Scientific Realism and Ontological Relativity*

1. Realism, Relativism, Pluralism

The preeminent question of the metaphysics of classification is that of whether the world is itself naturally subdivided into kinds of things. Are kinds out there, so to speak, or are they rather artefacts of convention, existing only insofar as classificatory practices are brought to bear by creatures such as ourselves? In this paper, I examine this question from the point of view of the sciences, and more specifically, from the perspective of the most fulsome view of the epistemic credentials of the sciences regarding what's 'out there': scientific realism. As I hope to show, approaching the metaphysics of classification from the perspective of scientific realism has important consequences for one's very understanding of the perspective itself. Thus, by considering the nature of kinds from this perspective, I aim to shed light not only on the metaphysics of classification, but also on the nature of realism with respect to scientific knowledge.

Scientific realism (simply 'realism', henceforth, unless otherwise indicated) is the view that our best scientific theories are true, or approximately true, or to put it in terms other than truth, that they describe well, or to some significant degree of success, the ontology of parts of the world. There are explicit caveats built into this coarse definition ('best' theories, 'approximate' truth, 'significant degrees' of success), and I will make no attempt to expound these particular qualifications here. A further clarification of the definition, however, furnishes a central motivation for what follows. Realism is often explicated in terms of three sorts of commitment: a metaphysical commitment to the existence of a mind-independent reality; a semantic commitment to interpret scientific claims literally (or as it is often put, "at face value"); and an epistemological commitment to regard these claims as furnishing knowledge of both observable and unobservable entities and processes. After the demise of

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logical empiricism and various forms of instrumentalism (which construe terms for unobservables as elliptical for terms concerning observables), the semantic component of realism is now widely accepted by realists and antirealists alike. The epistemological component is highly contested, but has at least been elaborated in a number of ways. In contrast, though also highly contested, the metaphysical component remains largely unexplored.

Indeed, in philosophical considerations of the sciences, much more work has been done to clarify what it might mean for the world to be mind-*dependent* than has been dedicated to clarifying the notion of mind independence. My goal in what follows is to articulate several aspects of mind independence for the realist. In section 2, I consider the default assumption implicit in most treatments of realism, to the effect that the world comprises an objective, mind-independent, natural kind structure. This "taxonomic monism" emerges from a venerable tradition in philosophy, but is undermined by modern science. In section 3, I consider the family of views traditionally regarded as foils for taxonomic monism, under the heading of "pluralism." Given the rejection of monism suggested by modern science, pluralism beckons, but our most detailed versions of pluralism are all forms of antirealism, and thus of no use to the realist. In section 4, I present an account of pluralism for realists in three parts, the first of which I maintain is central to any plausible account of realism. The second and third parts are optional extras, following from further commitments that realists may but need not accept. One consequence of these considerations is that the commonly asserted opposition between realism on the one hand, and pluralism and relativism on the other, represents an entirely false dichotomy.

My concomitant use of the terms 'pluralism' and 'relativism' here may give some pause. Pluralism is often portrayed as a virtue, but my use of the term is not intended to render the position for which I will argue anodyne and thus more attractive than it might otherwise seem. For there is no disguising the fact that the pluralism I endorse stems from an inescapable relativity of certain classificatory practices to scientific contexts of investigation and description. Relativism is often portrayed as the enemy of realism, and while there are forms of relativism that fit this mould, I will argue that the forms I describe here are not only consistent with realism, but ground a pluralistic attitude with respect to ontology that is required of sophisticated realists in the era of the modern sciences.

2. *The Poverty of Taxonomic Monism*

How is the metaphysical dimension of realism—the commitment to the existence of a mind-independent world—typically conceived? It is not uncommon to see passing suggestions of, or allusions to, "the (one true) natural kind structure of the world," but elaborations in this context are scarce. An important exception is Psillos's (1999) influential characterization of realism, which gives slightly more detail regarding what seems an underlying consensus:

> The metaphysical stance [i.e., the metaphysical component of realism] asserts that the world has a definite and mind-independent natural kind structure . . . [this] thesis is a basic philosophical presupposition of scientific realism. It is meant to make scientific realism distinct from all those anti-realist accounts of science . . . which reduce the content of the world to whatever gets licensed by a set of epistemic practices and conditions. In particular the metaphysical stance implies that if the unobservable natural kinds posited by theories exist at all, they exist independently of humans' ability to know, verify, recognise, that they do. Instead of projecting a structure onto the world, scientific theories, and scientific theorizing in general, discover and map out an already structured and mind-independent world . . . this metaphysical thesis is prerequisite to any meaningful defence of scientific realism. (xix–xx)

The core of this description of the metaphysical component of realism is the thesis that there is a unique organization of aspects of the world into mind-independent kinds. The connotation of uniqueness is an implication of the term 'definite' in the expression "definite and mind-independent natural kind structure." Parts of this putatively unique structure then constitute the targets of the epistemological dimension of realism, which maintains that one can have knowledge of these aspects, even with respect to unobservables. Realists standardly conceive of these aspects in terms of the various entities and processes described by our best scientific theories, so let us regiment the thesis as follows:

Taxonomic Monism (TM):

There is a unique structure of mind-independent entities and processes.

