

## REALISM AND THE PROBLEM OF *INFIMAE SPECIES*

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Modal conventionalism is the view that two crucial forms of sameness are mind-dependent. There is no phenomenon of sameness in kind, on this view, except in virtue of our conventions for individuating nature's kinds; there is no phenomenon of numerical sameness across time, for an individual member of some natural kind, except in virtue of our conventions for individuating such members.<sup>1</sup> Modal conventionalism has its realist opponents. These opponents have argued, following Kripke's lead more than thirty years ago (Kripke 1972), that the boundaries of at least many of nature's kinds are carved out by nature itself, and not by our classificatory practices (e.g., Millikan 2000: *passim*, e.g., pp. 25 and 72). But they have not generally argued, with anything approaching the same vigor, that modal conventionalism is wrong in its other main claim. They have not in general argued that the world-given connections among properties, that make those properties mind-independently be membership conditions for some natural kind, at the same time make those properties mind-independently be persistence conditions for the members of the kind—properties the departure of which constitutes a ceasing-to-exist for the object that formerly had them. On the contrary, opponents of modal conventionalism have

sometimes allowed that, in even the case of the kinds that have the strongest intuitive claim to being *natural* kinds—more on this distinction in the next paragraph—a member of that kind can lose these kind-characterizing properties, and can thus depart from the kind, without ceasing to exist.<sup>2</sup> Realists have claimed mind-independent status for the borders of natural kinds, but have not taken the borders to ground a mind-independent fact of the matter as to how long, and in what circumstances, the individual members of that kind exist. The task of this paper is to identify one main reason for reluctance to extend realism about kinds to realism about persistence, and to remove that reason. This paper thus undertakes to defend a full-blown modal realism.

The word “kind” can legitimately be applied to all sorts of groupings of the world's components, and it is important to be clear that only some of these groupings are at issue in the dispute between modal conventionalism and modal realism. On one legitimate usage of “kind,” there are kinds from which, according to everyone's intuitions, a member (or a sample) can depart without ceasing to exist—kinds for which the membership-conditions do *not* double as persistence conditions. There are Californians and sexagenarians and lawyers, and sexagenarian Californian law-

yers. It is perhaps no accident (more below) that the members of kinds from which departure seems *not* to amount to a ceasing-to-exist are rarely characterized by any—or certainly not by many—properties beyond those after which they are named. Californians have little in common beyond their place of residence. And where the members of such kinds *are* characterized by a plurality of properties, typically those properties are held together only by the “and” in our definition of the kind. Sexagenarian Californians need not be lawyers. On a different usage of “kind”—a usage often signaled by speaking of “*natural kinds*”—there are kinds whose members (or samples) are characterized by a rich range of common properties, properties held together by the workings of the world, and not just by an “and” in our conception of the kind. Intuitively, it seems that humans, uranium atoms, frogs, and water are all examples of such kinds. Quite often these kinds are “inductively rich”: we can expect to discover commonalities among their members that did not figure in our initial conception of the kind. It is perhaps no accident that our intuitions generally say that from these kinds, members (or samples) cannot depart without ceasing to exist. If a uranium atom undergoes fission and is a uranium atom no longer, our intuitions say, it has been destroyed; if some water is subjected to hydrolysis, leaving only a volume of oxygen and a volume of hydrogen, our intuitions say that the water exists no longer.

But if these last intuitive judgements are correct, what *makes* them correct—in what does correctness consist here? This is the issue that divides modal conventionalists from full-blown modal realists. Conventionalists say that correctness consists in conformity to our conventions for judgements of numerical sameness across time—our conventions for making judgements of the form, “same object still continuing to exist,” “same object no longer existing,” “new object coming to

exist.” (It is likely that, if we really do have such conventions, the conventions apply not directly to particular kinds, but to kinds of kinds—to *physical elements*, to *chemical compounds*, perhaps to *biological species*, etc. Sidelle 1989: pp. 59–61.) These conventions are not arbitrary, conventionalists will say. It is unsurprising that we are inclined to take kind-membership more seriously, the more the kind is inductively rich—for it is the members of such kinds that figure prominently in scientific prediction and explanation. This motivates us to judge that an object’s departure from such a kind is no mere alteration, but amounts to an ending of an existence. Even so, conventionalists will add, our conventions *are* merely conventions. If someone were to judge that when a uranium atom undergoes fission, nothing has been destroyed, and that all that has happened is that some matter has undergone an alteration, such a person would not have made an empirical error, and would not have gotten the world wrong. The person would merely have spoken strangely (Sidelle 1998: pp. 438–441; cf. Sidelle 1989: pp. 105–109).

Full-blown modal realists contend that correctness, in our judgements as to where objects do and do not persist, consists in conformity to a mind-independent phenomenon of persistence, of numerical sameness across time. Someone *would* have gotten the world wrong, according to this view, if he judged that when a uranium atom undergoes fission, nothing really is destroyed—indeed he would have made an *empirical* mistake. The very tests that tell us that the properties characteristic of uranium atoms hang together tightly enough to form a mind-independent kind, full-blown realists would say, likewise demonstrate that these properties are persistence-conditions for the members of that kind. Persistence is something that we trace, not something that we stipulate, according to full-blown modal realism.

Realists have argued that the conventionalist side in this dispute is internally unstable, even self-contradictory (Elder, 2004: chap. 1; Elder 2006; Elder forthcoming). But the realist side is not without apparent trouble, trouble connected precisely with the empirical test which realists see us as running to determine which properties mark out the borders of mind-independent natural kinds. On the account of this test that one might initially offer, the test detects natural kinds not only where we expect to see them, but also in more narrowly delimited areas. Humans and frogs and water all test out as natural kinds, on this test as most readily understood: but so do human adolescents and cancer-sufferers, tadpoles, and ice and steam. If *by* identifying the membership conditions for natural kinds, this test *thereby* identifies persistence conditions for the members and samples of those kinds, it will apparently follow that many natural objects (and samples) have incompatible persistence conditions. When some human outgrows adolescence, it will apparently be the case both that the adolescent has ceased to exist, and that that very adolescent has moved to a new phase of his existence. When some tadpole metamorphoses into an adult frog, that very object, apparently, will have ceased to exist and have continued to exist; when some ice melts, that very matter will have been destroyed, and will have passed into a different state.

