why the essentialist and interest-relative approaches to classification are in conflict.

I

Philosophers often ask whether the ultimate scientific theory will "carve nature at the joints". Colorful as this expression is, its import remains unclear. On one reading, the metaphor seems to say that the final true theory should posit categories which correspond to the categories that exist in nature. However, how could we ever conclude this? It is not as if we have a way of determining which categories exist in nature apart from the ultimate scientific theory. If we were to discover that our categories did not cleave to nature's own divisions, that would be to discover that we have not yet uncovered the ultimate categories. That is, we would not have found the final theory of the world and we should go ahead and amend our classifications accordingly. But someone could maintain that our categories might still not correspond to nature's own, indeed that it is in principle impossible for human beings to discover the true categories in nature. Thus, it might be held that given our cognitive and other capacities, nature's true divisions will always elude us despite our best efforts. These considerations lead to thorny issues in metaphysics and epistemology which have been the subject of much philosophical debate.

However, that debate is not the subject of this paper. Rather, a related claim about scientific classification seems to be capable of a quicker res-

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olution and may be more profitable to pursue. That is the view of scientific taxonomy which might be expressed by saying that the ultimate scientific theory will organize the world into a number of nonoverlapping, mutually exclusive categories. Richmond Thomason has given this claim a more precise, algebraic formulation, proposing that any taxonomic system is an *upper semilattice*, and elaborating on this as follows:

> Taxonomic systems are characterized by a property which is not in general possessed by semilattices:
>
> (D) No natural kinds a and b of a taxonomic system overlap unless a < b or b < a.
>
> The principle D of disjointness holds because the natural kinds of a system of classification may be conceived of as obtained by a process of division. The universe is first divided into disjoint sorts (e.g., *animal, vegetable*, and *mineral*), then these are further divided into disjoint sorts, and so forth. (1969, 98)

In Thomason's principle (D), "<" denotes the relation of species to genus or, more generally, the relation of "subsumption". Therefore, what is being denied is not the simple claim that the same individual can belong to different kinds. That claim would clearly be violated, for example, by the familiar Linnaean system in biology, with its hierarchy of broadening categories from species and genus to class and phylum. In that phylogenetic system, each organism belongs to a series of increasingly inclusive taxa.[1] By contrast, Thomason's principle says that two kinds can only overlap if one of those kinds is subsumed under the other. So an individual *can* belong to two or more natural kinds, provided those kinds can all be put in subsumption relations with one another. Rather than say that kinds cannot *overlap*, one might express this claim by saying that they cannot *crisscross*.

Suppose that *a*, *b*, and *c* are individuals, and *F* and *G* are natural kind categories; if *a* is grouped together with *b* under natural kind *F*, and *b* with *c* under natural kind *G*, then the disjointness principle states that *a* and *c* will be grouped together either under *F* or under *G*. For example, if humans are classified together with gorillas as primates, and gorillas are classified with cows as mammals, then humans and cows should also be classifiable together under one of those two categories, mammals or primates (intuitively, whichever one is higher). In this case, the principle is satisfied since they are classified together as mammals. The disjoint-

[1]Beginning with George Gaylord Simpson (1961, 19), biologists have used the term "category" for the groups species, genus, family, and so on, and the term "taxon" for particular species, genera, families, and so on. That usage will be followed in this paper, although "category" will also be used in a much broader sense to mean any group identified by a scientific theory.

ness principle says that the natural kinds identified by scientists should form a nested hierarchy of categories which do not crisscross.

The picture that emerges is neat enough, but it seems to be violated by certain familiar categories. Consider the example of a certain tiger that is at one and the same time a mammal and a quadruped.[2] The two kinds, mammal and quadruped, are not disjoint, for there is overlap between mammals and quadrupeds (the set of tigers being one member of the overlap) and yet neither kind is subsumed under the other since some nonmammals are also quadrupeds and some nonquadrupeds are mammals. To illustrate, if humans are classified together with tigers as mammals, and tigers are classified together with iguanas as quadrupeds, neither of these categories, mammals or quadrupeds, include both humans and iguanas. If one accepts the standard Linnaean taxonomic system, one seems committed, by the disjointness principle, to dismissing the category quadruped as a not-so-natural kind.

