**PROPERTIES.** Our every assertion or thought involves properties or relations. Most simply, we predicate some property of some thing: the earth is round. Sometimes we refer to properties by name or by description: red is the color of blood. Sometimes our quantifiers range over properties: galaxies come in many shapes and sizes.

This familiarity with properties, however, does not reveal what properties are. Indeed, the question is equivocal, both in ordinary and in philosophical discourse. There are different conceptions of properties, equally legitimate, corresponding to the different roles that properties have been called upon to play (Bealer, 1982; Lewis, 1983, 1986). And for each conception there are different theories as to what sort of entity, if any, is best suited to play the role. The most fundamental division is between abundant and sparse conceptions of properties. On an abundant conception every meaningful predicate expresses some property or relation, including 'is blue or round', 'is on top of a turtle', 'is identical with the planet Mars'; a property's instances need not resemble one another in any intrinsic respect. Abundant properties are needed to serve as "meanings," or components of "meanings," in a compositional semantics for language. On a sparse conception of properties a predicate expresses a property only if the objects satisfying the predicate resemble one another in some specific intrinsic respect; perhaps 'has unit positive charge' and 'is ten kilograms in mass' are examples. Sparse properties are needed to provide an objective basis for the scientist's project of discovering the fundamental classifications of things and the laws that govern them. Properties, whether abundantly or sparsely conceived, are neither language- nor mind-dependent: they existed before there were beings to talk and think about them; they would have existed even had there never been such beings.

In this article only conceptions of properties are explicitly distinguished and discussed, although much of what is said applies also to relations and to propositions. Other philosophers' terms for 'property' in the abundant sense include 'attribute' (QUINE [7; S], 1970), 'propositional function' (RUSSELL [7], 1919), and 'concept' (Bealer, 1982; FREGE [3; S], 1884); 'universal' and 'quality' have for the most part been interpreted sparsely. Ordinary language allows abundant or sparse readings of 'characteristic', 'feature', 'trait', and more.

## ABUNDANT CONCEPTIONS OF PROPERTIES

How abundant are the properties on the abundant conception? Whenever there are some things, no matter how scattered or dissimilar from one another, there is the abundant property of being one of those things. Thus, for any class of things, there is at least one abundant property had by all and only the members of that class. It follows that there are at least as many abundant properties as classes of things and that the abundant properties outrun the predicates of any ordinary language. (There are nondenumerably many classes of things—assuming an infinity of things—but at most denumerably many predicates in any ordinary language.) Abundant properties, owing to their very abundance, must be transcendent, rather than immanent: they are not present in their instances as constituents or parts. It is not plausible to suppose that an object has a distinct constituent for each and every class to which it belongs.

If we say that whenever there are some things, there is exactly one property had by all and only those things, then a property may be identified with the class of its instances. For example, the property of being human may be identified with the class of human beings. But there is a well-known objection to this identification (Quine, 1970). Consider the property expressed by 'is a creature with a heart' and the property expressed by 'is a creature with kidneys'. If properties are "meanings," or semantic values, of predicates, then the properties expressed by these two predicates are distinct. Yet, these predicates, we may suppose, are coextensive: as a matter of fact, any creature with a heart has kidneys, and vice versa; the class of creatures with a heart is identical with the class of creatures with kidneys. Thus, distinct properties correspond to the same class and cannot be identified with that class.

Different responses to the objection invoke different criteria of individuation for properties, that is, different criteria for deciding when properties, introduced, say, via predicates that express them, are one and the same. One

response simply denies that 'is a creature with a heart' and 'is a creature with kidneys' express distinct properties. More generally, properties expressed by coextensive predicates are identical. Call this an extensional conception of properties. A property so conceived may be identified with the class of its instances. Extensional conceptions of properties are adequate to the semantic analysis of mathematical language and extensional languages generally (TARSKI [8], 1946).

A second response holds that 'is a creature with a heart' and 'is a creature with kidneys' express distinct properties, because it is logically possible for something to satisfy one predicate without satisfying the other. On this response properties expressed by necessarily coextensive predicates are identical; properties expressed by accidentally coextensive predicates are distinct. Call this an intensional conception of properties. If one accepts the standard analyses of logical possibility and necessity in terms of possibilia, then a property, on the intensional conception, may be identified with the function that assigns to each possible world the set of possible objects that has the property at the world. If one holds that each object exists at, and has properties at, only one world, then a property may more simply be identified with the class of (actual and) possible objects that has the property (Lewis, 1986). Properties, on the intensional conception, are appropriate semantic values for predicates of (standard) modal languages and intensional languages generally (CARNAP [2; S], 1947; KRIPKE [S], 1963).