This is a problem that modal conventionalists can manage to avoid altogether. For from their standpoint, there is no phenomenon of numerical sameness across time except in virtue of our practices of individuation. Consequently, we need only attend to the judgements about persistence that are implied by the ways we use our sortals, and we will have settled the question whether something has ceased to exist, or has instead continued. We need only note that we treat “adolescents” and “tadpoles” as *phase* sortals (Wiggins 1967: pp. 7, 29)—that is, we say that an adolescent

can cease to be an adolescent without ceasing to *be*—and we will have settled the question whether something in the world goes on existing after, say, it reaches age eighteen. We need only note that we treat “ice” as a *substance* sortal—we say that once the ice in your glass has melted, there no longer is any ice in your glass—and we will have settled the question whether, when some ice does melt, an existence has ended. But for the full-strength modal realist, numerical sameness across time is an extra-linguistic, mind-independent matter. Its reach across time is determined by the natural kind to which the *thing*, or the *matter*, now in front of us belongs. The appearance, therefore, that one and the same thing (or one and the same matter) belongs to *two* (or more) different natural kinds threatens a contradiction.

But this threat is merely apparent, this paper will argue. It can be dispelled by attending closely to the sort of evidence that realists see us as being guided by, in our judgements as to where nature has carved out a genuine kind. In the less worrying sort of case, this evidence does indeed show that one and the same thing belongs to both a more specific and a more general natural kind, but the thing’s membership in the two kinds does not after all yield incompatible persistence-conditions: any circumstance in which a thing departs from the more specific kind will be a case in which it departs from the more general kind as well. The more worrying sort of case, which this paper will consider first and at much greater length, is the one typified by the examples offered so far. Here it appears that a single thing belongs to a more specific natural kind and to a more general one, and it seems completely obvious that *that very thing* could depart from the more specific kind while continuing to be a member of the more general one. The solution must be, as this paper will argue, that only one of these putative kinds is truly a natural kind, and truly grounds persistence-conditions for the things that belong to it. In

all such cases it is the more specific putative kind that is the impostor—such putative kinds fall below the level of nature’s “least kinds,” its *infimae species*.<sup>3</sup>

## I

The threat to full-scale modal realism that this paper examines consists in the appearance that one and the same object—or one and the same matter—has incompatible persistence conditions. Just that sort of problem is addressed in the literature on “material constitution,” and one might wonder whether responses to the problem that have been devised there might be employed by the modal realist. The present section will look briefly at the two responses that initially seem most promising. But in the end, the threat to modal realism will have to be dispelled by stronger measures. For as applied to the present problem—viz., that one thing can apparently belong to both a more general and a more specific natural kind—both responses appear artificial and implausible.

The first response is to multiply entities. When a human adolescent turns into an adult, or a piece of ice melts, perhaps one thing *has* ceased to exist—this being a member of the more specific natural kind—while another thing has continued to exist, namely the member of the more general natural kind. The claim, in other words, would be in all the putative transitions we have envisioned, the space before us has not one occupant, but several. That is just what is often said about the statue of Goliath and the (lump of) clay: the former is destroyed if it is crushed, but the latter goes on existing; so the statue is a distinct thing from the clay; but it perhaps should not surprise us that these two things can occupy the same space at the same time, or can be composed of all the same material parts (Wiggins 1968, Burke 1994, Zimmerman 1995; but cf. Sidelle 1992: §7). Just so, a person is found exactly where a human body is; fictions involving brain-scanning

show that the person can survive alterations that end up destroying the human body; but for all that it may be acceptable to endorse a thesis of Coincidence, locating the person now in exactly the same place as the body now. Perhaps we even can *understand* how two distinct objects can occupy the same place by invoking what Lynne Rudder Baker calls “the Constitution view” (Baker 2000). The human body constitutes the person, we perhaps should say, and this not only permits but requires that the body be present exactly where the person is; similarly, the lump of clay constitutes the statue.

But the cases of concern to the modal realist cannot plausibly be handled in this way. When an adolescent is before us, a human is before us—but since there can be a human before us only *by* there being an adolescent or a child or an adult before us, it seems unwarranted to claim that, *in addition to* the adolescent before us, there is *also* a human before us. When a human is before us, by virtue of there being an adolescent before us, the relation between the human and the adolescent would seem to be *identity*. Similarly for the H<sub>2</sub>O now before us, which appears simultaneously to belong to the more specific natural kind *ice*: some H<sub>2</sub>O can be present before us only *by virtue of* there being present before us some ice, or some liquid water, or some steam. So when there is in fact some ice before us, it seems unwarranted to claim that there is, *in addition*, some H<sub>2</sub>O before us. In all the cases that pose a threat to the modal realist, the relation between the member of the more specific natural kind and the more general natural kind appears to be identity, not coincidence.

The other response (adapted from Burke 1994) would be to say that when a tadpole gives place to an adult frog, or some ice melts, *nothing* continues to exist. True, in the former case, there is at the end a member of (say) the species *Rana pipiens*, just as there was at the beginning. But the member of *Rana*

*pipiens* that is present at the end, on this other response, would be a *numerically distinct* member. For the member that was present at the beginning was a tadpole, and the member that is there at the end is not a tadpole. Just so, it is not *the very* H<sub>2</sub>O that is present after the melting, as was present before: the original H<sub>2</sub>O was some ice, and the H<sub>2</sub>O present after the melting is not.