Before proceeding to criticize this principle, consider how Thomason might resist this last charge. He has claimed that kinds pertaining to a taxonomic system do not overlap. It might be said that we cannot conclude from the above example that the category quadruped is to be dismissed; rather, it can be said to belong to a *different* taxonomic system or scientific theory. A number of different systems can be conceived to coexist and the principle need only hold intrasystematically, not intersystematically. However, implicit in Thomason's explication of the principle is that the ultimate theory should be a single, overarching system. He writes that "[t]he universe is first divided into disjoint sorts . . . then these are further divided into disjoint sorts, and so forth" (1969, 98). Moreover, the three categories which he imagines to constitute the first division—animal, vegetable, and mineral—are unlikely to be thought of as pertaining to the same subsystem or theory. Therefore, I will interpret Thomason to say that the principle is supposed to hold for all genuine scientific categories. Even if one demarcates subsystems in the ultimate theory, Thomason's principle can be posited to obtain among them as well as within them.

II

One of the things which make the disjointness claim interesting is that a number of philosophers can be interpreted to hold a view of taxonomy which contradicts it, even though none of them articulate the claim in this form. Philosophers of science commonly say that classification is "interest-relative"; however, that claim is somewhat imprecise. In a triv-

[2]The example is derived from Kitcher (1982), although he uses it for a somewhat different purpose.

ial sense it is true, since science generally serves human interests, and the philosophers who hold such a view do not always spell out any further claim they might be making. But in some cases their view can be reinterpreted as a negation of the disjointness principle. The philosophers to be discussed do not argue their case in great detail, but in each instance their position amounts (partly at least) to a denial of Thomason's principle.

One can find such an opposing view in W. V. Quine's work on natural kinds:

> [W]e retain different similarity standards, different systems of kinds, for use in different contexts. We all still say that a marsupial mouse is more like an ordinary mouse than a kangaroo, except when we are concerned with genetic matters. Something like our innate quality space continues to function alongside the more sophisticated regroupings that have been found by scientific experience to facilitate induction. (1969, 129)

If field mice are lumped with marsupial mice under the category mouse, and marsupial mice are lumped with kangaroos under the category marsupial, neither of these two categories is capacious enough to accommodate both field mice and kangaroos. Therefore, the disjointness principle is violated by the two categories, mouse and marsupial.

Richard Boyd uses the example of whales and porpoises, which he says might be classified with mammals for some purposes and with fish and other maritime animals for others, "For purposes of many sorts of investigations (of fishing industries, or animal locomotion, for example) it may be perfectly rational to classify whales and porpoises together with the bone and cartilaginous fish" (1979, 395). To see how this system of classification violates the disjointness principle, first give the name "maritime animal" to the category which includes both whales and cartilaginous fish. Then, using the same procedure as above, swordfish and whales are included in the category maritime animal, and whales and koala bears are included in the category mammal, but neither of these categories includes both swordfish and koala bears.

In a similar vein, John Dupré has defended a position which he calls "promiscuous realism", "The realism derives from the fact that there are many sameness relations that serve to distinguish classes of organisms in ways that are relevant to various concerns; the promiscuity derives from the fact that none of these relations is privileged" (1981, 82). As an example, he contrasts the (non-Linnaean) category tree with the (Linnaean) category angiosperm. He states that "for most purposes it is much more relevant whether something is a tree or not than whether its seeds develop in an ovary" (ibid., 80). The illustration that these two categories violate the disjointness principle proceeds along the now-familiar lines. Both cedars and palms are trees and both palms and geraniums are angiosperms, but neither of these two categories, trees and angiosperms, include both cedars and geraniums.

