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A WORLD OF DISPOSITIONS*

Perhaps the fundamental concepts of physical ontology are those of objects and events; for it is widely assumed that the world itself is amenable to being characterized successfully by means of an event ontology or an object ontology, where the outstanding difficulty is simply one of finding the right sort of fit. Although these pathways have seemed promising, they have not been without their own distinctive difficulties, for despite an area of agreement concerning suitable criteria for the individuation of objects, substantial disagreement abounds regarding appropriate standards for the differentiation of events.[1] This matter is consequential for both perspectives, moreover, since whether objects are to be constructed from events or events from objects, neither view presumes either category *alone* provides a sufficient foundation for an adequate ontology.[2] The problems which they share have resisted successful explication, nevertheless.

These theoretical difficulties would be easy to understand, of course, were neither objects nor events themselves the fundamental constituents of the world's structure, prevailing opinion to the contrary notwithstanding; and, indeed, that assumption underlies the project undertaken here. For the purpose of this paper is to propose a dispositional ontology for the physical world, according to which (a) every structural property of the world is a dispositional one, (b) a physical object is a specific ordered set of dispositions, and (c) every event that occurs during the course of the world's history is a manifestation of some dispositional property of the world. An attempt to provide theoretically adequate principles of identity for properties, objects, and events within this ontological framework is one important aspect of this inquiry. Among its potential benefits are promising solutions to a variety of problems, including (i) an ontological justification for various modal distinctions, (ii) a theoretical clarification of the relationship between proper names and definite descriptions, and (iii) a plausible indication of the interconnections between minds and bodies from a dispositional ontological point of view. In order to elabo-

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rate these benefits, of course, the fundamental concepts upon which they depend require adequate explication, which the following account is intended to provide.

1. THE ONTOLOGICAL OBJECTIVE

As a preliminary consideration, it may be useful to attempt to clarify the precise objectives of an analytical ontology as a basis for measuring the degree of success that a particular account may or may not happen to attain. For this purpose, the idealized notions of (a) a nomically perfect theory T^* and of (b) a logically perfect language L^* may serve as heuristic instruments in articulating the theoretical objective of (c) a categorically perfect ontology O^*. Prior to defining these concepts, however, let us assume the following principle:

> *The Principle of Relativistic Realism*, i.e., the world exists as an entity apart from our beliefs about it, but the properties of the world are linguistically relativized in the sense that there is more than one language in which it may be described; hence, there is no unique descriptive language.[3]

This principle implies, in particular, that there may be extensionally adequate alternative languages, which are nevertheless not translationally intensionally equivalent languages (where a language is extensionally adequate if and only if it accommodates all truth-functional modes of statemental composition). Whether an extensionally adequate language L may fulfill the conditions for a logically perfect language, however, will depend upon its adequacy to express all the true statements that describe the world.[4] Let us furthermore assume:

(a) that a theory T is *a nomically perfect theory* T^* if and only if every lawlike sentence true of the physical world (but not every sentence, every true sentence, or every lawlike sentence) is a logical consequence of T; and,

(b) that a language L is *a logically perfect language* L^* if and only if (i) there is a one-to-one correspondence between the predicates of L and the properties of the world, (ii) there is a one-to-one correspondence between the proper names of L and the nameable objects of the world, and (iii) there is a one-to-one correspondence between the logical operators of L and the kinds of ways in which the properties and objects of the world may be related.

Observe that a theory T may be a nomically perfect theory T^* even though some sentences that are either false or unlawlike follow from it. This result is acceptable to the extent to which the unlawlike sentences that number among the logical consequences of T are logical consequences of any theory, namely: those sentences that all theories necessarily imply on syntactical principles, i.e., the class of logical truths. It is unacceptable, however, to the extent to which it allows a theory arbitrarily swollen by the conjunction of sentences that are otherwise either unlawlike or false to qualify as 'nomically perfect'. Let us therefore characterize a theory T as a *maximal* nomically perfect theory T' if and only if every logical consequence of T is either a lawlike sentence true of the physical world or a logical truth *and* every lawlike sentence true of the physical world is a logical consequence of T.[5]

Since lawlike sentences are logically general, i.e., are not restricted to a finite class of instances on syntactical or semantical grounds alone, proper names are not constituents of lawlike sentences; consequently, a logically perfect language is not a necessary condition for a nomically perfect theory (for satisfaction of conditions (b)(i) and (b)(iii), but not (b)(ii), is sufficient to formulate a nomically perfect theory, maximal or otherwise).[6] Insofar as a language L satisfying a sufficient condition for the formulation of a nomically perfect theory T' possesses special significance for ontological investigations, let us characterize a language that satisfies conditions (b)(i) and (b)(iii) as a *minimally* logically perfect language L' (while keeping in mind the fact that, strictly speaking, a minimally logically perfect language is not necessarily a logically perfect language at all).

Let us assume that the objective of an analytical ontology is to provide a theoretical analysis of the most basic kinds of things (objects, properties, or relations, for example) of which the world is made. With respect to the notion of a logically perfect language, therefore, an ontological investigation may be envisioned as a theoretical analysis of the most basic kinds of words (such as names, predicates, and operators) of which such languages are made. From this point of view, analytical ontology provides a theoretical analysis of the basic kinds of relations that obtain between language and the world, i.e., analytical ontology is a metalinguistic enterprise, as the following definition reflects:

(c) an ontology O is *a categorically perfect ontology* O^* (with respect to

language L) if and only if (i) L is a logically perfect language L^* and O is a theoretical analysis of the basic kinds of relations between L and the world that is both logically elegant and theoretically illuminating; or, (ii) L is a minimally logically perfect language L' and O is a theoretical analysis of the basic kinds of relations between L and the world that is logically elegant and theoretically illuminating.[7]

The difference between (i) and (ii) might therefore be characterized as capturing the difference between an ontology theoretically adequate for the purposes of *science* (by investigating the structure of minimally logically perfect languages sufficient for the formulation of maximal nomically perfect theories) and an ontology theoretically adequate for the purposes of *philosophy* (by investigating the structure of logically perfect languages in general). A categorically perfect philosophical ontology, moreover, would appear to be more encompassing than a categorically perfect scientific ontology, since the former logically entails the latter (though not conversely). The important difference between them, of course, is that a philosophical ontology embraces the analysis of proper names, while a scientific ontology does not.[8] A significant question, therefore, would appear to be whether or not a scientific ontology could fulfill the objectives of a philosophical ontology, in principle (an issue which seems to hinge upon the theoretical dispensability of proper names within the context of a logically perfect language). The investigation of this problem, moreover, not only promises to clarify the relationship between philosophical ontologies and scientific ontologies but will also provide a severe test of the extent to which (in Quine's fine phrase) 'philosophy of science is philosophy enough'.[9]