The idea of a "structure" of natural kinds is a redolent image, familiar to all who were taught in school to divide (for example) the kingdom

Animalia into different phyla, phyla into classes, and so on ultimately into genera and species. It suggests natural groupings that stand in certain well-defined relations to one another—in the present example, relations of hierarchical subsumption of categories in a taxonomic tree—that together constitute the relevant structure. The identification in some ancient and scholastic philosophy of kinds with essences (collections of intrinsic properties that are both necessary and jointly sufficient for kind membership) is one way of exemplifying TM, but not the only way. For even a more liberal attitude regarding kind membership is compatible with the notion that there is a unique division of the world into mind-independent categories. On such a view, the kind structure of the world might include cluster kinds (those whose members lack anything resembling essences, but instead possess sufficiently many of some set of properties), or kinds with vague boundaries (some of whose members are borderline cases), and nevertheless admit of the sort of uniqueness of general taxonomic framework that realism allegedly requires. In this respect, TM is ecumenical.

Consequently, the tenability of TM is not strictly correlated with that of an essentialist understanding of kinds, which many philosophers today regard as outmoded.[1] *Prima facie*, however, TM is outmoded nonetheless in light of the modern sciences, in the sense that not all classificatory practices in these fields respect the notion that there is a unique division of nature into kinds. Indeed, they often employ and 'quantify over' categories belonging to systems of classification that carve nature in such a way that the categories of one cannot be mapped onto those of another in a structure-preserving manner. The most transparent example of this comes from attempts to codify the species concept in biology, where at least four distinct families of approach serve different scientific ends. The phenetic species concept groups organisms according to degrees of similarity of phenotypic traits, while the interbreeding species concept distinguishes groups according to the reproductive boundaries of actually or potentially successful interbreeding populations. The members of ecological species share a particular ecological role or niche, and phylogenetic species are historical lineages of organisms whose boundaries are marked by speciation and extinction. The application of these different concepts produce different taxonomic structures, and it is widely accepted that the application of different classificatory principles in different contexts of biological investigation and explanation is entirely legitimate from a scientific point of view.[2]

Though TM may appear outmoded in the sciences generally, there are at least two ways in which one might resist the further implication that TM is false. Neither strategy of resistance, I believe, is compelling. The first is to appeal to some form of reductionism: if TM is a problematic doctrine in the context of biology, then so much the worse for biology! If biological taxa are the paradigmatic kinds of ancient philosophy, surely chemistry and physics describe the paradigmatic kinds of today. These more 'fundamental' sciences, so the argument goes, furnish eminently plausible examples of kinds with which to populate the structure of TM; everything else, including biology, is ultimately reducible in some way to these more fundamental fields. This response, however, is dubious on several fronts. The vague assertion that everything is 'reducible' remains, despite considerable dogmatism, little more than a promissory note. Visions of the possibility of the reduction of the social sciences to biology, biology to chemistry, and chemistry to physics inspired by Oppenheim and Putnam's (1958) inverted pyramid have not been substantiated. These different domains of inquiry ask different questions regarding different entities and processes, and there is no evidence to suggest that facts at 'higher' levels of description are generally and in principle capable of being expressed in terms of facts about entities and processes at 'lower' levels.[3]

Of course, an absence of evidence for the plausibility of scientific reductionism may not by itself spell the death of TM, but consider the following. Even if the reduction of all other scientific facts to facts about kinds in chemistry and physics *were* possible in principle, significant problems would remain for TM. The first is that it is not a foregone conclusion that the subject matters of chemistry and physics could not also admit of alternative kind structures, just as in the case of biology. Indeed, attention to the details of classificatory practice in these domains reveals no argument for uniqueness *per se*. For example, recent discussions of the taxonomic challenges facing the classification of enantiomers (pairs of molecules possessing mirror image structures) in chemistry suggest that different classifications are likely warranted in different chemical contexts (Slater 2005).[4] Undoubtedly, the case for alternative classificatory schemes is most controversial in fundamental physics (see Pickering 1984, chapter 14, for instance), in part because there are no ready alternatives to the Standard Model, which yields a particular taxonomy of subatomic 'particles'. Lacking an alternative with which to challenge our intuitions, it is difficult to know

how to assess the likelihood of there being some deep ontological facts that would make this possibility more or less likely. The upshot is a degree of metaphysical uncertainty as to whether the fundamental ontological categories envisioned by contemporary physics could be otherwise.

Another difficulty facing the appeal to reductionism is that even if reduction to a unique physical taxonomy were possible in principle, it would be insufficient to render TM plausible. For even if there is only one structure of mind-independent, fundamental physical entities and processes (the reductive base), this would not entail that there is only one structure more generally. Indeed, examples from biology and (arguably) chemistry attest to this. In order for reductionism here to serve the cause of TM, it would have to be the case not merely that facts about entities and processes at 'higher' levels are in principle capable of expression in terms of those at 'lower' levels, but furthermore, that only the lower level entities and processes are genuinely existent. But what motivation is there for this further, metaphysical thesis? None is forthcoming from the sciences. Different scientific disciplines investigate different categories of entities and processes. *Prima facie*, the realist regards these categories as constituting naturally specifiable divisions. In the absence of a compelling reason to think that the entities and processes of higher-level domains are illusory, violations of TM remain. In the absence of such a reason, the reductionist picture here yields no support for TM, because unique taxonomic structure is evidenced by only a tiny fraction of scientific kinds, and realism is not restricted to this fraction. Thus, the currently unsubstantiated dream of reductionism would be insufficient to establish TM even if it were true.