One obvious objection to these attitudes to scientific taxonomy might be that they do not properly concern *scientific* categories at all. Among the three authors quoted, none state clearly that the offending categories cannot simply be dismissed as pseudoscientific ones. For Quine, the violation of disjointness concerns the rivalry between scientific categories and "our innate quality space" (1969, 129), rather than different scientific categories or different systems of scientific classification. He does not say that this innate classification scheme will be bypassed in due course, but he does make a clear distinction between "primitive standards" and "theoretical standards" (ibid., 128). Similarly, although Boyd speaks of these classifications being used by "many sorts of investigations", some of the investigations involved may be brushed off as nonscientific ones and the categories that ensue dismissed as nonnatural kinds. Finally, Dupré's concern is mainly to discuss terms from ordinary language (such as "tree") and part of his point is that they often do not correspond neatly to scientific terms. (His ultimate aim is to criticize the account of natural kind terms given by the causal theory of reference on the basis of these divergences between classification in ordinary language and in science.) Thus, the ordinary terms could be said to be less privileged than the scientific ones. In all cases, such categories can be envisaged to drop out in a future science, being a throwback to a primitive taxonomy which is not truly explanatory and does not pick out the right similarities among organisms. The objector might conclude that the categories that have been cited (mouse, maritime animal, and tree) are, to misuse Hamlet's phrase, "a little more than kin, and less than kind".

If one were to adopt this attitude to the purported counterexamples to the disjointness principle, an explanation would be owed of the apparent resilience of such taxonomic categories and the fact that they seem to coexist with the more hard-nosed scientific ones. But one need not rest with this general response, for the real challenge is to uncover categories which are undeniably scientific yet undermine the disjointness principle. These should be such that they cannot just be dismissed as categories which provide partial relief from our ignorance of a certain domain, pending further inquiry. Of course, it will not be possible to assert that any given classification scheme is final and will never be superseded, for that would be to anticipate the end of inquiry. Still, one should be able to demonstrate that at least some respectable scientific categories clearly violate Thomason's principle.

III

A less pedestrian example might be a category such as parasite, which is the basis for the emergence of the subdiscipline of parasitology in the biological sciences. Biologists have occasion to make many general statements about parasites and it is unquestionably a bona fide scientific category, despite the fact that it cuts across phylogenetic taxa. In a standard textbook on parasitology, the authors state:

> Parasites have lost the capacity for continuous free living and have become dependent for their existence upon one or more living species. They have, in general, lost sense organs, locomotor abilities, and certain metabolic functions such as the elaboration of some digestive enzymes. These losses are compensated by various gains: a habitat that provides abundant food, shelter, and some protection, a long individual life, specialized modes of reproduction and life cycles, and specialized organs of attachment. (Noble and Noble 1982, 7)

The authors go on to make various generalizations about the host organisms with which parasites associate, as well as about the nature of the association between the parasite and the host:

> A single host body provides limited space, and it eventually dies. To satisfy this need, parasites depend upon the food and habits of the host. Appropriate triggering mechanisms initiate the change from infective stages to parasitic stages. Once the parasite has begun its existence in a new host body, other triggering mechanisms initiate each change of the parasite during its development. (Ibid.)

The similarities which exist among all parasite-host associations justify the isolation of parasites as distinct natural kinds. Like the categories encountered in the previous section, this one also cuts across the familiar Linnaean ones. The demonstration that this category violates the disjointness principle proceeds as before. Both tapeworms (phylum Platyhelminthes) and fleas (order Siphonaptera) are parasites and both fleas and flies (order Diptera) are insects, but tapeworms and flies are neither both parasites nor both insects.