Since the definition of a categorically perfect ontology (of either kind) is hypothetically relativized to a logically perfect language (of one kind or another), the fact that there are no logically perfect languages may be viewed as a stumbling block on the path to ontological progress. Fortunately for the prospects of both science and philosophy, this perspective appears to be unduly pessimistic; for although an exhaustive verification of the theoretical claims of a proposed ontology *vis-à-vis* the physical world would indeed require access to a logically perfect language, the tentative development of a theoretical analysis intended for this purpose may nevertheless be pursued on the basis of the far-from-perfect language resources actually at our disposal. Indeed, although contrived

under less than ideal evidential circumstances (as are all scientific theories), one or another ontological proposal might qualify as a categorically perfect ontology (even though, to be sure, in the absence of a logically perfect language that fact could not be verified). The prospects for the development of an adequate ontology would be enormously enhanced, of course, were the language resources at our disposal actually representative of all the different kinds of names, predicates, and operators that a logically perfect language would yield. As a working hypothesis, therefore, let us assume that the language resources at our disposal are (more or less) categorically representative, while acknowledging in advance that this assumption may subsequently require revision. Although the conception of a logically perfect language thus provides an heuristic instrument which illuminates the character of a categorically perfect ontology, construction of a categorically perfect ontology is not dependent upon access to any logically perfect language. These considerations are therefore reassuring to the extent to which they support the conclusion that the objective of ontology is at least not obviously logically impossible.

2. A DISPOSITIONAL ONTOLOGY

In order to facilitate the systematic development of a dispositional point of view, let us begin by considering the concepts fundamental to that analysis and subsequently ascertain whether or not the framework it provides is adequate for either scientific or philosophical purposes. The most important among them, of course, is the concept of a disposition itself, which may be formulated along the following lines:

(D1) A predicate is *dispositional* if and only if the property it designates (a) is a tendency (of universal or statistical strength) to bring about specific outcome responses when subject to appropriate singular tests, where that property (b) is an actual physical state of some individual object or of an arrangement of objects (should it happen to be instantiated by anything at all).[10]

The predicate expression, 'half-life of 3.05 minutes', would be an example of a statistical disposition, for the property it designates is a tendency for tests of specified kinds, i.e., time-trial tests of various durations, to bring about (probabilistically, in this case) specified out-

come responses, i.e., losses of various quantities of mass, that is an actual physical state of (at least one) individual object or collection of objects (if any sentence that attributes this property to something happens to be true). At least three features of this conception warrant further elaboration, namely:

(i) It is important to differentiate between dispositional properties, *per se*, and the possession of a dispositional property by any individual thing; for the definition of dispositionality specified here precludes the (all too tempting) presumption that properties of such a kind must necessarily be instantiated by any individual at all. Indeed, from this point of view, the possession of such a property by some object or collection of objects is (merely) an historically contingent occurrence which should properly be classified, not as a disposition, but rather as an event.[11]

(ii) A specific collection of objects, of course, may possess dispositions to bring about various outcomes with varying strength when arranged in relevantly different ways, as a loose ignition wire convincingly displays. Consequently, it is important to recognize that, although the dispositions of the individual members of a collection of objects do not themselves change simply by virtue of the way they are arranged, collections of objects are collectively disposed to bring about different outcomes when they are arranged in different ways, where *arrangements* themselves are understood as ordered sets or sequences of things.[12]

(iii) Since dispositional properties specify the outcome responses that would be brought about (either invariably or probably) by the occurrence of singular relevant tests, a dispositional predicate itself may be informally defined as a set of ordered triples each consisting of a test trial description T_i, an outcome response description O_j, and a numerical strength specification r_k, i.e., $\{\langle T_1, O_1, r_1\rangle, \langle T_2, O_2, r_2\rangle, \ldots\}$, where the number of members of the set is determined by the variety of different trial tests and different response outcomes that are ontological constituents of that specific disposition.[13]

These considerations have quite significant implications from the linguistic point of view. Let us assume as a preliminary frame of reference a language with the structure of a first-order predicate calculus (without identity), such that a well-formed formula of that language is either a truth-functional compound of its atomic sentences (whether quantified or not) or an atomic sentence itself (which shall be assumed to consist of the

concatenation of a predicate constant with an individual constant, i.e., a definite description or a proper name). Then from the dispositional perspective, it is apparently theoretically important to draw a distinction between *predicate constants* (of whatever degree), such as '*H*', and the *sentential functions* that may be constructed from them, such as ⌜*Hx*⌝. For, while the predicate constant '*H*' designates a specific disposition, i.e., a half-life of 3.05 minutes, the sentential function ⌜*Hx*⌝ stands for ⌜*x has* a half-life of 3.05 minutes⌝; but since the instantiation of any disposition by anything at all is an historically contingent happening (from the ontological point of view), *the sentential function* ⌜*Hx*⌝ *exhibits the form of an event attribution* – where the concatenation operation itself is a linguistic representation of an instantiation relation that is historically contingent – rather than (merely) designating this specific disposition.[14]

The difference that emerges here is therefore particularly noteworthy, since it is common practice among philosophers and logicians to consider the sentential function as an especially useful device for formalizing predicate constants themselves. The importance of the distinction thus displayed is further reinforced when consideration is given to Quine's theoretical separation of *eternal sentences* and *occasion sentences*, where a sentence is eternal if and only if its truth value remains the same from speaker to speaker and for all times.[15] Since an occasion sentence is a sentence that is true on some occasions and false on others, while events (of various kinds) may be presumed to occur on some occasions (but not on others), it seems reasonable to adopt the principle that an eternal sentence is an event description if and only if that sentence itself is the eternal form of an occasion sentence, i.e., *occasion sentences are the basic elements of language for the description of events.*[16] Thus, the sentence, 'Lincoln is President in 1862' (employing the tenseless sense of 'is'), describes an event, for it is one eternal sentence form of the occasion sentence, 'Lincoln is President'. A further corroboration of this criterion, moreover, is provided by sentences of which there are *no* occasion sentence forms, i.e., logical truths, which surely should not qualify as providing event descriptions.[17]

In order to articulate the dispositional conception of an object, however, it is necessary to introduce one further definition, namely:

(D2) A property χ is a *permanent* property of every member of a reference class K if and only if (a) there is no process or procedure –

whether natural or contrived – by means of which a member of K could lose that property without also losing membership in K; and (b) the possession of χ by a member of K is not logically entailed by the reference class description of K.[18]

The permanent properties of members of the reference class consisting of things whose molecules have the atomic number 15 thus include being soluble in turpentine, in vegetable oils and in ether; having a garlic-like odor, producing skin-burns on contact and igniting at 30 °C; but they do *not* include being employed for military purposes, being sold under restricted conditions, or being referred to by the predicate 'white phosphorous', i.e., those 'transient' properties that things may gain or lose independently of their membership in this reference class.[19]

As it happens, these distinctions provide a plausible theoretical basis for differentiating 'natural kinds' along the following lines:

(a) So-called mass nouns, such as 'water' and 'red', may be characterized as designating natural *property* kinds, in the sense that, when 'water' is taken as designating a (pure) liquid whose molecules have the chemical structure H_2O and 'red' is taken to designate light whose wavelength falls between 6100 and 7500 Å, the members of both reference classes possess many different permanent dispositional properties, such as having a freezing point of 32 °F and a boiling point of 212 °F at sea level atmospheric pressure in the case of water, or such as exhibiting particular interference and diffraction patterns under particular experimental conditions in the case of red.