Consider now a second strategy for the defence of TM. Perhaps instead of saying "so much the worse for biology," one could say: "so much the worse for the sciences altogether!" That is to say, the observation that examples of scientific classification appear to undermine the notion that the world admits of a unique kind structure is metaphysically impotent; one might regard TM as legitimate, from the point of view of metaphysics, despite our best science. There is precedent for this sort of thinking in Locke's (1975/1689, Book III, chapter III, §15) distinction between real and nominal essences, the former constituting the objective categories of nature, and the latter merely the categories we use for purposes of natural philosophy (and otherwise). A sceptic might thus contend that

we can have no warranted expectation that the sciences yield knowledge of the former, and that our epistemic grasp extends only so far as the latter. But note: such an attitude would be antithetical to the realist position that is the subject of our present investigation. Realism incorporates the view that our best scientific theories *do* provide knowledge of a mind-independent reality. Therefore, the contention that scientific theories provide no such knowledge is, in the present context, neither here nor there. The battle between realism and antirealism must be fought elsewhere; it is not my concern here.

We are left with a rejection of TM: it is not the case that there is a unique structure of mind-independent entities and processes constituting the world, so far as realism is concerned. And yet, if there is to be an account of mind independence that is consistent with realism, clearly one aspect of TM must be retained. A commitment to the existence of mind-independent entities and processes must be retained in some form or other, or else the metaphysical dimension of realism is nullified. *Some* sort of knowledge of mind-independent entities and processes is integral to realism. In the wake of the rejection of TM, then, there is only one way to go:

Taxonomic Pluralism (TP):

> There is more than one structure of mind-independent entities and processes.

3. Antirealist Pluralism

Traditionally, pluralism with respect to classification is presented as the prerogative of various schools of antirealism, and it is not difficult to see why. Once science is conceived as something other than an investigation into "the way things are mind-independently" (the definite article here, 'the', connoting uniqueness), the most likely determinants of the *ways* things are, or could be, or could have been, are generally taken to mind-*dependent* features of the world: human conventions, driven by sometimes irreconcilable interests in different contexts, including the desiderata of inductive generalization, predictive utility, explanatory satisfaction, and so on. This recourse to convention is the primary spur to antirealist rejections of the metaphysical dimension of realism. The strong implicit (and sometimes explicit) commitment of many realists to a rejection of any such role for

convention creates the impression that pluralism is of necessity incompatible with realism, and thereby, of necessity, associated with some or other form of antirealism. Unless this state of affairs can be undermined, the prospects for TP seem poor. For as things currently stand, one is left with a choice between forms of pluralism that may respect the taxonomic practices of modern science, but leave no room for mind independence as required by realism.

Consider, for example, the idea of conventionalism in early twentieth-century philosophy of science. The conventionalist about the geometry of spacetime holds that there is no fact of the matter, no way spacetime geometry is, apart from the ways one might decide to treat physical descriptions of spatial, temporal, and spatiotemporal measures in mathematical terms. These descriptions cannot be viewed as reflecting mind-independent facts about spacetime geometry, for they are chosen on the basis of a pragmatic assessment of what best serves our ends in describing the phenomena and nothing more. The logical empiricist claims that scientists adopt a linguistic framework within which descriptions of entities and processes can be formulated, but the adoption of a framework is once again a matter of convention subject to pragmatic choice, and questions external to a framework, to use Carnap's (1950) idiom, concerning whether such entities and processes exist independently of it, have no sense at all. Neo-Kantian approaches to scientific knowledge more generally share this feature. The governing paradigms that form the shared commitments of members of scientific communities on Kuhn's (1970/1962) view, for instance, are constitutive of any talk of ontology, and the Strong Program in the sociology of scientific knowledge takes a similar position with respect to the role of social practices and institutions in classification (see Barnes, Bloor, and Henry 1996, ch. 3). Putnam's (1981) "internal realism" is yet another variation on this neo-Kantian theme.

There is a common denominator shared by these antirealist rejections of TP that may prove instructive for the task of moving realism forward. Not only can each be interpreted as countenancing the prospect of more than one structure of entities and processes (thus violating TM)—via different conventions, linguistic frameworks, paradigms, and so on—but crucially, each takes substantive, human, conceptual contributions to be (in part) constitutive of kind structure in a very particular and significant manner. On each of these views, the very notion of extricating mind-in-

dependent content from theoretical descriptions is incoherent, because the relevant conventions are inextricably fused with the content of these descriptions. Kant's critical philosophy is the primordial exemplar: his Copernican revolution aims to fuse epistemology (our ways of knowing) with ontology (what's 'out there') in such a way as to overcome the scepticism he saw as an inevitable consequence of prior rationalism and empiricism. Philosophical reflection here may yield insight into the nature of our forms of intuition and categories of understanding, but it cannot yield insight into the world apart from these ways of knowing. (Consider an analogy: most organismal traits are joint products of processes involving genetic, developmental, and environmental inputs; it is not generally possible to decompose traits into components caused exclusively by one input or another.) The mix is inextricable.