One of the most influential modern biological taxonomists, Willi Hennig, has clearly endorsed the general principle of taxonomic pluralism in biology. Although he is a staunch practitioner of phylogenetic systematics, the branch of biology which attempts to classify organisms on the basis of their descent,[3] Hennig has claimed unequivocally that a variety of different classification schemes can be retained side by side:

[3]Strictly speaking, there is more than one phylogenetic approach to systematics. Hennig has been instrumental in founding the approach to biological taxonomy known as "clad-

> Each organism may be conceived as a member of the totality of all organisms in a great variety of ways, depending on whether this totality is investigated as a living community, as a community of descent, as the bearer of the physiological characters of life, as a chorologically differentiated unit, or in still other ways. The classification of organisms or specific groups of organisms as parasites, saprophytes, blood suckers, predators, carnivores, phytophages, etc.; into lung-, trachea-, or gill-breathers, etc.; into diggers of the digging wasp type, mole type, and earthworm type; . . . are partial pieces of such systematic presentations that have been carried out for different dimensions of the multidimensional multiplicity. (1979, 5)

Again, the point about the categories that Hennig mentions is that they crisscross the Linnaean ones, thus violating the disjointness principle. There does not seem to be a way of dismissing them as illegitimate or of ruling that they will necessarily be abandoned by future scientists. Hennig is certainly not claiming that classification is arbitrary and need serve no theoretical purpose. Rather, the systems in question are each justified by *different* theoretical purposes:

> In reality, nothing at all is achieved by a completely nontheoretical ordering of organisms. All results of biological investigation, in whatever partial discipline they may have been gathered, have meaning only if a realm of applicability can be seen in them that extends beyond the individuals (single organisms) from which they were derived. Thus the results must have validity for certain groups of individuals. . . . These groups of individuals may pertain to a physiological (homoiothermy, for example), ecological (parasites), phylogenetic (insects), or any other constructed system. (Ibid., 8)

Even though Hennig wants to defend the claim that the phylogenetic system is a "general reference system", he thinks it necessary to erect other systems of classification as well. Thus, all these systems can coexist comfortably.

To avoid leaving the impression that all the counterexamples to the disjointness principle pertain to biology, let us survey a few examples from other sciences. Classification by chemical formula seems to be the basic system in chemistry. But there are many substances which, although

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istics". In contrast with other phylogenetic approaches, it emphasizes evolutionary branching as opposed to other types of evolution in determining classification. But proponents of other approaches have very similar views. Simpson concurs, "We must thus accept the possibility and in fact the need not only of many classifications but also of many *kinds* of classifications, that is, of classifications based on different sorts of relationships and serving different purposes" (1961, 26).

diverse in terms of chemical formula, share salient characteristics from the point of view of the biochemist, chemical engineer, or materials scientist. Examples of chemical kinds pertinent to the biochemist or physiologist are vitamins and hormones. Although their members are not homogeneous from the point of view of chemical formula, these are indisputably scientific categories which are determined on the basis of macroproperties or functional characteristics. Similar examples of substances pertinent to the concerns of the chemical engineer and materials scientist, such as polymers, plastics, and dyes, cannot be characterized even according to general features of their chemical formula but must be picked out in terms of different properties. Even the classification of atoms does not seem to be immune to these sorts of counterexamples. They need not only be classified according to chemical element or the number of protons in their nucleus. Nuclear physicists sometimes find it more useful to group atoms in terms of atomic weight rather than atomic number, as this is a better indication of their radioactivity and pattern of decay.

At this point, the following attempt could be made to defend the disjointness principle. We could restrict its domain to some bedrock of finely divided categories in each realm. In the case of biological organisms this could be species taxa and in the case of chemical exemplars, chemical formula. While the biological examples adduced above crisscrossed some of the higher taxa from the phylogenetic system, no classification scheme was encountered which grouped specimens from the same species in different categories. The same could be said of the chemical categories; they might have crisscrossed classes of compounds arranged according to general features of their chemical formula (for example, organic and inorganic compounds), but none put different samples of the same substance, picked out according to chemical formula, in different categories. The counterexamples were such that they did not subdivide the finest-grained categories identified according to chemical formula or species. Since that is the case, someone might say that Thomason was at least right about a foundational level of categories in each domain. Although higher categories might not always be disjoint, a basic level of categories are disjoint in the appropriate sense. Perhaps one could restrict the disjointness principle to this basic level.