But this response departs so radically from the judgements we are accustomed to making, as to what shows that a member (or sample) of some natural kind has gone on existing, that it would afford the modal realist only an implausible and strained defense against the puzzle cases we are considering. Just what is sufficient to show that one and the same natural object has persisted across a span of time? To this question any philosopher who defends an ontology resembling that of common sense (trees, tables, dogs) or that of learned science (quarks, atoms, electrons, molecules) will give an answer on which membership in some one natural kind is necessary for persistence, and membership in that kind together with spatio-temporal continuity is sufficient. That is, a large part of the answer will be that the existence of an individual object begins when the properties characteristic of some natural kind come jointly to be instanced, continues so long as those same properties continue to be jointly present along some spatio-temporally continuous path, and ends when one or more of these properties fails to be present (Thomasson forthcoming: chap. 3; cf. Macdonald 2005: pp. 114–122). This answer entails that one and the same member of *Rana pipiens* is present both before and after the tadpole metamorphoses into an adult frog. The challenge to the modal realist remains.

What about the persistence-conditions for portions of the *stuffs* and *matters* of nature (gold, H<sub>2</sub>O, petroleum)? On this question philosophers who defend an ontology like that of common sense or ordinary science will offer

much the same sort of answer. The answer will be that for some gold to be present before us is for the properties characteristic of that natural kind jointly to be instanced before us, and that so long as those properties continue to be present, across some continuous path through space and time, *that very gold* continues to exist. The situation becomes less straightforward when we ask not what it is for *some gold* (or H<sub>2</sub>O, etc.) now before us to go on existing, or to have been in existence earlier, but ask the same question using nouns that appear to refer to discrete objects—when we ask, that is, what is involved in the continued (or previous) existence of the *parcel* or *sample* of gold now before us. How much diminution or scattering a *parcel* or *sample* can undergo seems to be a very context-sensitive affair, and it can plausibly be claimed that there is no fact of the matter as to how long the same *parcel* or *sample* of gold (or of H<sub>2</sub>O, etc.) endures, apart from how we choose to talk (Elder 2004: chap. 7; Elder 1998). Henry Laycock, who vigorously affirms the reality of matters and stuffs, claims for this reason that *parcels* and *samples* are conceptual artifacts, contrived by speaking of the various kinds of matter that occur in nature as if they had naturally segmented members—as really is the case with natural kinds such as *trees*, *dogs*, *atoms*, and *electrons* (Laycock 2006: pp. 48–52, 137–138, 154). Whether Laycock is right or not about parcels and samples, it seems clear that familiar ontologies license the question of what is sufficient for *some gold* or *some water* now before us to have existed somewhere in the past, or to go on existing somewhere in the future. And here the answer will be broadly the same as in the case of some dog now before us, or some atom: the right properties must jointly be instanced, at all the times we are asking about; and so long as the joint instantiation of those properties follows a spatio-temporally continuous path, linking these times to one another, we will be right to claim that *the*

same gold (or *the* same atom or dog) persists across those times.

## II

Modal realists hold that the borders of nature's kinds are fixed mind-independently; that the membership conditions for these kinds are at the same time persistence conditions for the members of these kinds; and that we can determine empirically what these membership-cum-persistence conditions are. By what empirical tests might we do this? The easiest initial answer to this question generates the appearance that modal realists face a problem about objects having incompatible persistence conditions. The more careful answer removes that appearance.

On anyone's understanding of nature's kinds, kinds are classes whose members are united with one another, and set off from the members of other kinds, by virtue of their properties. For each natural kind one envisions a list of properties, such that all members of the kind will have all the properties on the list, and no members of any other kind will have all those properties. But what connects together the properties on the list? This is the first question that divides modal realists from modal conventionalists. For realists, the answer must ultimately have nothing to do with our classificatory practices. The properties on the list must be connected together strictly by the way the world works. The only plausible unpacking of this basic idea is that it is the *causal* workings of the world that tie together the properties that jointly are distinctive of any natural kind. Those properties must be causally "geared together": it must be the case that alterations in one or another of these properties—replacement of it by a contrary property—would ensure answering alterations in others of these properties (Author's book, Author's article a). This connection between hypothetical variations—this "invariance"—is at least a consequence of the sort of causal connec-

tion that must hold between the properties characteristic of a world-given kind; if the "manipulability" account of causal connection recently defended by Woodward and Hitchcock is correct, such "invariance" is actually constitutive of causal connection (Woodward and Hitchcock 2003a, 2003b; Woodward 2003; Hitchcock 2001a, 2001b). In any case, the vocabulary of Woodward and Hitchcock will serve to make the basic idea of the relevant causal connection more precise. In the fundamental case, the properties characteristic of a kind *K* that is carved out by the world, and not by us, must be such that a hypothetical intervention on one or another of these properties, that replaced the given property by one of its contraries, and that did not *directly* act on any other of the properties characteristic of *Ks*, would, just *by* intervening on that one property, entrain a corresponding variation in one or more others of the properties characteristic of *Ks*.<sup>4</sup>

But two details must be added, before we can claim to have an adequate account of the connection that glues together the properties characteristic of a world-constituted kind. First, because we are talking about an intervention on properties that *Ks* *must* have to be *Ks*, we must not think of this intervention as producing an alteration in *Ks* themselves. For once the intervention replaces its target property by a contrary, there no longer are *Ks* there to have been altered. To speak of such an intervention, then, is not to compare a hypothetical "after" phase to a hypothetical "before" phase in the career of one or more *Ks*; it is rather to compare one *kind* to another. It is to ask, "on the sole assumption that some property *p1* that is characteristic of *Ks* is replaced by a contrary property *p2* or *p3*, in some other kind *K'* highly similar to *K*, is it thereby ensured that some other property *r1* that is likewise characteristic of *Ks* is replaced in *K's* by some contrary property *r2* or *r3*, etc.?" If the answer is Yes, then the relevant sort of causal "gearing"

obtains between property *p1* and property *r1* in *Ks* (Elder 2004: chap. 2). Let us say that in this case, property *p1* controls property *r1* in *Ks*. There is a particularly *strong* causal “gearing” between *p1* and *r1*—*p1* controls *r1* *strongly*—just in case a *wide* range of interventions on *p1*, replacing *p1* with contraries more and more different from *p1* itself, yields *commensurately* different variants on *r1* in kinds similar to *Ks*.