This common denominator of inextricability explains why pluralism about classification has been, traditionally, the prerogative of antirealism. To put it crudely, from a perspective shared by many forms of antirealism, it is *because* the mix is inextricable that one cannot reasonably aspire, as the realist does, to a knowledge of mind-independent entities and processes. And here, I believe, lies the key to a realist account of classificatory pluralism. An element of human convention is an inescapable feature of scientific classification; that was the moral of section 2. But what if it were possible to decompose a given structure of entities and processes into components in such a way as to make plain which are mind-independent, and which are products of convention? If such a thing were possible, the realist would then be in a position to concede the role played by convention in formulating scientific descriptions of entities and processes on the one hand, thus admitting pluralism, but take a realist attitude toward the relevant mind-independent components of the structure on the other. It is precisely this sort of having one's cake and eating it too that is key to satisfying TP. Indeed, it is difficult to imagine how one could escape the antirealist morass of inextricability otherwise. But is such a thing possible?

Though it forms no part of the motivation for the view, one recent, putative formulation of realism might be interpreted so as to furnish a decomposition into conventional and mind-independent elements of the sort required by TP. The innovation introduced by this view is to limit the realist's epistemic commitment regarding unobservable entities to a belief in the mere existence of such entities generally (as opposed to any more

specific knowledge regarding particular unobservables and their first order properties), thereby rejecting the notion of determinate reference to any particular unobservable entities.[5] Consider a scientific theory, $T(T_u, T_o)$, where 'T_u' represents the terms of the theory that putatively refer to unobservable entities, and 'T_o' represents the terms that putatively refer to observables. The Ramsey sentence of the theory, R(T), is formed by replacing all unobservable terms with existentially quantified predicate variables, $x_1, x_2, \ldots x_n$, so that $R(T) = \exists x_1 \exists x_2 \ldots \exists x_n T(x_1, x_2, \ldots x_n, T_o)$. An entity whose place is held by a variable in R(T) is "whatever it is" that satisfies the relations there specified. R(T) is thus indeterminate with respect to reference concerning the unobservable. Where T makes specific claims regarding unobservable entities (for example, 'electrons have negative charge'), R(T) merely asserts that there exist some entities ('something has something') such that the observable consequences of T are true. On this putative formulation of realism, one commits only to the truth of R(T).

Admittedly, this sort of Ramsey-sentence realism is a realism of sorts—it does commit to the existence of unobservable entities. Furthermore and of genuine interest presently, it can be understood as a means of satisfying TP, because any two distinct theories, T and T′, that have all the same observable consequences (that is, any two theories that differ only with respect to what they state regarding the unobservable) are theoretically equivalent so far as the Ramsey sentence realist is concerned. This is a consequence of the fact that any two observationally equivalent Ramsey sentences are consistent with one another.[6] And so, on the view that one should commit only to the truth of Ramsey sentences, theoretical equivalence is effectively reduced to observational equivalence. To put it another way, on this view, any two theories that differ with respect to what they assert regarding the unobservable but share all the same observable consequences are equivalent, properly construed, in the sense that there is no difference between them so far as ontology is concerned. Now, assume that both the observable and unobservable entities and processes described by R(T) and R(T′) are mind-independent. Different conventions with respect to the ontology of unobservable entities and processes à la T and T′ are possible. Crucially, however, any choice between these different conventions can be nothing other than pragmatic, because T and T′ are, on the Ramsey sentence view, equivalent to one another.

Ramsey-sentence realism can thus be interpreted as satisfying TP. It is no doubt abundantly clear, though, that as a form of realism, the position

is extraordinarily weak. It is so weak, in fact, that it seems both reasonable and important to distinguish between Ramsey-sentence realism—a realism merely with respect to the existence of unobservable entities and processes of some kind or other but otherwise entirely unspecified—and scientific realism, which incorporates a commitment to some more substantive knowledge of the relevant entities and processes and what they are like. It is in terms of this latter commitment that realism in the context of scientific knowledge is typically conceived, and with good reason. For arguably, any position is rendered nearly empty *qua realism* if it is compatible with the view that a scientific theory is true merely in virtue of there being *some* unobservables such that the observable consequences of the theory are true. I submit that if there is to be an account of TP that is compatible with realism, it should yield more substantive knowledge of the unobservable. In the next and final section, I propose an analysis of TP from the perspective of a significantly more robust (and resultantly, more plausible) understanding of realism.

4. Realist Pluralism

4.1 Sociability-Based Pluralism

How, then, can the realist have her cake and eat it too? I will suggest in what follows that the combination of realism and pluralism described by TP can be understood in at least three different, mutually compatible ways. It would seem that some version of the first of these theses, which I will label 'sociability-based pluralism', is a requirement if TP is to be tenable. The latter two, which I will label 'metaphysical nature-based' and 'manifestation-based' pluralism, involve further commitments which the realist need not make. I suspect that at least some realists will find these latter two theses tempting nonetheless, however, for the explanatory value their further commitments yield. But to begin, let us consider the notion of sociability.

One route to the rejection of natural kinds as conceived in ancient and scholastic philosophy is furnished by nominalism, traditionally associated with the view that the only things that exist are concrete particulars. The nominalist contends that there are no universals or abstract objects more generally. Predicates ostensibly associated with such things are, on this view, merely names for classes of particulars. Thus, if natural kinds are conceived as universals—abstract entities instantiated or exemplified

by certain particulars (the members of the relevant kinds)—nominalism is clearly incompatible with an ontology of natural kinds. The similarity relationships in virtue of which one groups particulars into *nominal* kinds are selected, claims the nominalist, by human convention, and while such groupings are useful in various ways (in facilitating scientific prediction and explanation, for example), they should not be reified or held to exist somehow apart from the associated conventions. Any version of nominalism that is consistent with the mind-independent existence of concrete particulars, and that adds to this the notion that alternative conventional groupings of particulars are possible, thereby approaches the neighbourhood of TP. It nevertheless fails to satisfy TP, of course, because the possible structures of mind-independent entities and processes it admits are not themselves mind-independent.