A third response holds that the properties expressed by 'is a creature with a heart' and 'is a creature with kidneys' are distinct because they are structured entities with different constituents: the property expressed by 'is a creature with a heart' has the property expressed by 'is a heart' as a constituent; the property expressed by 'is a creature with kidneys' does not. On this response properties have a quasi-syntactic structure that parallels the structure of predicates that express them. Call two predicates isomorphic if they have the same syntactic structure and corresponding syntactic components are assigned the same semantic values. On a structured conception of properties, properties expressed by isomorphic predicates are identical; properties expressed by nonisomorphic predicates are distinct. (Structured conceptions are sometimes called hyperintensional because they allow necessarily coextensive predicates to express distinct properties.) Structured conceptions subdivide according to whether the unstructured semantic values are intensional or extensional and according to whether the relevant structure is surface grammatical structure, or some hypothetical deep structure, or structure after analysis in terms of some chosen primitive vocabulary. Structured properties may be identified with sequences of unstructured properties and other unstructured semantic values. Structured properties, on one version or another, have a role to play in the semantic analysis of propositional attitudes and of hyperintensional languages generally (Carnap, 1947; Cresswell, 1985).

Thus far, this article has assumed that predicates of ordinary language are satisfied by objects once and for all. In fact, most ordinary language predicates are tensed; they may be satisfied by objects at some times but not at others. For example, 'is sitting' is true of me now, but was false of me ten minutes ago. On a tensed conception of properties, whether or not a property holds of an object may also be relative to times. Most simply, tensed properties may be identified with functions from times to untensed properties. Tensed properties may be taken as semantic values for tensed predicates.

We have, then, a plurality of abundant conceptions of properties. Which is correct? One need not and should not choose. A plurality of conceptions is needed to account for the multiple ambiguity in our ordinary talk of properties. And it seems that both structured and intensional conceptions are needed for compositional semantics: structured properties are needed to provide distinct semantic values for predicates, such as 'is a polygon with three sides' and 'is a polygon with three angles', that are necessarily coextensive without being synonymous; intensional properties are needed to provide distinct semantic values for unstructured predicates that are accidentally coextensive. To accept a plurality of conceptions, it suffices to find, for each conception, entities that satisfy that conception's criteria of individuation.

Realists with respect to some conception of properties hold that entities satisfying the individuation criteria for the conception exist (*see* REALISM [S]). Realists divide into reductionists and antireductionists. Reductionists identify properties, under the various conceptions, with various set-theoretic constructions (in ways already noted): classes, functions, or sequences of actual or possible objects (Lewis, 1986; *see* REDUCTION, REDUCTIONISM [S]). Antireductionists reject some or all of these identifications. For some antireductionists, classes are suspect or esoteric entities; classes are to be explained, if at all, in terms of properties, not vice versa (Bealer, 1982; Russell, 1919). For other antireductionists the problem is not with classes, but with the possibilia that comprise them (on intensional conceptions). Possible but nonactual entities are to be explained, if at all, in terms of uninstantiated properties, not vice versa (Plantinga, 1976). According to the antireductionist, properties are basic or primitive; it is merely posited that there are entities satisfying the appropriate individuation criteria. Some entities, after all, must be taken as basic; according to the antireductionist, properties are an acceptable choice.