But this proposal will not work. Although all the alternative categories that have been suggested so far happen to be more coarse-grained than individuation by species or by chemical formula, others can be put forward which cut across these categories as well. Both chemists and physicists talk about the phases of matter: solids, liquids, and gases. Clearly, these categories group together samples of substances with widely different chemical formulas and exclude other samples with those very same formulas. Liquid water and liquid alcohol share some properties which neither of them shares with gaseous water or gaseous alcohol.

Similarly, in talking about magnetic materials, scientists distinguish diamagnetic, paramagnetic, and ferromagnetic materials. The second category includes samples of substances in which magnetic properties have been temporarily induced under certain conditions. For example, samples of chromium are capable of weak induced magnetism when brought close to a magnet. The third category includes samples of substances such as iron and nickel, which have become permanently magnetized when exposed to an external field. Therefore, both categories group together samples of substances with different chemical formulas and omit other samples of those same substances. A sample of iron and a sample of nickel might both be classified as ferromagnetic, but different samples of these two substances which have not been exposed to the requisite field will be excluded from this category.

Similarly, in biology, Hennig has proposed that organisms of the same species may be distinguished on the basis of the different stages in their development, thus: larva, pupa, and imago. (In order to accommodate this taxonomic fact, Hennig 1979, 6, proposes that the biological individual should not be the organism but the "semaphoront", an organism at a particular time. An entomologist himself, Hennig seems particularly sensitive to developmental questions.) Larvae of different species may be classified together for certain purposes, but the category larva will exclude some other organisms belonging to those two species. Therefore, even if the disjointness principle were restricted to some basic level of categories in each domain, that would not render it immune to counterexamples. One cannot even specify a foundational base of mutually exclusive categories because any such set of categories might be further subdivided for some scientific purposes.

According to the conception of scientific taxonomy being defended here, there is generally not a single natural kind, or even a nested hierarchy of kinds, that each specimen or sample instantiates. This situation need not reflect ignorance, but may instead be the taxonomic procedure at the end of inquiry. That is just because scientists often decide to classify two exemplars or groups of exemplars together for some purposes but not for others. Even at the end of inquiry, there can be two scientific theories about a certain domain both of which are valid even though they group the elements of that domain in different ways. Note that it is now possible to observe why this view of scientific classification can be said to be interest-relative. If each time a scientist divides up the world it is relative to a particular set of interests, we would expect that different interests will generally result in crisscrossing categories.

IV

Consider now the motivation for holding the principle of the disjointness of natural kinds. Given any exemplar that is a fitting subject of scientific study, say the tree outside my window, what would be the reason for supposing that only a set of disjoint kinds can be predicated of it? Such an object has a multitude of properties: It is an angiosperm, a plant, a tree, a living organism, a huge collection of various organic molecules, an object with a certain mass, the favored nesting site of a certain kind of bird, and so on. An adherent of the disjointness principle might say that all these properties can be predicated of it, but not all of them are *natural kinds*. Of the above list of properties, presumably only being an angiosperm and being a plant are the true scientific properties (these two categories being the phylogenetic ones). It is by no means obvious that scientific realism requires such a rigid view of taxonomy and some empirical evidence seems against the view, so why do some philosophers appear to hold it? Thomason says something in an attempt to make it plausible in the passage quoted in the first section. He writes that natural kinds "may be conceived of as obtained by a process of division". But positing a process of division is insufficient to justify disjointness. Nothing about the scientific enterprise would lead one to suppose that subsequent divisions should not crisscross the ones already made without thereby supplanting them.