The failure of nominalism here in connection with TP is instructive: it focuses attention on the question of how precisely the realist should attempt to realize the desideratum of extricating knowledge of mind-independent aspects of the world from facts expressed by means of human convention in taxonomy. In its identification of mind-independent content with the existence of particulars, the nominalist position just outlined does not achieve this separation in quite the right way for the realist; the structures of kinds of particulars it admits are not mind-independent. But what if one were to identify the mind-independent content of scientific descriptions not with particulars *per se*, but rather with those *properties* that are commonly attributed to particulars in such descriptions? This, I suggest, and as I shall now argue, is the key to a realist version of TP.

It is perhaps obvious that the sciences are not primarily in the business of generating knowledge concerning particulars. That is not to say, of course, that scientific knowledge is not applicable to particulars, since often, what one is most interested in doing in scientific contexts is to investigate or manipulate a particular instance of some kind of entity or process. Rather, it is to say that such knowledge generally takes the form of a description of the properties that particulars may possess, and the behaviours they exhibit as a function of having these properties, as opposed to more specific knowledge concerning any given particular in epistemic isolation. Thus we learn that bodies with charge, in virtue of having this property, exhibit certain characteristic behaviours involving electromagnetic forces; in virtue of having the disposition to donate a proton or accept an electron

pair, acidic substances exhibit certain characteristic behaviours when brought into contact with alkaline substances; traits within a population of organisms with high degrees of fitness, in virtue of having this property, exhibit certain characteristic patterns of expression in future generations; and so on. The first step in understanding TP in a way that is compatible with realism is to make scientific descriptions of these properties the central focus of realism itself. As a first step, then, let us understand scientific realism in terms of a realism about such properties in the first instance.

How might taking properties (as opposed to particulars) as the focus of realism help to motivate an account of TP? At first blush, one might reasonably wonder how it could. For is it not the case that properties such as charge and having an exoskeleton are properties *of* particulars? What has been gained in this shift of emphasis? The answer is this: taking properties to be the focus of realist commitment in the first instance introduces precisely the sort of taxonomic flexibility the realist needs in order to satisfy the requirement, specified in TP, that there exists more than one structure of natural kinds. For once the weight of one's realism is borne by properties in the first instance, one then has the flexibility to acknowledge that these properties can be grouped, conventionally, in different ways, yielding different categories of particulars. Indeed, this recapitulates an observation made earlier in section 2, in connection with the deficiencies of TM. It is *because* scientists are at liberty to focus on different collections of the properties of living things that they are able to construct different species concepts, each of which emphasizes different properties in structuring systems of kinds. The same can be said of the properties of enantiomers. One can be a realist about the properties of organisms, molecules, and so on, and yet recognize different collections of these properties as constituting different taxonomic categories, and consequently, different structures of kinds.

On this picture, the very notion of a kind is tied up with convention, but the substrate of conventional choice is the set of properties the sciences describe, and to whose mind-independent existence the realist may confidently subscribe in accordance with our best science. It should be immediately clear that this recasting of the notion of kindhood represents a significant departure from the traditional framing of these issues in terms of a conflict between nominalism and realism about universals. The properties on the basis of which scientific realists analyze taxonomy are

not the metaphysician's properties of kindhood, which I identified earlier with an approach taken in ancient and scholastic philosophy: the property of being *Homo sapiens* (*Homo sapien*-hood); the property of being an electron (electron-hood); etc. Perhaps, in modern scientific terms, these properties could be analyzed as conjunctive properties of some sort—electron-hood might be analyzed as a complex, conjunctive property whose conjuncts are the simple properties of negative charge, mass 9.11×10^{-31} kg, and so on. Conversely, the current proposal for realism appeals to simple properties: those on the basis of which the very concept of a kind of particular is constructed with scientific purposes in mind. Furthermore, the precise ontological status of these properties, as contested by realists about transcendent (Platonic) and immanent (Aristotelian) universals, trope theorists, and traditional nominalists, is immaterial so far as scientific realism is concerned.

So far so good, but as it stands, this realist account of TP is yet incomplete. Indeed, as it stands, it may yet seem insufficiently different from nominalism. Both positions entail that different collections of properties may be taken by convention to constitute different taxonomic categories. Recall that the reason the nominalism with which we began this section foundered in connection with TP was that, although it is compatible with a commitment to the existence of mind-independent entities and processes, it is sadly incompatible with the notion that different structures of kinds of entities and processes are likewise mind independent. Having built a strong element of human convention into the current proposal for realism, wherein properties described by the sciences are susceptible to grouping in different ways so as to produce different classificatory frameworks, have I not rendered the current proposal likewise incompatible with TP?

