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MATH MATICS

C. B. MARTIN

ON THE NEED FOR PROPERTIES: THE ROAD TO PYTHAGOREANISM AND BACK*

ABSTRACT. The development of a compositional model shows the incoherence of such notions as levels of being and both bottom-up and top-down causality. The mathematization of nature through the partial considerations of physics *qua* quantities is seen to lead to Pythagoreanism, if what is not included in the partial consideration is denied. An ontology of only probabilities, if not Pythagoreanism, is equivalent to a world of primitive dispositionality. Problems are found with each. There is a need for properties as well as quantities and these properties must be qualitative as well as dispositional. So there is a need for physical qualia (qualities) for the depiction of the intrinsic character of the finest interstices of nature.

In order to make any progress in philosophy, and philosophy of science in particular, we must be clear on our metaphysics. Perhaps highest on the list of notions to be clarified is that of a property. The elimination of some elementary confusions about the nature of properties will go far to clean up less fundamental topics. My arguments against universals and in particular against D. M. Armstrong's account of universals appears in Armstrong et al., 1996(b) and in Martin, 1996(a).

1. LINGUISTICIZATION OF PROPERTIES

Predicates are linguistic and mind-dependent entities, whereas many properties of objects are not. Linguisticism is silly, but it is also endemic and largely unnoticed by many passing ontologists. The suggestion of it needs expunging from the motto "To be is to be the value of a variable", but appears unmistakably in what can be described as a kind of *Holus Bolus* view (Martin 1980; 1993) that suggests that it is the object *simpliciter holus bolus* that makes each of many statements about it true or false. But when the statements:

(A) The passion fruit is round

and

(B) The passion fruit is purple

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In order to make any progress in philosophy, and philosophy of science in particular, we must be clear on our metaphysics. Perhaps highest on the list of notions to be clarified is that of a property. The elimination of some elementary confusions about the nature of properties will go far to clean up less fundamental topics. My arguments against universals and in particular against D. M. Armstrong's account of universals appears in Armstrong et al., 1996(b) and in Martin, 1996(a).

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are true of one and the same object, in each case it is something in particular *and* different *about* the object that makes each statement true. The predicates are built to pick these out.

Furthermore, *different* things (properties) about (or of) the *same* object are causally operative in different ways (or inoperative) for different effects. The object is causally operative in some event for particular effects only in virtue of *some* of its properties *rather* than others. It is not operative *holus bolus* for each and every effect. Therefore, properties are needing for causality. Without properties, objects are empty and predicates blind. (Martin 1980; 1993)

Without a doubt, if one compares two *objects* in terms of their similarities and dissimilarities one needs to do this concerning some respects thought to be “in common” between them. This has led to the invocation of the numerically identical universal as the common element. The need for this is removed when one sees that object detection, discrimination and even identification is dependent upon a more basic detection, discrimination and identification of things *about* objects, namely, properties of objects – colors, movements, shapes, loudnesses, tastes, textures, and the temporal pulses and changes and spatial spread of these.

This requires a *mind-shift* from the philosopher’s usual emphasis upon exact or inexact similarity between *objects* (that need a *respect* in which to be similar) to exact or inexact similarity between a specific property or *respect* (of an object) that since already detected or specified needs no *further* respect in which the respects or properties are similar.

An infant or an adult may be selectively attending to a specific property of an object or to exactly similar specific properties of a number of objects without attending to the object or objects themselves. Exercising the natural and basic capacity to detect and come to fix upon some specific property arousing his or her interests, the agent can group exactly similar properties either of different parts of the same object or of different objects. And it can discriminate these properties from dissimilar properties. It can do these things without need of further respects.