The second detail concerns how *centralized* the causal connections are, that glue together the properties in a world-constituted kind. This paper has so far said that in the fundamental case, interventions on one or another of the properties characteristic of *Ks* yield answering variations in others of the properties characteristic of *Ks*. But it has not said that there need be any *one* property characteristic of *Ks*, such that interventions on it will yield variations on *all other* properties characteristic of *Ks*. This would be to say that for any world-constituted kind, there is some one characterizing property that controls all the other properties in the nature of that kind, and hence one property that is found in no other world-constituted kind. Now, the literature on natural kinds since Kripke’s *Naming and Necessity* (1972) has focused on kinds such as *water* and *gold*—kinds for which there *is* some one property (e.g., *has microstructure H<sub>2</sub>O*, *has atomic number 79*) that, plausibly, controls all the others—and this may encourage the thought that *every* natural kind must have a nature that is controlled by a property found in no other natural kind. But historically, the concept of a natural kind has not required so centralized a connection among the characterizing properties. Historically, the concept of natural kind has simply been that of a plurality of objects (or portions) over which we can run inductions that non-accidentally succeed—inductions that would not succeed if projected over objects outside that plurality, or that might succeed for such outside objects but only by

accident. This role requires only that there are world-given connections—causal connections, to be precise—that together a set of properties *jointly* found across the entire plurality of objects, and not *jointly* found elsewhere. It does not require that there is any *one* property that *individually* is found across, and not outside, this plurality. Natural kinds, on this historical conception, may be characterized by properties that individually are “run of the mill,” found in other kinds as well; what distinguishes a natural kind may be only a *combination* of such properties, that can occur in no other natural kind.

So we should assume, pending argument to the contrary, that the causal connections that gear together the properties of a world-constituted kind may be decentralized. Perhaps they can be criss-crossing; perhaps they can be branching. Here is an example of branching connection. Suppose that *K* is characterized by just three properties, *p1*, *r1*, and *s1*, and suppose that each of these properties is individually capable of occurring in other natural kinds. Then we might end up finding that there is no one answer to what happens if, in some closely similar kind, *p1* is replaced by the contrary property *p2*. It might happen that one closely similar kind is *K'*, in which *r1* itself is again present, and that in this case the replacement of *p1* by *p2* entrains a replacement of *s1* by *s2*, but that another equally similar kind is *K''*, in which *s1* itself is still present, and that the replacement there of *p1* by *p2* entrains a replacement of *r1* by *r2*. In this case it is false that *p1* controls both *r1* and *s1*. There is a causal connection between *p1* and both *r1* and *s1*, but it is disjunctive, “branching” (Author’s article b). But for all that, the properties {*p1*, *r1*, *s1*} are, *in combination*, found in no other natural kind than *K* itself.

For present purposes, then, this paper will assume that the properties in the nature of a world-constituted kind need not all trace to a single underlying property; they may

be connected together by overlapping and decentralized causal gearings. This less demanding requirement on how an essential nature is connected together *will* indeed require revision (in §4), and the revision will be important. But for now, let us allow the requirement to stand.

Now, at last, for the question whether realists about modality need worry that human adolescents constitute a world-constituted kind in their own right, or that *Rana pipiens* tadpoles do, or that ice does. Human adolescents clearly are similar, in massively many ways, to human adults and human children. But they do differ in respect of their age, and this difference brings other differences with it. There is such a field of study as adolescent psychology; one can also specialize in the health problems of adolescents. Thus a hypothetical intervention on the age of adolescents, that replaced their ages with ages falling in the contrary-ranges containing the ages of adults or of children, but did not directly act on any of the other properties characteristic of adolescents, would yield generically human creatures characterized by properties contrary to *other* properties characteristic of adolescents, properties beyond just the adolescents' ages—it would yield creatures having one contrary psychological profile or another, one contrary pattern of brain organization or another, one contrary packet of liabilities to disease or another. Or consider ice. Ice is similar to liquid water and to steam in at least one important respect—it is composed of molecules having chemical structure  $H_2O$ . But it differs from those kindred stuffs in that its temperature is lower than  $32^\circ F$ , and this difference brings other differences in its train. If hypothetically we were to intervene on some ice, replacing its temperature with a temperature falling either in the contrary range *between*  $32^\circ F$  and  $212^\circ F$  or the contrary range *above*  $212^\circ F$ , but without acting directly on any other properties characteristic of ice, we would end up with some matter

that selected one contrary or another of the molecular arrangement characteristic of ice, one contrary or another of the specific volume (i.e., the volume-per-weight) characteristic of ice, one contrary or another of the visual appearance of ice, etc. The temperature (or rather temperature-range) characteristic of ice thus turns out to control a number of the other properties characteristic of ice. The case of *Rana pipiens* tadpoles, finally, is in one way like the case of ice, in others like the case of human adolescents. The similarities that join *Rana pipiens* tadpoles to *Rana pipiens* adults, and to transitional *Rana pipiens* organisms, are not so much surface-level similarities as microstructural ones—creatures belonging to all three classes are characterized by roughly the same genome. The fundamental factor that separates *Rana pipiens* tadpoles from creatures in the other two classes is, as with human adolescents, a mere matter of age. But the difference in age again entrains other differences. Variation on the age characteristic of the tadpoles ensures, by itself, replacement of morphological and physiological properties characteristic of the tadpoles by commensurately different morphological or physiological properties.