In answer to this question, let me now introduce, at last, the concept of 'sociability', which I take to underpin the idea of sociability-based pluralism. Begin with the observation that although properties described by scientific theories are amenable to different sorts of construction into particulars, it is also the case that from the perspective of realism, the extent to which these constructions are 'up to us' as human systematizers is, importantly, constrained. Though scientists are at liberty to call different groupings of properties kinds (for example, species) as best suits various and different scientific purposes, they are *not* at liberty to determine what groupings of properties there are, in reality. Properties, or property instances,

such as the sorts I have offered as examples here—charge, the disposition to donate a proton, fitness, and so on—are not, so far as empirical investigation would appear to suggest, randomly distributed across spacetime. They are, to coin a metaphor, systematically 'sociable'. They occur in various patterns of coherence in spacetime. And thus, while scientists are certainly free to label different patterns of coherence as constituting different structures of entities and processes (for example, species as interbreeding collectives, species as historical lineages, etc.), it is surely not up to them what patterns *there are*. The choice as to which we recognize is conventional, but the structures we recognize are not.

The metaphor of sociability here is appropriately suggestive in a number of ways. For instance, some groupings of properties are more sociable than others. The mass, charge, and spin of an electron, for example, are always found together where there are electrons, whereas the properties in virtue of which an organism may belong to a successfully breeding population may admit of a looser association, as is common in the case of cluster kinds. And just as in the literal use of the term, where a given person's sociability may be realized in different ways through participation in different social circles, in the figurative use of the term here, a given property may be sociable in different ways, figuring in different constructions of entities and processes in different frameworks of kinds. The charm of the metaphor should not distract us, however, from what is in fact a substantive metaphysical thesis. Sociability-based pluralism entails that there are many different ways one might draw circles around groups of properties so as to label a kind, and correspondingly, that many different patterns of spatiotemporal property distribution exist in nature. The sciences recognize some of these patterns and describe them as categories of things. While in practical terms, this picture of classificatory practice thus resembles the nominalist's, in metaphysical terms, it is entirely opposite: where nominalism recognizes no mind-independent categories in nature, sociability-based pluralism recognizes innumerably many.

The position I have described here satisfies TP, the thesis that there is more than one structure of mind-independent entities and processes, and thereby furnishes an account of the metaphysical dimension of realism that is compatible with the sorts of taxonomic practice one finds exemplified in the modern sciences. There are many ways one might carve nature at its innumerable joints, but in contrast to the various forms of an-

tirealist pluralism I canvassed earlier, according to sociability-based pluralism, there is a mind-independent basis for carving, *viz.* properties and patterns of property distribution that exist quite independently of us. In this way, one can indeed combine realism with pluralism after all.[7]

4.2 Metaphysical Nature-Based Pluralism

I take some form of sociability-based pluralism to be a minimal requirement for the realist in making sense of TP. Recall that 'realism', as I am using the term here, refers to scientific realism (unless otherwise indicated), and this involves a commitment to some substantive knowledge of both observable and unobservable aspects of a mind-independent world, as revealed by science. The epistemological dimension of realism thus exceeds less ambitious possibilities for satisfying TP, such as a commitment to the mere existence of mind-independent structures (external world realism), or a commitment to the mere existence of unobservable structures (Ramsey-sentence realism). In going further, I have suggested that scientific knowledge can be minimally interpreted as a knowledge of patterns of socially distributed properties. There is much more to be said about this, however: there are further challenges to realism here, responses to which may invoke yet further forms of pluralism in the realm of ontology. In each case, as I will suggest, the relevant responses appear to involve philosophical commitments that go beyond those I have adduced in order to elaborate sociability-based pluralism. In the remainder of this section, I will briefly consider two such challenges and possible realist responses. I make no assumption that these considerations exhaust the pluralist commitments a realist might make (to be sure, the challenges I will cite do not exhaust those offered to realism), but I do take these particular challenges to be especially pressing for the realist, and thus worthy of some attention here.

Let us assume that the realist should adopt some form of sociability-based pluralism. Having fixed on certain sociable groupings of properties for purposes of taxonomy, in many contexts of scientific investigation, further questions inevitably arise regarding the more precise metaphysical natures of the members of taxa thus constructed. These are finer-grained questions about the precise ontological category or categories to which an entity may belong, where 'ontological category' here refers not to the name of a particular taxon, but rather to the ontological *type* or *character*

of its members. For example, in evolutionary biology, having adopted the phylogenetic species concept (according to which species are historical lineages), finer-grained questions about the metaphysical character of members of species have been posed by biologists: is the extension of '*Homo sapiens*' comprised of individual organisms that combine to make up the lineage?; or is the lineage itself a spatiotemporally extended individual, having organisms as (mere) parts?; or . . . No doubt there are cases in which settling finer-grained metaphysical questions of this sort is arguably inessential to the scientific endeavour concerned. It is less clear, however, that these sorts of questions are generally, safely ignorable when it comes to the interpretation of the associated theory—that is, in ascertaining what knowledge the theory contains or yields.

Several infamous examples of the relevance of what can be regarded as finer-grained metaphysical questions to the interpretation of scientific theory come from fundamental physics. Having determined, for example, what properties one has in mind in classifying different elementary 'particles', finer-grained questions naturally arise concerning the more precise ontological categories to which these particles belong. The Standard Model in subatomic physics describes a number of particles whose precise ontological nature is notoriously difficult to assess. They are not particles in the everyday sense of the term, modelled on the notion of macroscopic objects, which have definite spatiotemporal trajectories, and all of whose properties are well defined at all times at which they can be said to exist. Quantum mechanics describes the behaviours of these entities in ways that make it unclear whether or not they can be regarded as individuals at all. In some contexts such as that of measurement, they appear to behave like objects with well-defined properties, but in others, they behave more like events (comprising excitations of a field; all elementary particles can be viewed as quanta of associated fields). Importantly, there is no consensus in the interpretation of current physics regarding whether particles or fields furnish "the correct" fundamental ontology. Questions regarding individuality, object-hood, and event-hood are matters of enduring controversy.