(b) Ordinary general nouns, such as 'planet' and 'amoeba', by comparison, may be envisioned as designating natural *object* kinds, in the sense that, though these predicates likewise specify reference classes whose members possess (what may be referred to as) *integrated sets of permanent dispositions* (such as reproductively multiplying by fission or exerting a gravitational attraction that is directly proportional to its mass), included among them is the tendency to take impermeable external forms, because of which the members of these classes occur as numerically distinguishable things.[20] The difference between natural things of these distinct varieties itself thus appears to be dispositional in kind.

The point of classifying amoebas and water as *natural* kinds, I presume, is that they represent integrated sets of dispositional properties which happen to have been manifest during the course of the world's 'natural'

history, i.e., as features of its physical and biological evolution, independently of contrivance by man. The 'naturalness' of natural kinds should not be made too much of here, however; for Stutz Bearcats and permanent waves, although 'artificial' property and object kinds when viewed from this perspective, are ontologically on a par with 'natural' kinds to the extent to which permanent dispositional properties accompany membership in those classes. The important theoretical distinction, therefore, is really the difference between the transient properties (such as being frozen) and the permanent properties (such as a freezing point of 32 °F) of things (such as pure water), rather than the distinction between natural and 'artificial' kinds. For the members of classes of both kinds possess permanent and transient dispositions, a difference (it should be stressed) which depends upon a (presupposed) reference class description.[21]

Given these considerations, the dispositional conceptions of (particular) kinds of things and of things of (particular) kinds may be defined as follows:

(1) (particular) *kinds of things* are specific arrangements of (permanent and transient) dispositions, independently of whether or not these distinctive sets of properties happen to be instantiated during the course of the world's history; and

(2) *things of* (particular) *kinds*, therefore, are instantiations of some specific arrangement of (permanent or transient) dispositions that happen to occur during the course of the world's history, regardless of whether or not these arrangements constitute object *or* property kinds.

Existential hypotheses, such as, 'There are amoebas', or, 'Something is red', are true, therefore, if and only if those object and property kinds happen to be instantiated by at least one thing during the course of the history of the world; and, indeed, from this point of view, object kinds and property kinds are theoretically on an equal footing, for the truth conditions for property hypotheses, such as, 'Something is omnipotent', appear no less (and no more) obvious than those for object hypotheses, such as 'There are unicorns'.[22]

It is significant to notice that the dispositional conceptions of kinds of things and of things of kinds do not logically imply that instantiations of specific arrangements of dispositional properties must necessarily happen to be instances of *object* kinds as numerically distinguishable things. They therefore leave open the logical possibility that properties may be manifest *in the form of things that are not objects* (a possibility that appears to be

of more than hypothetical interest *vis-à-vis* developments in quantum mechanics, which suggest that radiant energy may be a phenomenon of precisely such a kind). Even independently of consideration for contemporary physics, however, it seems to be a benefit of this ontology that it does not beg the question with regard to this specific issue; for surely the existence of photons as arrangements of dispositions that are nevertheless not numerically distinguishable things would appear to be a physical possibility which requires *empirical* investigation.[23]

The dispositional conception of things of (particular) kinds, by contrast, does logically imply that two different things are objects of a kind when (and only when) they are instantiations of the same object kind arrangements, which therefore presupposes the theoretical specification of some reference class for an unambiguous determination. Ice cubes and water ponds are things of the same kind as members of the reference class *water*, yet may not be things of the same kind as members of the reference classes *frozen water*, *rectangular figures*, and *duck sanctuaries*. Indeed, since individual things may lose or gain properties during the course of the world's history without losing their identity as those individual things (as a book may become worn and its pages torn or a professor might gain weight and his hair turn gray), the continued existence of specific objects as nevertheless the same objects requires theoretical identification of those objects as members of an underlying reference class as follows:

(3) *individual objects* are continuous sequences of instantiations of particular arrangements of dispositions during the course of the world's history, where any object ceases to exist as an object of a particular kind whenever it no longer instantiates the corresponding (reference class) description.

Indeed, were individual objects invariably identified as instances of the totality of properties they happen to instantiate at one particular time, no object could survive a change in any property at all.[24]

3. A SCIENTIFIC ONTOLOGY

Since an ontology is categorically adequate for the purposes of science if and only if it provides a logically elegant and theoretically illuminating analysis of the basic kinds of relations that obtain between logically perfect languages (sufficient for the formulation of maximal nomically

perfect theories) and the physical world, the adequacy of this dispositional ontology for the purposes of science theoretically depends (in part) upon (a) the explication it supports for lawlike sentences, (b) the principles it provides for identity of properties, and (c) the distinctions it affords concerning physical and logical modalities. Since the dispositional conception of lawlike sentences has been the subject of a previous investigation, that aspect of the present inquiry will not be covered in detail here; nevertheless, certain elements of that account are sufficiently fundamental to a dispositional ontology to warrant their review.[25]

(a) From this point of view, lawlike sentences are conceived as *logically general dispositional statements* attributing permanent dispositional properties to every member of a reference class; for example, 'white phosphorous is soluble in turpentine', 'Homogeneous and symmetrical dice are fair', and, 'Radon has a half-life of 3.82 days'. Since an object would not belong to a reference class K if it did not possess the property χ, the basic form of lawlike sentences is that of a subjunctive generalization, which may be formalized by employing the non-extensional 'fork' operator, i.e., the subjunctive conditional, as follows:

(I) $\quad (x)(t)(Kxt \supset \chi xt),$

which asserts, ⌜For all x and all t, if x were K at t, then x would be χ at t⌝; for example, 'For all x and all t, if x were white phosphorous at t, x would be soluble in turpentine at t'.[26]