The natural direction for detecting, discriminating, recognizing, or identifying properties is through the perception of what is demarcated *about* an object through, as it were, its “outline” marked and bounded (allowing for occasional “overlap”) by differences and similarities, exact and less-than-exact from and to what else is within perception *about* the object and its environment. This can be achieved at the most primitive level of detection and also at the higher levels of discriminatory, recognitional and identificatory responses needed for cognitive expertise. One *gradually* comes to acquire cognitive skills reacting to similarities and differences concerning

properties, whether one has a many-exactly-similar-tropes view or many-instantiations-of-one-universal view. If there are many exactly similars then it will be natural for one to *group* them.

To (1) note the physical extent and/or duration of some *one* simple property-universal in a particular instantiation or set of many instantiations or to (2) note the physical extent and/or duration of some simple trope or set of exactly similar tropes seems to be a strikingly similar procedure.

At the ontological level, whichever of these notations one uses (and the tropes vs. universals issue may not come to more than that), it is the resemblance or difference between the properties of objects, events or states of affairs that is basic to the resemblance or difference between objects, events or states of affairs. Two objects are similar to and different from one another in *virtue* of the similarity to and difference from different things *about* (properties of) the objects.

This ontological-epistemological model is a corrective to overly object-oriented and false accounts of the perceptual and conceptual development of infants in the womb, and the very young.

Even as adults we can be *as* the infant in total disregard of what *has* the qualities or properties with which we may be totally absorbed. This often is the case with painters, composers and even more pedestrian sensualists.

If one were to reject the ultimacy of objects and replace them with space-time segments or “worms” or fields, there would still be properties, that is, things *about* or things *had* by these segments or fields that would not *be* these segments or fields themselves or even be *parts* of them. These properties would be more than mere mathematicized measures. Even concerning such elementary particles or fields or space-time representations there is need of more than quantities and numbers. Every quantity or measure is such only in virtue of there being qualities *for* which or of which it is the quantity or measure. The alternative is an unacceptably empty desert of Pythagoreanism unsurprisingly endorsed by Quine in “Whither Physical Objects?” (Quine 1976).

2. THE COMPOSITIONAL MODEL

The anti-realist notes that there can be alternative ways of classifying nature and falsely concludes that the world is indeterminate and classification-dependent. On the contrary, a completely realist way of representing the manifold variety of nature is available (Martin 1993).

Such factors as the stability and (observable) reproductivity of some varieties rather than others of interrelated properties in nature make some modes of classification of things more “natural” or “useful” than others.

Correlative with this would be factors concerning the evolution of the complex structures of the classifying organisms themselves. For instance, some interrelatings of properties rather than others produce figure-ground perceptions that provide greater ease of recognition and interest, that in turn produce conditions for the movement, sustenance and survival of the organism.

The organism must be selective, and reject or ignore most of the interactivities and interrelatednesses that exist in nature. It would not survive if it tried to accommodate in its classifications the endless variety of interrelatednesses in nature. It does not follow, of course, that the unselected interrelatednesses are not just as real as the selected ones. Nor does it follow that there are not limits to the scope of interrelatednesses. Square pegs and round pegs do not fit the same way into square or round holes. Furthermore, some relationships of properties simply do not obtain as, for example, those required for the existence of a unicorn.

Believing what is false may be helpful for survival and even necessary to it. There seems no *a priori* limit to place on this. But let us take the more optimistic view that the human organism has one of the best classificatory mechanisms that nature can provide, a mechanism that may be used for discovering at least something of what is basic in nature. This mechanism includes both perceptual classificatory capacities and extrapolatory (from perception) capacities. The extrapolatory capacity is used to fashion explanations of the more complex and directly observable in terms of the simpler. That is, complex things with their complex properties and complex interrelations as various wholes may be explained by reference to their having a composition or constitution of simple/simpler parts with simple/simpler properties and relations that are not directly observable.

I shall explore the nature and consequences of this model, but first I want to examine the notions of wholes and parts and of levels of being and levels of explanation.

It must be evident, even to the ontologically timid, that where the simpler parts, properties and relations go so must go the complex wholes. Yet it appears that there has been confusion about the relationships of constituents of a system to the system, or of constituents of a whole to the whole.