Another motivation for the disjointness principle, which surfaced more recently, has to do with essentialism, though it may also have been part of Thomason's original intention.[4] In the course of showing that essentialism cannot be derived from the causal theory of reference on its own, Nathan Salmon has claimed that the disjointness principle is implicitly utilized by proponents of the causal theory to generate their famous necessary a posteriori truths. That is, they use it to establish modal essentialism about natural kinds. One such necessary a posteriori truth is the sentence "Water is H_2O", which is said to hold in all possible worlds in which water exists:

> From these three ingredients—the ostensive definition of water, the fact that the paradigm has the chemical structure H_2O, and *the fact that consubstantiality consists in having the same chemical structure*—we easily generate the necessary *a posteriori* truth that water is H_2O . . .. (Salmon 1981, 163; emphasis added)

[4]Later in the same paper, Thomason gives a brief sketch of a possible-worlds semantics of natural kind terms, according to which "natural kinds are *constant* functions taking possible worlds into sets of individuals . . ." (1969, 100). He proposes the account after stating, "For Aristotle, natural kinds enter into the essence of things and so give rise to necessary truths" (ibid., 99).

The third premise on Salmon's list is the relevant one, and it asserts that being of the same chemical substance (in his terminology, being "consubstantial") consists effectively in having the same chemical structure.

Salmon explains that the above premise is just a "special instance" of the disjointness principle. However, this is not immediately obvious. He later spells out two such premises which are used in the derivation of essentialism about natural kinds:

> If some sample of a given substance *z* has a certain chemical structure *F*, then every sample of substance *z* has chemical structure *F*.
>
> If some member of a given species *z* is a member of a certain biological class, then species *z* is completely subsumed under that biological class. (Ibid., 257)

There are two possible interpretations of these principles. Under the first interpretation, the term "substance" in the first principle and the term "class" in the second principle are being used as generic terms for the notions of chemical category and biological category, respectively. Thus, the first principle says that for any given chemical exemplar, there will only be a single chemical category which it instantiates. That would make it truly a special instance of the disjointness principle, since it would mean that chemical categories or kinds do not crisscross (in fact, it seems to be saying something stronger, for it implies not only that chemical kinds do not crisscross, but that they do not even overlap—but that complication can be set aside). Similarly, the biological principle would be taken to mean that bona fide biological categories cannot crisscross species taxa. In both cases, the claims would be special cases of the disjointness principle, and we have looked at examples which show that such claims cannot be upheld in light of actual taxonomic practice.

However, a second interpretation of Salmon's principles takes his terms "substance" and "class" in a much narrower sense to refer to categories drawn from particular systems of classification as opposed to generic scientific categories. In the case of the first principle, the category "substance" might be taken to pertain to that system of classification based on chemical formula or structure. In the second case, the term "class" might be taken as the name of that biological category in the Linnaean system which is located between the categories order and phylum and which includes the taxa *Mammalia*, *Insecta*, and so on. On this reading, the two principles which Salmon cites merely state the basis or the partial basis (in the case of the biological principle) for being classified under two particular classification systems. The first says that classification by substance picks out chemical samples on the basis of their chemical structure. The second principle says that classification by species picks out biological specimens (in part) on the basis of the class to which they belong. On this second interpretation, the principles do not seem vulnerable to the objections advanced to the disjointness principle.

It turns out that the latter, more innocuous interpretation of the two principles (which sees them as stating the bases for two particular systems of classification) is the one which Salmon intends (this is clear from circumstantial evidence from the text as well as from a private communication from Salmon). Therefore, Salmon does not seem to make explicit use of the disjointness principle, as it has been understood here, in his derivation of essentialism. Instead, he thinks that all that is needed in the derivation is a weak version of the disjointness principle. That version says merely that scientific categories are disjoint *within* a particular classification system (an interpretation of Thomason's principle which was rejected in the first section). Nevertheless, I would maintain that the full-blown version of disjointness is presupposed by the direct reference theorists in their derivation of essentialism. To support this claim, I will look in a little more detail at the strategy used by direct reference theorists to derive essentialism about natural kinds.