In order to exhibit the *causal* significance of lawlike sentences, however, alternative formulations are required which employ the (probabilistic) 'causal' conditional (represented by the 'n-fork' operator), where the causal conditional is essentially strong than the subjunctive by embracing a primitive *brings about* relation as well. As it happens, the causal conditional provides a suitable basis for the explicit definition of dispositional predicates as follows:

(II) $\quad x$ is χ at $t =$ df $(T^1xt \supset_m O^1xt^*) \cdot (T^2xt \supset_n O^2xt^*) \cdot \ldots;$

which asserts, ⌜x is χ at t⌝ means, by definition, ⌜T^1-ing, T^2-ing, ..., x at t (invariably, if the disposition is of universal strength u; probabilistically, if it is of statistical strength r) brings about O^1-ing, O^2-ing, ... x at t^*⌝; and so on. For example, the dispositional predicate, 'x is soluble in turpentine at t', might be explicitly defined as, 'completely submerging x

in turpentine at t would invariably bring about its completely dissolving at t^*; partially submerging x in turpentine at t would invariably bring about its partially dissolving at t^*; . . . ,' and so forth.[27]

The causal formulation of lawlike statements, therefore, may be obtained by substituting one conjunct of conjunctive definitions of form (II) in lieu of the dispositional predicate they (partially) define in sentences having the form (I) to yield statements exhibiting the following structure:

(III) $\quad (x)(t)[Kxt \supset (T^1xt \supset_m O^1xt^*)]$,

which asserts, ⌜for all x and all t, if x were K at t, then T^1-ing x at t would (invariably or probably) bring about O^1-ing x at t^*⌝; for example, 'For all x and all t, if x were white phosphorous at t, then partially submerging x in turpentine at t would invariably bring about its partially dissolving at t^*'.[28] Since no set of extensional statements is logically equivalent to any subjunctive (or causal) conditional, however, the analysis of lawlike sentences supported by a dispositional ontology implies that extensional languages are theoretically inadequate for the formulation of nomically perfect theories.

(b) Perhaps the most important issue underlying the choice between truth-functional and non-truth-functional languages emerges from consideration of the differences distinguishing *properties* and *classes*. Quine has posed the problem and proposed a possible solution:

> classes are the same when their members are the same, whereas it is not universally conceded that properties are the same when possessed by the same objects. . . . But classes may be thought of as properties if the latter notion is so qualified that properties become identical when their instances are identical.[29]

In spite of its superficial plausibility, however, Quine's proposal appears to evade rather than resolve this problem; for the principle he recommends, i.e.,

(IV) $\quad (F)(G)[(F = G) \equiv (x)(t)(Fxt \equiv Gxt)]$,

that is, 'For all properties F and G, F is identical to G if and only if, for all x and all t, x is F at t if and only if x is G at t', fails in trial situations. For if all and only oval lockets happened to be made of gold, then it would be the case that for all x, x is an oval locket if and only if x is made of gold; but

surely the properties *gold* and *oval locket* are distinctly not the same; for the shape of something gold is not among the permanent properties of every member of that class, and being made of gold is likewise not a property that no oval locket could be without.

From the dispositional perspective, of course, this problem is perfectly intelligible; for the principle Quine adopts would be sufficient for its purpose *only at the expense of its extensionality*, i.e., by admitting 'possible worlds' into his sparse ontology or by embracing non-truth-functional logical connectives. For two properties would be identical if and only if all of their instances in any possible world would be the same, or if something would be an instance of one if and only if that something were also an instance of the other. The first of these conceptions thus requires quantification over every 'possible world' W as follows:

$$\text{(V)} \qquad (F)(G)[(F = G) \equiv (W)(x)(t)(FxtW \equiv GxtW)],$$

that is, 'For all properties F and G, F is identical to G if and only if, for all W, all x and all t, x is an F at t in W if and only if x is a G at t in W', which dissolves one theoretical problem at the expense of creating another (in providing an analysis of the truth conditions for possible world's assertions). For surely the least that is required of any such ontology is an explanation of which worlds are possible and why.[30]

The alternative provided by the dispositional account, by comparison, not only affords a principle for properties but a rationale for possible worlds as well. For an appropriate principle for the identity of properties is supplied by means of a subjunctive biconditional as follows:

$$\text{(VI)} \qquad (F)(G)\{(F = G) \equiv (x)(t)[(Fxt \mathrel{\ni\!\!-} Gxt) \cdot (Gxt \mathrel{\ni\!\!-} Fxt)]\},$$

that is, 'For all properties F and G, F is identical to G if and only if, for all x and all t, if x were an F at t then x would be a G at t and if x were a G at t then x would be an F at t', where sentences of the form, $\ulcorner Kxt \mathrel{\ni\!\!-} \chi xt \urcorner$, are true if and only if either (i) $\ulcorner Kx \urcorner$ logically entails $\ulcorner \chi x \urcorner$, in which case the subjunctive is warranted on logical grounds; or (ii) χ is a permanent property of every member of the reference class K, in which case the subjunctive is warranted on nomological grounds.[31] The properties *gold* and *oval locket*, therefore, are identical according to principle (VI) if and only if either, (i) the predicate 'gold' logically entails the predicate 'oval

locket', and conversely; or, (ii) (being) *gold* is a permanent property of every member of the reference class *oval locket*, and conversely. Hence, if something could be gold without being an oval locket or could be an oval locket without being gold, then those properties are not identical, while otherwise they are; which, of course, will be true or false independently of the historical contingency that, as a matter of fact, all and only oval lockets might happen to be gold.[32]

(c) The dispositional rationale for possible worlds, therefore, emerges from the recognition that, relative to a specific reference class description, it may be physically possible for every member of that class to possess such a transient disposition, but it is *not* physically possible for any member of such a class to not possess any of its permanent properties. As a result, from this point of view, *a world is physically possible (relative to the actual world) if and only if the permanent and transient properties of things are kept constant*, i.e., they remain permanent and transient properties of things of just the same kinds (relative to the actual world).[33] Physical necessities are consequently described by sentences that could not be false (independently of definitions), which are, nevertheless, not true on syntactical grounds alone, i.e., sentences attributing permanent dispositional properties as specified. On the assumption that N is a set of lawlike sentences in L containing every such true statement,

(i) for any sentence S in L, *S describes a logically possible (necessary, impossible) state of affairs or 'world'* (relative to L) if and only if it is not the case that L implies not-S (it is the case that L implies S, it is the case that L implies not-S), where S is not true or false as a matter of definition; and,

(ii) for any sentence S in L and any such set N, *S describes a physically possible (necessary, impossible) state of affairs or 'world'* (relative to L and N) if and only if it is not the case that L and N imply not-S (it is the case that L and N imply S, it is the case that L and N imply not-S), where S is not true or false as a matter of definition.[34]

The condition that S be neither true nor false by definition thus precludes the semantical preemption of logical and physical possibilities by stipulation (as e.g. the boiling point of H_2O at sea level atmospheric pressure might be absorbed within the meaning of 'water' itself, thereby converting previously empirical claims into semantical truths), preserving these basic modal distinctions.[35]

4. A PHILOSOPHICAL ONTOLOGY

Since an ontology is categorically adequate for the purposes of philosophy, by comparison, if and only if it provides a logically elegant and theoretically illuminating analysis of the basic kinds of relations that obtain between proper names in a logically perfect language and nameable objects in the world as well, the adequacy of a dispositional ontology for the purposes of philosophy depends (in part) upon (a) the criterion it supplies for the identity of events, (b) the principles it provides for the identity of objects, and (c) the explication it supports of the relationship between definite descriptions and proper names.