John Searle has very clearly expressed a position that imports levels of being and causality between constituents and wholes, and between macros and micro levels (Searle 1992):

There is nothing mysterious about such bottom-up causation; it is quite common in the physical world The solidity of the piston is causally supervenient on its molecular structure, but this does not make solidity epiphenomenal; and similarly, the causal super-

venience of my present back pain on micro events in my brain does not make the pain epiphenomenal.

My conclusion is that once you recognize the existence of bottom-up, micro forms of causation, the notion of supervenience no longer does any work in philosophy. The formal features of the relation are already present in the causal sufficiency of the micro-macro forms of causation.

The question to be asked is a simple one. It is not apparent how things that are identical with constituents of a whole thing have effects upon the whole that includes themselves. It is no better to speak of top-down causality. There the question would arise, "How does a whole thing that is constituted of its constituents cause something concerning what it is constituted by?" The constituents that are being affected by the whole must be part of the cause upon themselves. Added to this is the obvious problem of apparent over-determination occurring at each and every level. That is what is "mysterious about such bottom-up causation" or top-down causation and what is *not* "a straightforward matter".

This arises from a failure to consider *all* of the constituents with *all* of their interrelations and interactivities, actual *and* potential, for one another and whatever may be external to them with the varying degrees of stability of all of these, allowing, of course, for some degrees of addition or subtraction, alteration, configuration, or even qualitative alteration within whatever rough limits are applicable as limits for being that kind of whole.

When a whole is considered as over and above all of its constituents with all of their interrelations and interreactions and dispositions for these, that is to consider "over and aboveness" of the whole as a causal factor apart from anything concerning the causal operativenesses of any or even all of the constituents. Amongst its effects, it is supposed that there will be effects upon its constituents as well as effects upon other things that cannot be traced to the causal operativenesses of any or even all of the constituents. That is what is commonly meant by "top-down causality". "Bottom-up causality" also applies an over and aboveness notion of the effect of the whole in addition to *all* of the effects of the constituents upon one another and whatever is external to them (with all of the effects of acquiring *further* dispositions).

This doubtful invocation of levels of being with duplicated causes and effects at each level is tempting only because compositionalist accounts tend to be grossly inadequate. This over and aboveness of wholes to their constituents, however, becomes totally incomprehensible when the roles of the constituents are given their fair due in a well-developed compositional model. What are *ordinarily* called "collections" or "wholes" or "objects" can be added to, subtracted from, have substitutions made, or be changed in their properties (heated or cooled, for example) with linguistic propriety.

Attributing such things to a whole or an object is not inconsistent with attributing continuing identity. One must *avoid* a use of the term "identity" such that any entity over time can be said to lack continuing identity simply because it has changed properties or has lost some parts or added or had substituted some parts.

The old example of the statue not just being the ultimate constituents of clay is grossly misleading. The sculpture *is* just the clay constituents with a certain conformation of shape and size within rough limits of allowable deformation and loss, addition or change of properties of the constituents with the further condition of having an intentional formative action of an agent or agents that themselves have a compositional account.

In order to make *sense* of what kind of compositional account will work for what kind of whole or object, we must first decide the spatial-temporal bounds and properties and relations of what we are designating as a whole or an object and what capacities for affecting and being affected by *other* actual and possible things and what degrees of allowable loss or gain or substitution of parts and alterations of their properties there can be. *Then* and only then can we make the beginning toward plotting the spatial-temporal bounds of the constituents with their allowable range of interrelations and interreactions, and capacities or dispositions of these, with one another and whatever may be external to them with allowable degrees of stability and loss, gain, and substitution and alteration concerning the properties of the constituents for the relevant whole or object to be rendered without remainder in terms of those constituents.