Controversies such as these, concerning the precise metaphysical nature of fundamental physical entities, are grist for antirealist scepticism in the domain of contemporary physics. How might the realist respond? One possible reaction is to take a wait-and-see attitude pending future developments in the relevant science, thereby suspending belief in the

present. After all, though it is sometimes caricatured in such a way as to suggest the contrary, no sophisticated account of realism should require that one view *all* of science as yielding knowledge of a mind-independent world. Given the unsurprising variability one finds in the strength of the evidence for scientific claims of different sorts, it is only natural that the realist should tailor her commitments accordingly: where the evidence is strong, realism may be a defensible epistemic attitude; where it is weaker, the realist may rightly, with justification, be circumspect.

As a general, guiding principle, tailoring one's belief (or degrees of belief) to the strength of the evidence is sound epistemic policy, but is it a credible option in the present case? Here is the danger: if suspending belief in the realm of fundamental physics amounts to agnosticism regarding the reality of elementary particles, the realist runs the risk of fatally undermining her position. For the supposition that (at least some of) these entities exist would appear to pass all of the most common tests of realist conviction: *ex hypothesi*, such entities are detectable; the values of their properties can be measured with significant precision; they can be causally manipulated in intricate ways; they can be used to interfere with other entities; theoretical descriptions of them have been employed to make novel predictions that have been borne out in subsequent experiment. Therefore, if the realist is to take a wait-and-see attitude here, the associated suspension of belief should be applied only with respect to the precise metaphysical nature of these entities, not with respect to their existence *per se*, on pain of undermining realism. And this immediately raises a question as to whether believing in the existence of an entity while suspending belief with respect to its precise metaphysical character is a coherent combination for the realist.

There are, I believe, at least two coherent ways in which a realist might respond to the challenge of uncertainty in fine-grained ontology. The first is to make a *pragmatic* commitment to the precise metaphysical character of entities described in specific contexts of scientific practice. For example, if in the context of measurement our best scientific models represent elementary particles as individual objects with well-defined properties, that is the description to which realists should commit. If in another context our best models represent these entities as states of an associated field, that is the description to which realists should commit. On this approach, contrary to what one might otherwise expect, the fact that these contextual

descriptions are strictly incompatible with one another does not compromise realism, because one's commitment to the precise metaphysical natures of these particles is, in either case, merely pragmatic. That is to say, the epistemological commitment ordinarily associated with realism to interpret scientific claims as (approximately) true descriptions of a mind-independent reality is strategically withheld at the level of fine-grained ontology. From the point of view of realism, these different descriptions are then viewed simply as pragmatically effective, alternative means by which to characterize the same mind-independent targets of scientific interest in different contexts—predictive, explanatory, and so on.

The result here is a secondary form of pluralism, above and beyond but wholly compatible with sociability-based pluralism. The pragmatist's conception of truth is ultimately exhausted by considerations of utility, and as a consequence, it should come as no surprise that on this view, the metaphysical natures of particulars may be described in ways that vary from one context to another. This response to the challenge of variability in connection with fine-grained descriptions of the metaphysical natures of members of kinds does incorporate a nontrivial assumption, however. This metaphysical nature-based pluralism adds to the notion of sociability the contention that, at a certain depth of ontological refinement, pragmatist pluralism is consistent with a robust realism at shallower depths of scientific description.

4.3 Manifestation-Based Pluralism

Another possible realist strategy for coming to grips with questions about the precise metaphysical character of the members of scientific categories requires no recourse to pragmatism at any level of description. Like metaphysical nature-based pluralism, it adds a substantive philosophical commitment to those entailed by sociability-based pluralism. These two strategies for supplementing sociability are entirely distinct, requiring different supplementary commitments on the part of the realist, and though they constitute mutually exclusive options for the consideration of any given case, they do not appear to be mutually exclusive more generally. In other words, while metaphysical nature-based pluralism and what I will now describe as manifestation-based pluralism cannot both apply to any one case of ontological uncertainty, they may well be appropriate in different contexts of scientific practice. As a result, both may form part of the sophisticated realist's overall conception of mind independence.

The idea of manifestation-based pluralism begins with a particular understanding of the nature of many properties of scientific interest: *viz.*, that such properties are dispositional. A family of recent views exemplifying this understanding has come to prominence in recent philosophy of science, and I will make no attempt to defend it here.[8] Rather, my intention is simply to illuminate one potential consequence of the position for the prospects of realist-compatible pluralism. Thus, begin with the idea that properties of scientific interest—those whose patterns of sociability underwrite practices of scientific classification—are generally (if not always) dispositional. That is to say, they dispose the things that have them to behave in certain ways in specific circumstances. On this view, *inter alia*, the sciences yield knowledge of the modal features of their target systems in the world. A question then immediately arises concerning how such talk of modality should be interpreted. The most common response by proponents of the view is to adopt a realism about dispositional properties, and so, on a natural reading, manifestation-based pluralism suggests an acceptance of the reality of dispositions. Admittedly, however, some who accept that much of what is learned in scientific investigation is modal in character prefer deflationary, nonrealist analyses of modality generally, and of dispositional ascription more specifically. I will not take sides on this question here; though I will use the realist idiom, those who prefer ontological austerity may translate as they see fit.