(a) As we have observed, occasion sentences are the basic elements of any language for the description of events. In order to individuate between events, therefore, the relevant standard to employ appears to be definite descriptions for events by means of occasion sentence conjunctions; for surely event names (such as 'Lincoln's assassination' and '*Titanic*'s sinking') and definite event descriptions (such as 'the death of the 16*th* President' and 'the greatest peacetime naval disaster') may fulfill their intended roles (of individuating these singular events) on the basis of the principle that *event names and definite event descriptions name or describe a single such event if and only if every occasion sentence true of one of these occasions is also true of the other.*[36] It is therefore ironic to discover that the principle of identity for events has been with us right along but has been misinterpreted as the principle of identity for objects; for the 'standard' principle of identity, namely:

(VII) $\quad (x)(y)[(x = y) \equiv (F)(Fx \equiv Fy)],$

as applied to events, asserts that two different event names or definite event descriptions $\ulcorner x \urcorner$ and $\ulcorner y \urcorner$ name or describe the same event if and only if every property of one of those events is also a property of the other, i.e., every occasion sentence true of one of those occasions is also true of the other.[37]

It is important to observe that singular events are similar to individual objects in the sense that, were they invariably identified as instances of the totality of properties that happen to be simultaneously instantiated by everything at one particular time, then no event could survive a change in any property at all. Since principle (VII) establishes an identification of

precisely such a kind, therefore, a distinction must be drawn between *atomic events* and *molecular events* by envisioning molecular events as sequences of atomic events, where the basic principle of continuity for molecular events is provided by a reference class description [usually consisting of an event kind description, e.g., an assassination (of some person) or a sinking (of some ship), together with an identification of the individual object or collection of objects which instantiate that event kind, e.g., (the person) Lincoln or (the ship) *Titanic*]. The continued existence of specific events as the same events in spite of some change in the arrangements of dispositions they instantiate at different times, therefore, requires theoretical identification of those events as members of an underlying reference class once again as follows:

(4) *singular events* are continuous sequences of instantiations of arrangements of dispositions during the course of the world's history, where an event ceases to exist as an event of a particular kind whenever it no longer happens to instantiate the corresponding (reference class) description.[38]

From this point of view, therefore, the singular event referred to as *the sinking of the Titanic* is a molecular event consisting of a sequence of instantiations of the event kind *sinkings* (of ships) by the individual object *Titanic* which includes instantiations of the event kinds *collisions of ships with icebergs*, *insufficient and poorly-manned lifeboats*, and *loss of over 1500 lives*, in a sequence terminating with an instantiation of the event kind *ship at rest on the bottom of the sea*.

(b) Since an individual object is a continuous sequence of instantiations of particular arrangements of dispositions during the course of the world's history – where any object ceases to exist as an object of a particular kind whenever it no longer instantiates the corresponding (reference class) description – the object(s) named or described by different proper names or definite descriptions are numerically identical, i.e., a single thing, if and only if:

(VIII) $(x)(y)[(x = y) \equiv (F)(t)(Fxt \equiv Fyt)]$,

that is, 'For all x and all y, x is identical to y if and only if for all properties F and all times t, x is an F at t if and only if y is an F at t', i.e., the names or descriptions $\ulcorner x \urcorner$ and $\ulcorner y \urcorner$ name or describe the same object if and only if *the objects* $\ulcorner x \urcorner$ *and* $\ulcorner y \urcorner$ *name or describe instantiate the same ordered sets of dispositions in the same sequence of historical events*. The object named,

'Lincoln', is the same object described by the description, 'the 16*th* President', therefore, if and only if every disposition instantiated by the object named 'Lincoln' (such as *human being of male sex, store clerk, log splitter,* and *speech maker*) is also instantiated by the object described by 'the 16*th* President' and, indeed, in the same historical sequence (beginning with *birth in a log cabin in Kentucky* in 1809 and ending with *death from a gunshot wound* in 1865), and conversely. The role of temporal variables in formulating adequate principles for the identity of objects is theoretically indispensable, therefore, since it serves to locate sequences of singular events as features of atomic events in the history of the world.[39]

From this point of view, the fundamental distinction between the spatial and temporal properties of things appears to be as follows, namely: a spatial predicate designates a property that things have to other things (such as x is higher than y and to the left of z relative to frame of reference R) that is a feature of *atomic* events; while temporal predicates designate properties that things may have to other things (such as x is earlier than y and lasts longer than z on the basis of standard T) that are features of *molecular* events, i.e., properties that obtain between particular events (which may happen to be atomic or molecular) but are not properties of *individual* atomic events. The sentence, 'Books on physics are on the shelf above those on philosophy', for example, describes a feature of an atomic event; whereas the sentence, 'I read the paper before I went outdoors', by contrast, orders a particular set of events and is therefore itself molecular. Indeed, *a maximal set of occasion sentences,* i.e., the totality of all occasion sentences (whether macro or micro) that are true together without contradiction, provides a plausible criterion of simultaneity between events (relativistic considerations notwithstanding), while recurring sequences of event instantiations (such as the periodic rotation of an electron around its orbit), of course, may furnish suitable standards for measuring their duration.[40]

The differences between the spatial and temporal properties of things also clarifies the concept of dispositions as *actual physical states*; for particular dispositions are properties of objects and arrangements of objects that happen to be instantiated as features of atomic events, where *arrangements of objects* are collections of objects instantiating particular spatial relations, i.e., a spatial predicate designates a property that is fundamental to an arrangement's description. Since temporal predicates

describe relations that an atomic event only instantiates with respect to other (atomic or molecular) events, therefore, the properties they designate are *not* actual physical states of any such object or arrangement; as a result, *temporal predicates are not dispositional in kind*, i.e., historical relations are not dispositional properties. Since any event inherits an infinite number of temporal relations with other events merely by virtue of its occurrence (insofar as, e.g., every event occurs *prior to*, *subsequent to*, or *simultaneous with* innumerable other events), these historical properties establish a convenient source for definite event descriptions, but nevertheless these predicates do not designate dispositions. Because Lincoln is born in 1809 and Vesuvius destroyed Pompeii in A.D. 79, Lincoln instantiates the property *born 1730 years after the destruction of Pompeii by Vesuvius*; but since this property is not instantiated as a feature of any atomic event, it could not be a disposition.[41]