When suitably formulated, the compositional model expresses the thought (a) that there are not levels of being (or, rather, there is only one level of ultimate constituents), although there are levels of description and explanation (cf. pp. 25–28) and also expresses the thought (b) that the constituents in *all* of their interrelatednesses and interreactivenesses *and* their dispositions for these with one another *and* with whatever may be external, in all of their varying degrees of stability, do fully constitute and together *are* the whole (admitting some additions and subtractions and alterations of properties and configuration suitable for being that kind of whole). Nothing less than this will do as a compositional model.

This is to think that if the properties and relations of entities that we are considering are complex then the entities must have simpler constituents and their properties and relations must be simpler. The *ultimate* constituents are best left to theoretical physics to detect, though the completeness and correctness of the descriptions given to them may be suspect.

This general way of talking about the properties of ultimate constituents (elementary particles or aspects of fields or superstrings, etc.) is not affect-

ed by Nancy Cartwright's (Cartwright 1983) or Bas van Fraassen's (van Fraassen 1980) doubts about our present or even future capacity to develop a complete and true physics. *Whatever* (known or unknown) properties the ultimate constituents of nature have they are no more *purely* qualitative and in "pure act" than any more macroscopic or structural properties. (I shall take it as obvious that any structural property involves dispositionality and therefore cannot be used to "explain" dispositionality.) The properties of even supposedly elementary and non-structural particles themselves must be capable (at any time or space time segment) of more than they manifest. This is sometimes expressed (not happily, I believe) as possible world lines.

Any account of properties and dispositions whose concepts excluded application to the domain of elementary particles or fields or strings, etc. would be grossly deficient. Perhaps it is useful to see (*without* any scientific theory of their nature) why it is rationally inescapable to believe in their existence.

The reasonable belief in the existence of what were called "insensible corpuscles" in the 17th century and unobservable "atoms" before that does not depend upon a well worked out or even badly worked out scientific theory of their nature.

- (1) The first stage is to grasp the notion of composition in which a whole of a particular kind is supposed to be composed of and completely constituted by and is no more than parts of different kinds in various relations. The individual parts of a chair are not chairs, the individual parts of curry are not curry, and the individual parts of a tree are not trees.
- (2) The second stage is to grasp that things get larger by addition of parts and get smaller by loss of parts.
- (3) The third stage, with this knowledge, is to note that a tree gets larger and a ring, worn for a long time, gets smaller indiscernibly. That is, no matter how closely one observes the tree or the ring one cannot observe an increase by addition of parts or a decrease by loss of parts.

Spurning an explanation in terms of expansion as with a balloon, the thought of increase in size by the addition of unobservable parts of different kinds in various relations so as to constitute the tree is an understandable thought and a reasonable belief, and we do not have to think of observable entities or observable parts of entities as *plena*.

All of this is accomplished with no theory of the nature of these unobservable parts of things. That much, and it is a great deal, is not threatened by the doubts raised by Cartwright, or even by van Fraassen, about how much we can know about what Locke called “the finer interstices of nature”.

The bearing of developments in theoretical physics upon our views of things taken at the level of “ordinary” observation of and language about the macroscopic world is made graphic, for example, by the discordances between the “scientific image” and the “manifest image” (in the phrases of Wilfred Sellars) of color.

My first encounter with that kind of discordance occurred when, at the age of nine, I attended a public lecture by a physicist. He said that the objects we see, such as a table, were composed of parts called “particles” that were far too small for us to see or feel. These particles had far more space between them than the space they occupied. He went on, to my further astonishment, to say that these part-particles were of *many* kinds making up the objects and these particles were *moving*, constantly, at very great speeds. I thought the physicist mad and, on the instant, resolved never to attend a university where such nonsense occurred.

Then the physicist went on to say that it was as if we couldn’t get close enough to be almost within the swarm of particles with senses very different and sharper, rather like being at a great distance from a swarm of bees the swarm can appear as a solid object until one gets very close.