Let us turn now to the idea of manifestation-based pluralism itself. The fact that dispositions are often manifested differently, depending on the circumstances, furnishes the key to an alternative response to the challenge presented by variable descriptions of the fine-grained metaphysical natures of some scientific entities. One and the same entity may behave significantly differently in different circumstances, even when the properties associated with it are preserved from one circumstance to another. In such cases, on the dispositional view, different behaviours are simply different *manifestations* of one and the same property (or properties). Consider a simple, uncontroversial example. The molecular structure of a compound disposes it to behave in a number of different ways, depending on the ambient circumstances. It may dispose the compound to change phase (from solid to liquid, or liquid to gas) at different temperatures depending on variations in other environmental conditions (ambient pressure, the presence or absence of other chemical agents, and so on). In this way,

different stimulus conditions may elicit different causal processes involving the compound, and thereby elicit different contributions of its molecular structure to its behaviour. And so, one and the same property can dispose an entity to manifest different behaviours in different contexts.

Now, let us extrapolate this homely observation into a more controversial domain of application. Instead of pragmatically endorsing the representation of elementary particles in measurement contexts as objects with well-defined properties, for instance, let us say that in specific contexts —circumstances pertaining to measurement—the relevant entities are disposed to behave in the manner of objects with well-defined properties. Of course, this places no *a priori* restriction on how they may be disposed to behave in other circumstances, for that is the nature of dispositions. It is an empirical matter how the properties of an entity or a system of entities is disposed to behave in different contexts, and it is part of the function of scientific investigation and experiment to determine what these manifestations are, and in what circumstances one can expect to find them. Manifestation-based pluralism suggests that in the face of incompatible descriptions of the fundamental metaphysical natures of members of kinds, one can defuse the apparent conflict by appeal to the dispositions of properties, some of which admit of a plurality of manifestations, and whose sociable patterns of agglomeration are the underlying targets of realist commitment.

Is manifestation-based pluralism really the best approach for realism in response to fine-grained metaphysical uncertainty in the case of elementary particles? There is, I suspect, no easy answer to this question. For one thing, there is no obvious reason to think that the realist should adopt any one formula for responding to interpretational challenges of this sort across the board. It is in the details of particular cases that realism faces its sternest tests, and no one formula is likely to be universally compelling. In some cases—particularly those in which one has an underlying theory of the causal processes or other mechanisms by which putative dispositions are manifested in different ways—manifestation-based pluralism may seem an attractive recourse for realism. This is certainly the case in the example of molecular structure and phase change, where an underlying theory of inter- and intra-molecular forces and chemical bonds helps to put some meat on the bones of talk about dispositions and manifestations. There is no analogous underlying theory in the case of the seemingly disparate

behaviours of putative elementary particles, and as a consequence, the case for manifestation-based pluralism here is inevitably weaker. This is not to say that it is untenable, however. *Ex hypothesi*, even before the sciences revealed what we now know about the relevant forces and chemical bonds, molecular structures disposed compounds to behave in certain ways in specific circumstances.

Like sociability-based and metaphysical nature-based pluralism, manifestation-based pluralism makes a contribution to the general project of understanding the metaphysical dimension of realism in a way that respects the practice of science. That is, it contributes to our overall understanding of how the sciences can yield knowledge of a mind-independent world despite the rejection of taxonomic monism inherent in its classificatory practices, and despite the fact that even within a given taxonomic scheme, finer-grained metaphysical challenges to realism inevitably remain. Grappling with the metaphysical dimension of realism opens the door to relativism or pluralism in ways that many realists, no doubt, would rather not think about at all. But this neglect cannot be indulged if realism is to be a tenable epistemology of science. Not all forms of relativism or pluralism are inimical to realism. If the considerations presented here are cogent, there can be no tenable scientific realism without it.

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NOTES

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1. See Chakravartty (2007), chapter 6, for discussion and references in relation to this contention.

2. For a sample of this consensus, see Kitcher (1984), Dupré (1993), Stanford (1995), Ereshefsky (1998), and Okasha (2002).

3. The issue of reductionism encompasses several debates to which I sadly cannot do justice here. For an exploration of a number of different sceptical challenges to reductionism, see Galison and Stump (1996).

4. More generally, entities that form categories of scientific interest on the basis of a shared function or functions pose challenges to TM. See Khalidi (1993) and Slater (2009).

5. This is really a family of views: see Cruse & Papineau (2002); Worrall (2007); and Papineau (2010). For a forerunner of the approach, but couched in rather different terms, see Hardin & Rosenberg (1982).

6. For a formal proof, see English (1973).

7. This conclusion stands in stark contrast to much established doctrine regarding kinds. Compare Stanford (1995), which contends that the role of contextual interests in articulating different species concepts precludes realism in this domain, and Ereshefsky (1998), which suggests that the lack of a shared classificatory principle across species concepts precludes realism. Conversely, I take realism to be compatible with the 'stipulative' content of kind attribution, as examined in detail in LaPorte (2004).

8. Perhaps the best-known account of dispositions in connection with scientific knowledge is Cartwright's (e.g., 1999) discussion of "capacities." For further accounts, see Bird (2007) and Chakravartty (2007).

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