By virtue of the totality of spatial and temporal properties that any thing acquires by instantiating any property at all, therefore, every individual thing is a unique instance of every property it instantiates and every property instantiation is a unique event in the history of the world. Consequently, *a world is historically possible at t (relative to the actual world at t) if and only if the history of that world at t is the same as the history of this one at t*, i.e., the set of all true statements describing the instantiation of properties during the history of the world relative to t is true of each such world. On the assumption that N is a set of lawlike sentences and H is a set of historical descriptions (of atomic events occurring prior to t) in L, where N and H contain every such true statement,

(iii) for any sentence S in L and any such sets N and H, *S describes an historically possible (necessary, impossible) state of affairs or 'world'* (relative to L and N and H), if and only if it is not the case that L and N and H imply not-S (it is the case that L and N and H imply S, it is the case that L and N and H imply not-S), where S is not true or false as a matter of definition.[42]

Thus, if N is a maximal set of lawlike sentences and every member of N happens to be a general law of *universal* strength, i.e., a logically general statement attributing a permanent dispositional property of universal strength to every member of a reference class, then the future history of any world is deducible from any such set H for any such time t, i.e., there is only *one* historically possible world; otherwise, different worlds are historically possible at t.[43]

(c) On the basis of these reflections, the implications of such an ontology for the theory of proper names are theoretically intriguing. On general grounds, I take it, the satisfaction of a definite description is necessary and sufficient for the introduction of such a name within a language framework; for if any such name denoted *less* than one individual thing, the result would be a violation of the law of excluded middle, and if such a name denoted *more* than one individual thing, the result would be a violation of the law of non-contradiction.[44] Thus, the (historical) *existence condition* is ontologically significant in disclosing that Kripke's conception of proper names as *rigid designators* (uniquely denoting the same thing in every possible world) is philosophically sound if and only if every physical law is of universal strength.[45] Otherwise, names denoting things with identical dispositions and identical histories prior to time t might denote things differing in their histories and dispositions subsequent to t; for if even *one* law is statistical in strength, a rigid designator may name one thing in one possible world and another thing in another, *where both worlds are historically possible at t* – unless such worlds are trivially required to duplicate the actual world by identifying their histories for *all* times rather than those prior to *t*. The (historical) *uniqueness condition* is similarly significant in demonstrating the ontological consequences attending the selection of some specific definite description for a proper name introduction; for since every individual thing is a unique instance of every property that it instantiates at any time, *the kind of thing that is thereby being named requires explicit specification* (as a presupposition of such a definite description).[46] Otherwise, since any individual thing ceases to exist as a thing of that kind when it no longer instantiates the corresponding reference class description, it would be theoretically impossible to ascertain whether or not the thing named by any particular name continues to exist as an instance of an atom, a molecule, a certain shape or a certain size, and so on.

5. A WORLD OF DISPOSITIONS

From the ontological point of view, therefore, a world of dispositions may be construed as a continuous sequence of atomic events, each of which itself consists of the instantiation of an arrangement of objects that are themselves instantiations of dispositions. Since there are no causal connections, i.e., no 'cause and effect' or *brings about* relations, between

simultaneous happenings, events that are described by occasion sentence conjunctions that are all true together cannot be causes of one another; however, if an event of kind K and an event of kind T^1, or kind $T^2, \ldots$, are all instantiated as features of a single atomic event t by a single individual thing, a, it will (invariably or probably) be the case that an event of kind O^1, or kind $O^2, \ldots$, occurs as a feature of a subsequent atomic event t^* (where, in principle, there are no *a priori* boundaries to the variety of relevant test trials or outcome response consequents that may occur together as features of a single atomic event).[47] As a result, the continuous sequence of instantiations of arrangements of sets of dispositions that constitute an individual object's history not only records that historical sequence *per se* but also implicitly reflects those features of its past theoretically relevant to its explanation (where any feature of an atomic event t that contributes to bringing about the occurrence of some feature of atomic event t^* is theoretically relevant to its explanation).[48]

Rendering these *implicit* features *explicit*, of course, requires access to the set N of all lawlike sentences true of the physical world as well as access to the set H of all historical descriptions true of that individual's history, relative to which the occurrence of specific features of that history may be subject to systematic explanation; indeed, on the basis of those historical descriptions true of an individual a at a time t, the occurrence of subsequent events as features of that individual's history may be subject to systematic prediction as well (with logical certainty, if all of the relevant laws are universal; or with merely probabilistic confidence, if they are not). Hence, given the set N of all laws and the set H of true descriptions of any atomic event t during the course of the world's history, every feature of the subsequent atomic event t^* may be systematically predicted or explained as a manifestation of some underlying (universal or statistical) dispositional property of the world. The history of an object thus imposes 'causal constraints' upon its subsequent development, in the form of historically determined possibilities, necessities, and impossibilities for that object's future course.[49]

An illustration of the significance of this theoretical conception is posed by the relationship between bodies and minds, which appears to be as follows: as a product of heredity and gestation, each human being enters the world possessing a neurophysiological apparatus, i.e., a 'brain', with a determinate structure, K. Among the permanent properties of every

brain of structure K is a disposition to acquire other dispositions as outcome responses to certain kinds of trial tests, which may be referred to as its 'capacity to learn' or, for short, *intelligence*. The characteristics of this particular disposition, of course, vary as a function of the underlying structure; but, in any case, as that individual thing undergoes multifarious experiences during the course of its life history, it will acquire, as invariable or probable outcomes, innumerable complex tendencies to respond to specific kinds of environmental variables with specific kinds of outcome behavior. Since every event of this individual's history happens to be unique, such a thing may acquire behavioral dispositions of distinctive kinds; although, to the extent to which things of this kind are exposed to similar – though not *exactly* similar – happenings, their dispositional acquisitions will tend to be the same in kind, if not in strength. Indeed, as an ontological perception, things of many different kinds are analogous in their structural characteristics; for things that are *gold* are like things that are *people* insofar as gold has a characteristic malleability, melting point, and boiling point, and people too have characteristic degrees of flexibility, and boiling points, and melting points, when appropriately conceived. Yet each and every instance of either of these kinds is a unique individual thing.[50]