Persuaded by this clumsy analogy, the excitement of the thought set me, on the instant, to resolve to attend university where such matters were discussed.

I had, as others in the audience as well, a view of the solidity of things as some kind of *plenum*. That was why what the physicist said was so shocking at first. I gave up this view of solidity *qua plenum* from that moment.

When I was a graduate student at Cambridge, the dispute between Eddington and Stebbing about the solidity of a table was discussed. Eddington claimed that theoretical physics refuted our ordinary view of the solidity of a table. Stebbing disagreed, arguing that our ordinary view was inviolate because “If I drop a piece of paper on the table, it doesn’t pass through it”. I thought that Stebbing had missed the whole point. The point was that the ordinary implications that people make of “solidity” as implying a *plenum* turned out to be *false*. True enough, there are other ordinary implications of “solidity” such as that paper won’t just pass through the “solid” desk that remain true. I would claim that, often enough, the false implications and the true implications are wrapped together in how we think of the

solidity of things. That explains the shock (as Stebbing can't explain) of my younger self and others in the audience by what the physicist said.

Faced with some of the more mind-boggling theories of modern physics, one's most basic concepts are up for at least enough bending and twisting to allow intelligent consideration of what is being proposed.

It should be emphasized that even in terms of the most anti-intuitive amongst seriously considered hypotheses of physics there is something like a relative retention of edges of boundednesses. That is, there would be relative degrees of density of populations of particles (or aspects of fields) and relative degrees of stability of that density of such populations (or field-aspects). This provides an analogue at the level of elementary particles (or field-aspects) for the sizes and shapes and the edges and continuance and movements of macroscopic things and therefore a further reinforcement of a realist compositional model for the relationship of the macroscopic and the sub-microscopic.

None of this should suggest that the philosopher should react with dumb faith to the latest and changing revelations from theoretical physics or by an arrogant disbelief or a "That's what they say *now*" cynicism. It should incline philosophers to a greater alertness to alternative ways the world may be.

Ontology is the setting out of an even more abstract model of how the world is than that of theoretical physics, with *place-holders* for scientific results and some *excluders* for tempting confusions. Ontology and theoretical science can help one another along with, we hope, minimal harm.

This compositionism need not be Scientism. It leaves it open that the methodology of actual science has very naturally led to an incomplete and partial account of the finer interstices and constituents of nature. This will be discussed in a later section.

3. DISPOSITIONS

At the start, it will be helpful to get some terminology straight.

Picking one term to do all the work that my use of the term "disposition" is supposed to do is asking a lot of any single word. Some explanation may help to show that the choice of words has not been thoughtless.

The difference between capacities and dispositions disappears once one asks, "Under what conditions (reciprocal disposition partners) would the capacity be *exercised*?"

Capacities are capacities *for* (dispositions for) their exercises or fulfillments (manifestations) under certain conditions (reciprocal disposition partners).

The differences in circumstance of usage between “capacity”, “tendency” and “proclivity” is in what is considered to be the degree of availability or proximity of (spatial or temporal) reciprocal disposition partners or perhaps the degree to which there is the *start* of a process toward a result that would need the *loss* of reciprocal disposition partners or the *introduction* of a reciprocal prohibitive disposition partner to stop or interfere with the culmination of the mutual manifestation.

“Capacity” can also be used as the most non-specific indicator of a disposition’s reciprocal disposition partners for mutual manifestation.

I will continue to use the terms “disposition” and “manifestation” as the basic causal terms.

Expressing the qualitativity and dispositionality of any real property merely as “a way of thinking of, mode of predication concerning, way of regarding, looking at, etc.” suggests that it is merely in the eye or voice of the beholder. If the users of such deontologizing expressions wish to claim such anthropomorphism then the users should make *that* ontology fully explicit. If the users do not wish to endorse this anthropomorphism then they should join in the task of saying clearly *what* in the world the expressions indicate.