Eliminativists hold that, strictly speaking, there are no properties (*see* ELIMINATIVE MATERIALISM, ELIMINATIVISM [S]). They take aim, typically, at intensional conceptions, at conceptions with modal criteria of individuation. They claim that modal notions, such as logical possibility and necessity (whether taken as primitive or analyzed in terms

of possibilia), incorrigibly lack the clarity and precision required of a rigorous scientific semantics or philosophy (Quine, 1970). Eliminativists have the burden of showing how ordinary and philosophical discourse ostensibly referring to properties can be paraphrased so as to avoid such reference; or, failing that, of showing that such discourse is dispensible, merely a *façon de parler.*

## SPARSE CONCEPTIONS OF PROPERTIES

On an abundant conception any two objects share infinitely many properties and fail to share infinitely many others, whether the objects are utterly dissimilar or exact duplicates. On a sparse conception the sharing of properties always makes for genuine similarity; exact duplicates have all of their properties in common. Whatever the sparse properties turn out to be, there must be enough of them (together with sparse relations) to provide the basis for a complete qualitative description of the world, including its laws and causal features. The sparse properties correspond one-to-one with a select minority of the abundant properties, on some intensional conception. ('Intensional', because distinct sparse properties may accidentally be instantiated by the same objects.) Those abundant properties that correspond to sparse properties are called natural (or perfectly natural, since naturalness presumably comes in degrees; Lewis, 1983, 1986). The naturalness of properties is determined not by our psychological makeup, or our conventions, but by nature itself.

How sparse are the properties, on a sparse conception? First, there is the question of uninstantiated properties. If sparse properties are transcendent, there is no difficulty making room for uninstantiated sparse properties; perhaps uninstantiated sparse properties are needed to ground laws that come into play only if certain contingent conditions are satisfied (Tooley, 1987). If, on the other hand, sparse properties are immanent, are present in their instances, then uninstantiated sparse properties must be rejected, because they have nowhere to be (ARMSTRONG [S], 1978, 1989). Of course, uninstantiated sparse properties may nonetheless possibly exist, where this is understood according to one's favored interpretation of modality.

Second, there is the question of the compounding of sparse properties (and relations). Disjunctions and negations of natural properties are not themselves natural: their instances need not resemble one another in any intrinsic respect. For example, instances of the property having-unit-positive-charge-or-being-ten-kilograms-in-mass need not resemble one another in either their charge or their mass. It follows that there are no disjunctive or negative sparse properties (Armstrong, 1978).

The case of conjunctive sparse properties is less clear. There are two views. According to the first, since instances of a conjunction of natural properties, such as having-unit-positive-charge-and-being-ten-kilograms-in-mass, resemble one another in some—indeed, at least two—intrinsic respects, there exists a sparse property corresponding to the conjunction. According to the second view, the sparse properties must be nonredundant; they must be not only sufficient for describing the world but minimally sufficient. On this view conjunctive sparse properties are excluded on grounds of redundancy: a putative conjunctive sparse property would hold of an object just in case both conjuncts hold.

Similarly, structural sparse properties, such as being-a-molecule-of-$H_2O$, may be admitted on the grounds that they make for similarity among their instances. Or they may be excluded on grounds of redundancy: a putative structural sparse property would hold of an object just in case certain other sparse properties and relations hold among the object and its parts. But the exclusion of structural (and conjunctive) sparse properties faces a problem. It rules out a priori the possibility that some properties are irresolvably infinitely complex: they are structures of structures of structures, and so on, without ever reaching simple, fundamental properties or relations (Armstrong, 1978). A sparse conception that allowed for this possibility would have to allow some redundancy; and if some redundancy, why not more? This suggests that conjunctive and structural sparse properties should generally be admitted. (An alternative treatment makes use of degrees of naturalness and has it that conjunctive and structural properties are natural to some lesser degree than the properties in terms of which they are defined; a world with endless structure has no perfectly natural properties.)

If structural sparse properties are admitted, the sparse properties will not be confined to fundamental physical properties; there will be sparse properties of macroscopic, as well as microscopic, objects. For example, the sparse properties will include specific shape-and-size properties, such as being-a sphere-ten-meters-in-diameter (which are arguably structural properties definable in terms of sparse distance relations). However, the vast majority of ordinary-language predicates—'is red', 'is human', 'is a chair', to name a few—fail to express natural properties to which sparse properties correspond; rather, these predicates express properties that, when analyzed in fundamental physical terms, are disjunctive (perhaps infinitely so) and probably extrinsic. (This judgment could be overturned, however, if there are irreducible natural properties applying to macroscopic objects—most notably, irreducible phenomenological properties of color, sound, and such.)