From this point of view, therefore, every atomic event that occurs during the course of the world's history is a manifestation of some dispositional property of the world and every physical object that exists is an instantiation of some set of dispositions; as a result, every structural property of the world is dispositional in kind. On the basis of the preceding considerations, it appears to be a reasonable inference that a dispositional ontology provides a logically elegant and, in fact, theoretically illuminating analysis of the basic kinds of relations that may obtain between language and the world; indeed, to the extent to which the concepts of *object*, of *event*, of *property*, of *natural kind*, of *lawlike sentence*, *subjunctive* and *causal conditional*, of *logical*, *physical*, and *historical possibility*, of *names* and *descriptions* for objects and events, of *space* and of *time*, and of *explanation* and *prediction*, are both philosophically sound and theoretically derivable on the basis of definitions for *dispositions* and for *permanent properties* of things of a certain kind, the philosophical benefits of a dispositional explication of all of these conceptions appear to be enormously appealing. There will always be grounds

for dissent, to be sure, and the price of intensionality may be thought too high a price to pay, even for these benefits; but surely the burden of proof is on those who would deny the theoretical potential of a dispositional construction. Whether 'philosophy of science is philosophy enough', of course, depends upon the emphasis one chooses to place upon the world's contingent history as opposed to its physical structure; but there appear to be no obvious problems involving names and definite descriptions that lie beyond its scope or would warrant its rejection. The issue underlying the distinction between scientific and philosophical ontologies, after all, is whether there is more in heaven and earth than is dreamt of in our philosophy: for ontology, a world of dispositions is world enough.

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NOTES

* The author is indebted to Carl G. Hempel, Kenneth Henley, John Hooker, and Igal Kvart for stimulating comments on certain aspects of the issues dealt with here.

[1] R. M. Martin, 'On Events and Event-Descriptions', in *Fact and Existence* (ed. by J. Margolis), Oxford, Basil Blackwell, 1969, with comments by D. Davidson, R. J. Butler, and W. C. Salmon, provides an interesting illustration of some of the controversy over this specific problem.

[2] Unlike Martin, Russell and Reichenbach, for example, construct objects from events. Cf. Bertrand Russell, *The Analysis of Matter*, New York, Dover Publications, 1954, p. 286; and esp. Hans Reichenbach, *Elements of Symbolic Logic*, New York, The Free Press, 1947, pp. 266–274.

[3] This plausible principle suggests *the requirement of descriptive completeness* as a necessary condition for a logically perfect language L^*, namely: unless there is (at least) a one-to-one correspondence between the predicates in some language L and the properties of the physical world, no language will be adequate to express all the true statements that describe the world.

[4] Some of the inadequacies of extensional language are discussed with respect to lawlike sentences in James H. Fetzer, 'The Likeness of Lawlikeness', in *Boston Studies in the Philosophy of Science*, vol. XXXII (ed. by A. Michalos and R. Cohen), Dordrecht, Holland, D. Reidel, 1976; and with respect to confirmation in James H. Fetzer, 'Elements of Induction', in *Local Induction* (ed. by R. Bogdan), Dordrecht, Holland, D. Reidel, 1976.

[5] Of course, it would be theoretically problematical to require that all logical truths be logical consequences of a maximal nomically perfect theory as well, since such a theory would be inconsistent if it were complete, and conversely.

[6] Strictly speaking, the problem of ruling out proper names is more complex than indicated here; see, for example, Carl G. Hempel, *Aspects of Scientific Explanation*, New York, The Free Press, 1965, pp. 264–270. See also Section 2 below.

[7] The concepts of logical elegance and of theoretical illumination, of course, may themselves be subject to explicative investigation; but it seems clear on intuitive grounds than an ontology that is maximal in its range and minimal in its assumptions while exhibiting the systematic interconnections that obtain between such basic ontological categories as those of property, object, event, and so forth would qualify as logically elegant and theoretically illuminating.

[8] Insofar as explanations and predictions concern events belonging to the world's history, the theory of explanation and prediction would appear to be classified as an aspect of philosophical ontology from this point of view, especially when explanandum sentences themselves describe events involving individuals by name.

[9] 'If certain problems of ontology, say, or modality, or causality, or contrary-to-fact conditionals, which arise in ordinary language, turn out not to arise in science as reconstituted with the help of formal logic, then those philosophical problems have in an important sense been solved', W. V. O. Quine, 'Mr. Strawson on Logical Theory', *Mind* (October, 1953), p. 446.

[10] This definition incorporates the 'single case' aspect of dispositions which receives consideration in James H. Fetzer, 'A Single Case Propensity Theory of Explanation', *Synthese* (October, 1974).

[11] The assumption that every property is instantiated by at least one individual thing during the course of the world's history thus seems logically equivalent to the classical Aristotelian existential presupposition for categorical terms.

[12] Any feature of an experimental arrangement or of a test trial that influences the strength of the tendency for a trial of that kind to bring about specific outcome responses is theoretically relevant to that arrangement's description; see, e.g., the discussion of these issues in Fetzer, 'Elements of Induction', esp. pp. 152–154.

[13] Cf. W. V. O. Quine, 'On Ordered Pairs and Relations', *Selected Logical Papers*, New York, Random House, 1966, pp. 111–112. See also Section 3(a) below.

[14] Cf. W. V. O. Quine, 'Concatenation as a Basis for Arithmetic', *op. cit.*, esp. pp. 71–73, for a discussion of the role of concatenation in abstract contexts.

[15] W. V. O. Quine, *Word and Object*, Cambridge, The M.I.T. Press, 1960, p. 193.

[16] The account presented by Roderick Chisholm, 'Events and Propositions', *Nous* (February, 1970) appears to be the most similar to the present author's views; however, Chisholm neglects to draw the occasion sentence/eternal sentence distinction and therefore overlooks its theoretical importance. See Section 4(a).

[17] A sentence serving as a meaning postulate might be regarded as sometimes true and sometimes false, namely: before and after altering the relevant language framework. The distinction employed here is therefore relative to a specific framework at a specific time. However, see also Section 3(c) below.

[18] This concept is introduced in Fetzer, 'The Likeness of Lawlikeness', pp. 384–385.

[19] The transient property of being referred to by a certain predicate, such as 'white phosphorous', illustrates the possibility of taking some property away from the members of a reference class by the procedure of a linguistic change.

[20] Cf. Quine's discussion, *op. cit.*, pp. 90–95, esp. regarding so-called 'sortal' predicates.

[21] Cf. W. V. O. Quine, 'Natural Kinds', *Ontological Relativity and Other Essays*, New York, Columbia University Press, 1969, which neglects to take account of these important differences. The choice of an appropriate reference class, of course, is characteristically pragmatically determined; see also Section 4(c).