The properties distinctive of ice—or of human adolescents, or of *Rana pipiens* tadpoles—are thus causally geared to one another in just the way that a realist would regard as indicating a world-constituted kind. This is so, at least, on the only account of such causal gearing that we have so far found to be motivated. Thus it appears that a realist must regard ice as a natural kind in its own right, and so too liquid water and steam—and must think that all three kinds fall under the more general natural kind,  $H_2O$ . Just so, it appears that the realist must think that neither *human beings* nor *Rana pipiens* organisms are “least kinds,” *infimae species*. Rather she must think that though these are natural kinds—more on this below—each has more specific kinds that fall under it. Thus the

realist must seemingly say that, as a human being ages, a member of the more specific kind *children* grows and then ceases to exist, giving place to a member of the more specific kind *adolescents*, and later that adolescent ceases to exist, giving place to a member of the more specific kind *adult humans*. We still have not determined how a realist can manage to admit that, exactly where all this ceasing-to-be and coming-to-be is occurring, there is also a continuing member of the natural kind *human beings*. But in any case she must—or so it seems at present—think that the age of a fourteen-year-old human being goes tandem with a property that is essential to any member of the kind *adolescents*. This property will not *be* the property of having existed for fourteen years, for the realist will think of the adolescent as having come into existence only quite recently. But it will be the logical shadow of that property: roughly, it will be the property of existing twelve to eighteen-years-out on the spatio-temporal career of some human being.

### III

The same sorts of reasons that would lead realists to suppose that ice, liquid water, and steam are natural kinds will also lead realists to judge that  $H_2O$  is itself a natural kind. For  $H_2O$ —that is, *the stuff composed of hydrogen hydroxide molecules*—is characterized by a rich set of dispositional or “temperature-indexed” properties.  $H_2O$  is such as, at each of three different temperature ranges, to be solid, or to be liquid, or to be gaseous; such as, at each of these ranges, to have distinctive density and visual appearance; etc. The dispositional properties characteristic of  $H_2O$  and the microstructural property characteristic of  $H_2O$  are causally connected, indeed in a centralized way. The property *being composed of  $H_2O$  molecules* controls all the others. Interventions on this property that replace it with one contrary composition or another, and do not act directly on any of the

other properties characteristic of  $H_2O$ , yield matters characterized by contrary properties, themselves largely dispositional, of the sort discerned by what is called “physical chemistry.” It is even roughly true that progressively *greater* variations on this microstructure yield *commensurately* different packets of properties discerned by physical chemistry.  $H_2O$  passes the test for being a true natural kind. So do *human beings* and *Rana pipiens organisms*.

But then the problem about persistence conditions cannot be ducked: it appears that one and the same object, or one and the same matter, can belong to two different natural kinds, and will inherit from the two incompatible persistence conditions. The realist has few options for dealing with such cases. He *could* argue that (1) there is not after all one thing before us, but two, exactly coincident with each other—but this is the position that, in §1, we ruled implausible. Or he could argue that (2) membership in a world-constituted kind never generates persistence-conditions. Or he could argue that, despite appearances, (3) we are not in such cases dealing with two natural kinds after all. The one response that is off-limits to the realist is to say that a single thing can belong to two natural kinds, but that the thing’s ceasing to belong to one of the kinds amounts to its ceasing to exist, while its ceasing to belong to the other is compatible with its continuing to exist. For then the realist would have to give a decidedly un-realist answer to the question, what does it take for a property to be a persistence-condition for the members of such kind? The answer that realists *should* give, this paper has been saying, is that a property’s being a membership condition for some natural kind *amounts to* its being a persistence condition for the members of that kind. But if that is so, then the membership conditions for *every* natural kind are persistence conditions for their members. If for some natural kinds a membership condition fails to be a persis-

tence condition, then *more* must be required, for a property to be a persistence condition, than just its being a membership condition. The only plausible account of this “more” is that it comes from us. It would have to consist in the fact that our conventions for making judgements of numerical sameness across time dignify some natural kinds as being career-delimiting—as being such that membership in them is, so to speak, a life-and-death matter for the members—and other kinds as not being career-delimiting. But this is to say that numerical sameness of an object (or of some matter) across time is something that obtains only in virtue of our conventions, something that is our projection. That is a key tenet of modal conventionalism. A philosopher might with some plausibility claim to be a realist about modality without rejecting that tenet: that is exactly the case of the realist who offers response (2) above, as will be explained in the next paragraph. But no one properly called a realist about modality could *embrace* that tenet.

Response (2) may tempt the realist, but its problems are serious. The idea would be that though the adolescent and the human being are one and the same entity, departure from *neither* kind marks the end of that entity’s existence. In general, membership in *any* world-given kind *never* grounds persistence-conditions for the kind’s members. This position can actually be articulated in two different ways. One would be to say that it is simply false that there are persistence-conditions for any entities in the world: persistence-conditions by definition are conditions that can fail to obtain, but the real entities in the world are incapable of being destroyed or of ceasing to exist. The other would be to say that it is not false but confused to speak of there being failures of persistence in the world; there is actually no such phenomenon as an object’s ceasing to exist, and no such phenomenon as its persisting. The former version of the response is of course wildly