What are the properties on a sparse conception? There are three principal theories (or clusters of theories, since they each subdivide). According to the first, the properties sparsely conceived are just some of the properties abundantly conceived: the properties that are perfectly

natural. What makes some properties natural and others unnatural? One version of the theory simply takes naturalness to be a primitive, unanalyzable distinction among abundant properties (Quinton, 1957; see also Armstrong, 1989; Lewis, 1986). But since a property is natural in virtue of the resemblances among its instances, it might seem more appropriate to take instead some relation of partial resemblance as primitive and to define naturalness in terms of resemblance. The resulting version, called resemblance nominalism, can be worked out in different ways with different primitive resemblance relation (Price, 1953; see also Armstrong, 1989; GOODMAN [3; S], 1951; Lewis, 1983). The chief objection to the view is that partial resemblance between ordinary objects, no less than naturalness of properties, cries out for analysis. When two objects partially resemble one another, the objection goes, they must have constituents that exactly resemble one another, perhaps constituents that are literally identical. More generally, it is argued, properties must be constituents of objects if properties are to play a role in the explanation of the natures and causal powers of objects; one cannot explain an object's nature or causal powers by invoking a class to which it belongs. Sparse properties, then, must be immanent, not transcendent, entities.

What are these constituents of ordinary things? Not ordinary spatial or temporal constituents—or, at least, not always. For even an object with no spatial or temporal extension might have a complex nature and stand in relations of partial resemblance. If sparse properties are immanent, then they must be nonspatiotemporal constituents of things. There are two prominent theories as to the nature of these constituents. The first theory takes them to be universals (Armstrong, 1978, 1989.) They are repeatable: each of them is, or could be, multiply instantiated. And they are wholly present in their instances: an immanent universal is located—all of it—wherever each of its instances is located. When objects resemble one another by having a sparse property in common, there is something literally identical between the objects. It follows that universals fail to obey commonsense principles of location, such as that nothing can be (wholly) in two places at the same time. But that is no objection. Such principles were framed with particulars in mind; it would beg the question against universals to require them to meet standards set for particulars.

On the other theory of sparse properties as immanent, the nonspatiotemporal constituents of ordinary particulars are themselves particulars, called tropes (Armstrong, 1989; Lewis, 1986; Williams, 1966) or abstract particulars (Campbell, 1981). When ordinary particulars partially resemble one another by having some sparse property—say, their mass—in common, then there are distinct, exactly resembling, mass tropes as constituents of each. On a trope theory sparse properties can be identified with maximal classes of exactly resembling tropes (perhaps including merely possible tropes). Exact resemblance between tropes is taken as primitive by trope theory; but it is a simple and natural primitive compared to the partial resemblance relation taken as primitive by an adequate resemblance nominalism.

A possible disadvantage of a universals theory is that it requires two fundamentally distinct kinds of entities: universals and particulars. An ordinary particular cannot simply be identified with a bundle of coinstantiated universals, lest numerically distinct but qualitatively identical particulars be identified with one another. On a universals theory there must be some nonqualitative, nonrepeatable constituent of ordinary particulars to ground their numerical identity. A trope theory, on the other hand, needs only tropes to make a world. Ordinary particulars can be identified with bundles of coinstantiated tropes; numerically distinct but qualitatively identical particulars are then bundles of numerically distinct but exactly resembling tropes.

The great advantage of a universals theory is that it promises to analyze all resemblance in terms of identity: exact resemblance is identity of all qualitative constituents; partial resemblance is partial identity, identity of at least one qualitative constituent. But it is unclear whether the promise can be kept. Objects instantiating different determinates of a determinable—such as unit-positive and unit-negative charge—seem to partially resemble one another by both being charged without there being any analysis of this resemblance in terms of the identity of constituent universals or, for that matter, the exact resemblance of constituent tropes. A universals theory and a trope theory would then have to fall back upon primitive partial resemblance between universals, or tropes. Some of the advantages of these theories over resemblance nominalism would be forfeited.

Of the three basic theories of sparse properties—resemblance nominalism, a theory of immanent universals, and a theory of tropes—only one can be true; the theories posit incompatible constituent structure to the world. However, assuming each theory is internally coherent, and adequate to the needs of science, the question arises, What sort of evidence could decide between them? It seems that a choice between the theories will have to be made, if at all, on the basis of pragmatic criteria such as simplicity, economy, and explanatory power. There is as yet no philosophical consensus as to what that choice should be.

(SEE ALSO: *Metaphysics* [S])

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