[22] As Quine observes, 'to be is to be the value of a variable', serves as a criterion of the ontological commitments of an hypothesis or a theory; but what there is is another question. Cf. W. V. O. Quine, 'On What There Is', *From a Logical Point of View*, Cambridge, Harvard University Press, 1953, pp. 15–16.

[23] A useful discussion of this issue is presented in Alberto Cortes-Osorio, *Identity in Quantum Mechanics* (Indiana University, unpublished dissertation, 1971).

[24] Strictly speaking, temporal instants are atomic events in the course of the world's history, i.e., they are not ontologically primitive but derivative; this relationship is indicated (without elaboration) in Section 4(b) below.

[25] Fetzer, 'The Likeness of Lawlikeness'.

[26] Fetzer, 'The Likeness of Lawlikeness', pp. 385–386.

[27] Fetzer, 'The Likeness of Lawlikeness', pp. 386–388.

[28] Fetzer, 'The Likeness of Lawlikeness', pp. 388–389.

[29] W. V. O. Quine, *Mathematical Logic*, New York, Harper and Row, 1951, p. 120.

[30] These instantiations are to be construed as features of atomic, rather than molecular, events, as those concepts are defined in Section 4(a) and 4(b).

[31] Principle (VI) logically implies Principle (V), which implies Principle (IV), but not conversely, with respect to those properties instantiated as features of atomic events. But this issue is complex for features of molecular events.

[32] The falsity of a material conditional, of course, is logically sufficient to establish the falsity of the corresponding subjunctive conditional, but not conversely. An analysis of the fundamental logical relations between causal, subjunctive, and material conditionals from a dispositional point of view is presented in James H. Fetzer and Donald E. Nute, 'Syntax, Semantics, and Ontology: A Probabilistic Causal Calculus' (forthcoming).

[33] Fetzer, 'The Likeness of Lawlikeness', pp. 390–391, fn. 11. Note that here 'the actual world' is synonymous with 'the way things are', since it is not assumed that permanent or transient properties are inevitably instantiated.

[34] Cf. Reichenbach, *Elements of Symbolic Logic*, pp. 393–400, esp. pp. 396–398.

[35] Cf. Karl Popper, *Logic of Scientific Discovery*, New York, Harper and Row, 1965, p. 79, fn. 2. See also Fetzer and Nute (forthcoming).

[36] It is therefore essential that no temporal variables occur in Principle (VII) in order for that principle to serve the identity of events as opposed to the identity of objects.

[37] Cf. James H. Fetzer, 'On Mellor on Dispositions', *Philosophia* (forthcoming).

[38] Davidson suggests that events of certain kinds, such as arguments or, perhaps, love affairs are not invariably continuous; Donald Davidson, 'Events as Particulars', *Nous* (February, 1970), pp. 28–29; however, they should instead be viewed as examples of enduring dispositions with intermittent manifestations.

[39] In other words, the historical sequences instantiating these dispositions are not merely the same *kind* of sequences but the *very same* sequences in the case of both objects; otherwise, things with markedly similar life-cycles, such as electrons or ball bearings, might turn out to be identical when they are not.

[40] Spatial relations are likewise envisioned as derivative and not primitive on a dispositional construction, where the gravitational attraction of one object for another is a permanent disposition of those things having mass; thus, e.g., the square of the distance between two objects is proportional to their masses and is inversely proportional to the force of gravitational atraction between them, i.e., $d^2 = G(m_1 m_2)/F$. See also Section (2).

[41] Every property instantiation that happens to belong to any thing's history is a unique event in that history with temporal relations to other events; as a result, the property of

instantiating that property at that time is an *hereditary* property, i.e., a property that some thing may lose only by losing membership in every class of things that could instantiate that property.

[42] An explication of the independent concept of epistemic possibility may be found in James H. Fetzer, 'On "Epistemic Possibility"', *Philosophia* (April–July, 1974), p. 335.

[43] The crucial case is therefore that of statistical dispositions; see, e.g., James H. Fetzer, 'Dispositional Probabilities', in *Boston Studies in the Philosophy of Science*, vol. VIII (ed. by R. Buck and R. Cohen), Dordrecht, Holland, D. Reidel, 1971; and also Fetzer and Nute (forthcoming).

[44] Since otherwise '$(Ex)Fx \vee (Ex) - Fx$' is true, necessarily, by existential generalization, contrary to the hypothesis of null denotation; and since otherwise '$Fa \cdot -Fa$' is true, necessarily, by the hypothesis of multiple denotation. Cf. Herbert Hochberg, 'Strawson, Russell, and the King of France', in *Essays on Bertrand Russell* (ed. by E. D. Klemke), Urbana, University of Illinois Press, 1971, esp. pp. 311–313. See also John R. Searle, 'Proper Names and Descriptions', in *The Encyclopedia of Philosophy*, Vol. 6 (ed. by P. Edwards), New York, Macmillan, 1967, pp. 489–491.

[45] Saul A. Kripke, 'Naming and Necessity', in *Semantics of Natural Language* (ed. by D. Davidson and G. Harman), Dordrecht, Holland, D. Reidel, 1972, esp. pp. 269–270. Kripke's arguments, of course, may otherwise be *valid.*

[46] Thus, the existential condition should specify the underlying reference class K of which that thing is supposed to be a *uniquely different* member, as, e.g., '$(Ex)\{(Kx \cdot \psi x) \cdot (y)[(Ky \cdot \psi y) \supset (x = y)]\}$', which would indicate that class by implication. Of course, conversational contexts usually suffice.

[47] Except, of course, those imposed by logical and physical impossibilities. An exception to the general principle cited above, however, may be posed by so-called 'laws of co-existence'. See James H. Fetzer, 'Grünbaum's "Defense" of the Symmetry Thesis', *Philosophical Studies* (April 1974), for discussion of related issues.

[48] A general discussion of this issue is provided in James H. Fetzer, 'On the Historical Explanation of Unique Events', *Theory and Decision* (February, 1975). See also note 12 above.

[49] The theory of explanation attending the dispositional construction is set forth (in part) in Fetzer, 'A Single Case Propensity Theory of Explanation', esp. pp. 187–196. See also James H. Fetzer, 'Reichenbach, Reference Classes, and Single Case "Probabilities" ', *Synthese* **34** (1977), 185–217.

[50] 'Mental' properties are therefore necessary properties of physical structures, Kripke's criticism, 'Naming and Necessity', pp. 334–342, notwithstanding. Cf. C. V. Borst (ed.), *The Mind/Brain Identity Theory*, New York, St. Martin's Press, 1970, for alternative theoretical accounts of the relations involved here.