The approach adopted by direct reference theorists who attempt to establish essentialism is to take a sample of something in the actual world to stand in for a particular natural kind in all possible worlds. As Salmon explains it (relying on the account given by Keith Donnellan), natural kind terms "are paradigmatic in the special sense that they are 'definable' ostensively by way of reference to actual paradigmatic samples of the natural kind in question . . ." (1981, 164). Thus, one can take a particular glass of water to define the natural kind to which it actually belongs and go on to claim that it belongs to that natural kind essentially, that is, in all possible worlds. However, problems will arise when the sample belongs to a multitude of categories, none of which are privileged from a scientific point of view. If no foundational base of scientific categories exists, we have no reason to think that the sample in question does not stand in for the category liquid, for example, rather than the category H_2O. If it belongs to more than one such category and none of them are foundational, we will generally end up with a composite essence rather than a simple natural kind essence. In other words, if an individual sample belongs to a number of scientific categories (recall the tree at the beginning of this section), this will result in composite categories which are very different from the natural kinds normally posited by essentialists. That is why essentialists about natural kinds would seem to require the disjointness principle: to arrive at a foundational level of scientific categories which can be considered to be the natural kinds. They would not be able to establish essentialism about natural kinds in the ordinary sense unless each sample belonged to a single category at the most basic level so that it could be used to define it in a paradigmatic way.

Another problem with taking individual samples to be paradigmatic instances of natural kinds arises. Such samples or specimens sometimes do not belong to certain scientific categories for the duration of their existence. As already mentioned, some biological organisms progress through the categories pupa, larva, and imago. Let us assume for the sake of argument that essentialists are content to let natural kinds be composite categories. Still, if the composite category to which an individual sample belongs includes the category larva, it would be paradoxical to maintain that it belonged to that composite natural kind essentially. That would be equivalent to saying that it belonged to that kind in all possible worlds; however, we know that it will not even continue to belong to it in the *actual* world. If essentialists wish to bar such transitory categories from inclusion in a composite kind, they owe us a principled way of doing so.

In the previous section, I argued that if the disjointness principle is false, there will generally not be a bedrock of basic scientific categories. In the absence of such a foundational level of categories, philosophers who attempt to derive essentialism with the help of the theory of direct reference would have to settle, at best, for composite essences of an indefinite degree of complexity. Therefore, there are good reasons for thinking that the disjointness principle (in its strong and discredited form) is required to derive essentialism about natural kinds. As already mentioned, Salmon disagrees with this position since he holds that the relatively innocuous form of the principle is all that is required for the derivation of nontrivial essentialism from the theory of direct reference.[5] That claim is made in the context of a sustained argument that essentialism about natural kinds does not drop out of the theory of direct reference on its own, as some philosophers have assumed.

Finally, I will consider the bearing of this discussion on the doctrines of realism and essentialism. In regards to realism, I have not argued that there is no ready-made world or that the categories proposed by scientists do not really exist in nature. As far as I can tell, the fact that scientific categories are not disjoint does not affect the thesis of scientific realism; if categories are not always mutually exclusive, that should not make them any less real. There is nothing wrong with talking about carving nature at the joints as long as one bears in mind that nature's joints are not always disjoint. That is not to say that any categories into which we might carve the natural world are as good as any others. Some classifi-

[5]This point was conveyed in a private communication from Salmon. For him, the definitions given by direct reference theorists do not presuppose a unique bedrock of foundational categories; each definition merely presupposes a particular system of classification (e.g., the Linnaean system). But I have tried to suggest that the causal theorists cannot simply help themselves to such classification systems, for they are supposed to be giving definitions of the categories that are constitutive of those very systems.

cation schemes are justifiably rejected and replaced by alternatives. But it is to say that scientists are constantly recarving the world in accordance with their explanatory purposes and a number of these carvings can criss-cross without being rivals.

However, things stand differently with essentialism. Before discussing the disjointness principle, one might have a philosophical hunch that an "interest-relative" view of taxonomy is opposed to an essentialist one, but there does not seem to be a direct way of justifying this conjecture. I have tried to show that a precise way of formulating the interest-relativity thesis is by taking it to be a denial of the disjointness principle; this formulation also has the advantage of demonstrating the conflict between interest-relative classification and essentialism. If interest-relativity can be understood as the violation of disjointness, and disjointness is a crucial assumption in one derivation of essentialism, then the source of tension between interest-relative and essentialist classification is made plain.

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