at variance with the ontology of either common sense or of learned science, but it is not without precedent. In *Metaphysics Z*, 1029a3–36, Aristotle entertains the idea of a kind of matter—commentators call it “prime matter”—to which *no* properties are essential. This would be a matter that could pass from having any property to having some contrary property without being destroyed. One could thus take the former version as suggesting that the real entities of the world are portions of Aristotelian prime matter, wending their way continuously through space and time. The fact that the matter composing these portions has *no* properties essentially would raise a troubling question about *why* the portions of this matter would have to have spatio-temporally continuous careers at all. If a portion of such prime matter could switch from having (accidentally) the properties characteristic of *human adolescents* to having (accidentally) the properties of *Rana pipiens frogs*, why couldn’t it do this *suddenly*, leaping from the place occupied by a human adolescent to the place occupied by a frog? Why couldn’t such a portion of matter leap from the location where common sense discerns some ice to the location where common sense discerns some gold, without occupying any points in between? Relatedly, there would be bad questions about how many such portions there are—about how they are individuated. Perhaps this former version collapses into the claim that there is just The Stuff. The problems with the second version of the response are less exotic, but equally troubling. If there is no such phenomenon as an object’s persisting, there are not many of the properties that we suppose there to obtain in the world—since many properties require bearers that persist. Examples of such properties are *having such-and-such an annual growth rate*, or *having such-and-such a body weight when mature*. It is arguable that not even *velocities* would obtain in the world. Indeed it has been

argued that no dispositional properties would obtain in the world (Elder forthcoming).

It is response (3), to the sort of problem of incompatible persistence conditions, that appears to win by default. But that response really is independently plausible, as the next section will argue.

#### IV

Earlier we said that a plurality of properties hangs together causally in the way that, for realists, marks out a natural kind just in case each member of that plurality either controls or is controlled by some other member. But is this too weak a version of the causal connection that a realist should require? Intuitively, it seems plausible that any property that enters into the very nature of some world-constituted kind should reflect or grow out of other properties that members of that kind by nature have—that it should in some way be shaped or governed by other elements of that nature. But the temperature range that is characteristic of ice is controlled by the external setting of the ice, and not by any of the intrinsic properties of ice that would—if ice were a world-constituted kind in its own right—be ice’s essential properties. There are two different ways to see that this is so. The first is to ask how one would proceed if one wanted to fashion a matter that were maximally similar to ice, but that occupied temperatures in a different range. Would one go about trying to devise a matter with different visual properties from those of ice, or with different resistance to dispersal, or with a different ratio of volume-to-weight? Well, no. What one would probably do would be to take some existing ice and move it closer to a source of heat. For ice’s temperature is, in the language of causal-systems theory, an “exogenously determined variable” (Hitchcock 2001a, 2001b). The second and more vivid way to see that same point is to reflect that if the temperature of ice were controlled by other properties that entered into ice’s very

nature, it should be very easy to keep ice at a suitably low temperature. So long as one did not interfere, on a hot summer’s day, with the ice’s visual properties or resistance to dispersal or volume-to-weight ratio, there would be no need to keep the ice in the freezer!

Parallel points are even more obviously true in the case of the human adolescent and the case of the *Rana pipiens* tadpole. If human adolescents were a world-constituted kind in their own right, they would essentially be characterized (as we have seen) not by an *age* of twelve to eighteen years, but by the age-like property of being removed by twelve to eighteen years from the birth of a particular human child—a child to which the matter in the adolescent traces back, by a spatio-temporally continuous path. But this age-like property is not shaped or controlled by other properties characteristic of the putative world-constituted kind, *adolescents*. That is, if one wanted to intervene on a particular adolescent, so as to produce a creature having a different and greater age-like property, but otherwise similar as possible to the adolescent, one would not seek to replace the adolescent’s brain organization with that of an adult, or its propensity to acne with an adult complexion. If one wanted to intervene on a tadpole, so as to produce a creature farther along on a spatio-temporally continuous path that traces back to the hatching of a frog egg, but otherwise as similar as possible to the tadpole, one would not seek to replace the gills or the body size of the tadpole with the lungs or the body size of an adult frog. Strictly speaking, all one could do in either case would be to just sit back and wait.

Now, this very fact—the fact that you cannot *do* anything to manipulate the age-like properties of an adolescent or a tadpole, whether by intervening on those properties directly or by intervening on others of the creature’s properties—may create a suspicion that we made a mistake, above, when we first raised the question whether realists must

recognize *adolescents* and *tadpoles* and as natural kinds in their own right. Perhaps the right way to frame that challenge is not to say that the members of these kinds essentially exist at such-and-such a time span after an associated birth or hatching. Perhaps it is rather to say that the members of these kinds essentially have biological clocks set at specific (qualitatively specified) molecular settings. For one *could* act directly on such a setting, so as to alter it. But even so, the argument now being offered would go through. If one sought to intervene on a tadpole so as to produce a creature with a biological clock bearing a different molecular setting, one would not do so by replacing the tadpole's gills and body size with the lungs and body size of an adult frog. In all normal circumstances, a biological clock "runs on its own." The setting of that clock is not *controlled*, in the sense used in this paper, by other properties characteristic of the host organism.

Should the realist hold, then, that for the properties in some cluster to be closely enough connected together to mark out a natural kind, each property should both control some other property (or properties) in the cluster *and* be controlled *by* some other property or properties? This is better—but too strong! To see why, we need to ask whether the great influence that the temperature of some frozen  $H_2O$  has on the other characteristics of that very matter is sufficient to establish that *frozen  $H_2O$*  is a natural kind in its own right. The temperature of some frozen  $H_2O$  controls that very matter's texture and density and visual properties, but it does not control them all by itself. Instead that temperature merely actualizes dispositions underlain by the molecular composition  $H_2O$  that is characteristic of that matter. That temperature, in other words, is merely the occasion by which the molecular composition exercises one form of *its* control over the surface-level properties of that matter. A property that *all by itself* controlled a number of other properties in a

cluster that is characteristic of some natural kind (e.g., *is composed of molecules having structure  $H_2O$* ) would be deeply enough embedded in the nature of that kind to count as an essential property—even if that property were not itself controlled by any others. But a property that is controlled by factors exogenous to the nature of some natural kind, and that itself influences other properties of samples (or members) of the kind only by enlisting the powers of other properties that *do* belong to that nature, might quite plausibly be said to be a merely accidental property of samples (or members) of the kind.

This, then, is the revision that §2 said we would have to make in the realist's account of how closely a cluster of properties needs to be causally glued together in order for that cluster to be the nature of some natural kind. Each such property must either be shaped—that is, controlled—by some other property or properties in the cluster, or must be such as *all by itself* to control a number of properties in the cluster. This enables *having the molecular composition  $H_2O$*  to qualify as an essential property of the kind of matter,  $H_2O$ , even though one cannot manipulate the molecular structure of some of that matter by intervening on its texture or visual properties or density—even though, that is, the molecular structure of some  $H_2O$  is not controlled by any other properties characteristic of that  $H_2O$ . But it rules out *having a temperature lower than  $32^\circ F$*  as a property incorporated in the nature of any world-constituted kind. For though interventions on that temperature range *will* entrain variations in other properties of a sample of  $H_2O$ , the replacement temperature range will not *all by itself* entrain those other variations; rather, it will do so only by enlisting dispositions stemming from the molecular composition  $H_2O$  itself. This same revision entails that *having the roughly defined genome characteristic of *Rana pipiens** is a property essential to *Rana pipiens* tadpoles, while *existing within three*

*months of the hatching of an associated egg* is not an essential property of those tadpoles. Finally—to return to an example mentioned long ago—the revision explains why *humans suffering from cancer* do not constitute a natural kind in their own right. For while the presence of that disease entrains a number of features different from those of healthy humans, the disease brings about these differences only by enlisting the liabilities and capacities of the kinds of cells that belong to normal human physiology—properties that, plausibly, are essential to the more general kind *human beings*. Nor does *suffering from cancer* look any more like an essential property of a sub-group of humans if we consider, not symptoms which the presence of cancer controls, but properties *by* which the presence of cancer itself *is* controlled. It is not controlled by the symptoms it produces—no disease can be removed by simply stripping off the symptoms—and neither is it controlled by properties that can plausibly be considered essential both to those sufferers and to normal, healthy humans.

Realists about modality can be expected to argue that humans and  $H_2O$  and *Rana pipiens* organisms are all natural kinds. Realists might then understandably worry that under each of these natural kinds there fall other, more specific natural kinds. This worry might then lead realists to elect a half-strength realism about modality, denying that the membership conditions for nature's kinds *eo ipso* amount to persistence conditions for their members. But that half-strength position generates miserable puzzles, as we saw in §3. Happily, the worry itself can be dispelled. Accidental forms and versions of nature's kinds are just that—not kinds in their own right, but mere accidental forms of kinds.

## V

Yet might realists face a problem “from above” about divergent persistence conditions, even if not “from below”? Any human

is at the same time a member of the more general kind *mammals*. Any portion of water is, in a way, a sample of the more general kind *acid*—for HOH is the acidic base, the alkaline acid. (If the example seems strained, substitute the case of sulfuric acid,  $H_2SO_4$ .) It seems very likely that realists will need to treat both *mammals* and *acids* as genuine natural kinds, and very likely that the membership conditions for either kind are less stringent and more general than those for the subordinate kinds *human beings* and *water* (or *sulfuric acid*). Could it then happen that an individual organism, tracing out a spatio-temporally continuous path, should depart from the kind *human beings* without departing from the kind *mammals*? Or that some matter should depart from the kind *water* while continuing to belong to the kind *acid*? In that case, if membership conditions for nature's true kinds always double as persistence conditions, realists seem once again to face the problem of an individual that has both ceased to exist and continued to exist.

Of course no individual organism can be *just* a mammal: any individual organism must be a mammal *of one specific body size* or another, having *one specific Bauplan* and *physiology* and *immune system*, etc. No portion of acid can have *just* the chemical formula  $H$ \_\_\_: the hydrogen radical must be joined to some negative ion or other. So the best way to frame the present challenge to the realist is to ask whether an individual organism might depart from one specific mammalian species and move into another, while remaining numerically the same mammal throughout the process. We might focus on the features that differentiate humans from, say, dogs, and ask whether an individual human organism might undergo a gradual replacement of its human features with contrasting features that are more and more doggish, while remaining the same mammal throughout the process. We might ask whether some HOH ( $=H_2O$ ) might undergo a change in its chemical composi-

tion that moves it gradually from having the composition  $HOH$  to having the composition  $H_2SO_4$ , while that very matter nevertheless remains *the* very same (portion of) acid. (Or, if it seems strained to think of  $HOH$  as a kind of acid at all, we could ask whether some  $H_2SO_4$  could alter in its composition, ending up with the composition  $HCl$ , while yet being *the* very same acid as at the outset.)

But now it may seem that the challenge to the realist collapses before the realist even troubles herself to respond to it. For in many, many cases of such imaginary “species changing,” it turns out that an individual cannot survive departure from its original species without departing as well from the more generic kind to which it belongs. An erstwhile human being, in whom human traits are replaced to any appreciable degree by traits of dog physiology or behavior, will be a monster—and hence not a mammal, on the assumption that mammals are viable organisms. Some  $H_2SO_4$  that is half-way along on a “transition” to the composition  $HCl$  will, on the only scenarios that come readily to mind, be dissolved into a scatter of dissociated radicals—and hence will no longer be some acid at all.

Indeed the question raised by such cases is why one would ever think in the first place that some single object or some portion of matter could switch its affiliation from one specific natural kind to another, without relinquishing its membership in its more general natural kind. The answer would seem to be that we subscribe, half without realizing it, to the ancient idea that where a specific natural kind falls under a more general natural kind, the nature of the more specific kind is constituted by a simple combination of the properties essential to the more general kind together with differentiating properties, *differentiae*. Thus we may think, half without realizing it, that there are certain properties common to all mammals and to all mammalian species, and that an individual organism belongs to

one mammalian species rather than another simply by virtue of essentially possessing, in addition to these common properties, *differentiae* peculiar to its species. From there it is an easy step to supposing that, in the case of a given individual organism, one could just hold the common mammalian properties constant, while altering the *differentiae*. But this basic picture is confused. It ignores that the properties that make up the nature of the kind *mammals* are properties that must be implemented or embodied in one specific version or another. The organisms belonging to some mammalian species cannot *just* have the property, for example, of *giving birth to live young*: they must have that property *in virtue of* having one particular reproductive system or another, a qualitatively different reproductive system in the case of humans from in the case of dogs. Thus the features that distinguish humans from dogs are not merely external additions to the properties in virtue of which humans are mammals: they enter into the very nature of the mammalianness of humans, and shape what *being mammalian* comes to in the case of humans.

This point is important, since it is the key to what realists must say about the few cases in which something like “species changing” really is possible. Suppose that before us there is some sulfurous acid,  $H_2SO_3$ . Then what is before us also belongs to a more general natural kind—it is some acid. Yet if we submit that very matter to oxygenation, it ceases to have the composition  $H_2SO_3$ ; instead, we end up with some  $H_2SO_4$ ; and throughout the process, the matter before us is acidic. Is *the same acid*—not the same *kind* of acid, of course, but the same portion or amount or extent of acid—present before us throughout the process? If so, the  $H_2SO_3$  that was before us has ceased to exist, and the acid that was before us still does exist—and yet it seems indisputable that the acid that was before us just *was* the  $H_2SO_3$  that was before us.

But in fact there is little motivation, whether from philosophical reflection or from common sense, to say that it is the very same acid that is there throughout the process. Philosophical reflection shows that for this to be true, that very acid would have had to persist through an impossible transition. In the “before” phase of this transition, it would have had the persistence conditions of  $H_2SO_3$ , and in the “after” phase it would no longer have satisfied those persistence conditions—and yet it would still be there, it would still have persisted, and it would now have the persistence conditions of  $H_2SO_4$ . To think that this sort of transition can have occurred is to forget what “persistence conditions” means. But common sense too, it would seem, is happy to allow that it is not numerically *the* very acid that is there at the end of the oxygenation as was there at the start. It is new acid that was made from the old. This seems to be a case in which a position like the one adapted from Burke, in §1, articulates what common sense thinks. If a putative transition leads from (what common sense regards as) one natural kind to another, common sense will suppose that what is present at the later stage is something numerically distinct from what was present at the earlier stage; if a putative transition involves different phases

in what common sense regards as a single existence, common sense will balk at the idea that the two phases feature numerically distinct things.

## V

Realists can and should say, then, that the membership conditions for all natural kinds double as persistence conditions for the members and samples of those kinds. We no more carve out the existences of the world’s individuals, than we carve out the boundaries of nature’s kinds. This position does indeed face challenges, both “from above” and “from below.” The challenge “from above” comes from the fact that there really are relatively general kinds in nature, under which more specific kinds fall. This challenge can be dispelled by disabusing ourselves of the old “genus and *differentiae*” way of thinking of the more specific kinds. The challenge “from below” comes from the appearance that the various conditions in which the members of nature’s specific kinds find themselves mark out lower-order kinds. This challenge is the harder one, but can likewise be met: there really is a principled line beneath nature’s *infimae species*.

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## NOTES

1. The most careful presentations of the conventionalist position, in my opinion, are Sidelle 1989, Sidelle 1998, and Thomasson forthcoming. But the most influential endorsement of conventionalism is probably Putnam’s attack on “Self-Identifying Objects” (Putnam 1981: chap. 3), or on “ready-made objects” (Putnam 1982). The motivations behind conventionalism are largely epistemological, and no one has done better to make them vivid than Hirsch (1993, 1988a, 1988b)—even though Hirsch himself sometimes (1988a: pp. 699–700; 1993: pp. 52–53ff.) stops short of affirming conventionalism.
2. In Millikan 2000—where the term for natural kinds is “substances”—see, for example, p. 31 or p. 26; cf. Millikan 1984: pp. 281, 292–296. In *World Without Design* (2002), Rea argues that conventionalism (“constructivism,” in Rea’s parlance) raises problems so severe as to make the view virtually untenable (chap. 7), and displays sympathy with the realist position that nature’s kinds are constituted by nature itself, and not by our classificatory practices (chap. 6); but he argues that so long as realists remain naturalists, they have no means to argue that the members of nature’s kinds cannot depart from the kinds to which they belong without ceasing to exist (Rea 2002: pp. 102–104, 132–134). Jubien (1993) holds that the properties expressed by typical sortals (“dogs,” “atoms”) have mind-independent

existence, and hang together in mind-independent ways (Jubien 1993: pp. 111–115), and to this extent he can be said to hold that sameness-in-kind does not just obtain in virtue of our classifications; yet he definitely maintains that any *thing* that belongs to a kind can depart from the kind without ceasing to exist (Jubien 1993: chap. 5).

3. “*Infimae species*” is the coinage of interpreters of Aristotle; for Aristotle’s main discussion of *infimae species*, see *Posterior Analytics*, bk. II, chap. 13.

4. Woodward and Hitchcock undertake to give a clarification and systematization of the phenomenon of causation, but do not claim to analyze causation in non-causal terms; so if the use of “entrain” in this sentence sounds like a causal locution—sounds synonymous with “brings about”—the answer is that it really is a causal locution.

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