Dispositions come in at least three classes:

- (1) Dispositions such as solubility are such that what is soluble when the solubility is manifested, by its going into solution, then ceases to be soluble. However, what is in solution can be recovered from the solution and becomes soluble again.
- (2) Dispositions such as explosiveness are such that what is explosive when the explosiveness is manifested, by its being exploded, is not recovered from the explosion and does not become explosive again.
- (3) Dispositions such as the soundness of a bridge are such that what is sound when the soundness is manifested, by its performing soundly, does not then cease to have soundness.

I shall mainly be concerned with dispositions in the third group.

All intrinsic properties are dispositional, and dispositionality is fully real and actual. Dispositions can be actual though their manifestations are not. The properties of elementary particles or spatio-temporal segments of fields are not structural states. Yet such properties are not in pure act, that is,

manifesting at each moment or temporal stage all of which they are capable. They have dispositions, not all of which they are always manifesting, and, in the nature of the case *qua* elementary particles, their dispositionality is not explained in terms of properties of their constituents.

I have given arguments (Martin 1994) against explaining dispositions in terms of counterfactuals and will not repeat those arguments here.

Trying to account for dispositionality in terms of structural states is misguided, not only because what is structural is *evidently* intrinsically dispositional *itself*, but, more importantly, because the issue can be more clearly discussed in terms of *non*-structural properties.

A great advantage to discussing properties at the non-structural, non-macroscopic, elementary particle or elementary aspects of fields level is that one can avoid some reduction vs. non-reduction debates.

Discussion at a structural or macroscopic level is vitiated by debate concerning whether the properties at the higher level are anything over and above properties at a lower level with the usual gesturing toward all of the many varieties of supervenience that are at best ontologically useless and at worst misleading. Discussion at an elementary particle level (even with epistemic qualms) stops the moves to attempt to account for the properties in terms of still other properties at a *lower* level because (if we are epistemically lucky) there *aren't* any!

I devised the following case in the mid-1950s as a counter-example to verificationism and later as a counter-example to many reductive accounts of causal dispositions including Quine's account in *Word and Object*. According to Quine, an unmanifested disposition is explicable in terms of an object having a structure similar to a structure of an object that has *manifested* the supposed disposition.

The case is one of a cosmic geographical fact concerning the spatio-temporal spread of kinds of elementary particles. It is supposed that there are kinds of elementary particles in some spatio-temporal region of the universe such that they are different from the kinds of elementary particles of our own region and the regions are so vastly distant that the many special dispositions they have for intercourse with one another *never* have and never will have their very special manifestations and nothing else in the universe, in the nature of the case, is *like* them that does have the manifestations. Yet they have causal dispositions ready to *go*. The dispositional is as real and irreducible as the categorical. (Or, as I would prefer to say, the dispositional is as real and irreducible as the *qualitative*. Talking of the distinction as being between the dispositional and the categorical can suggest that dispositional is not really categorical: not really "there" in the object.)

A very devoted Quinean replied, “And if pigs had wings they would fly.” When I complained that he didn’t know any better than I did that this wasn’t a *true* case, he responded, “And if pigs had wings they would fly”. (I did not have the wit on the occasion to point out that somewhat irrelevant truth that if pigs had wings they *still* wouldn’t fly.)

Cause and effect itself should be explained in the more basic terms of the Mutual Manifestation of Reciprocal Disposition Partners. Dispositionality and Manifestation are well equipped to deal with elementary particles, because even a quark is capable of more than at any time it manifests given different reciprocal disposition partners. Start with any disposition partner and you find a network – a Power Net. (This should be useful in the characterization of non-local causality, if needed in physics.)

Any disposition is one amongst many alternative reciprocal disposition partners for some mutual manifestations.

A typical causal situation is Locke’s case of the turning with a particular force a key of a particular shape, size and hardness, etc. in a lock of a particular shape, size and hardness, etc., that is showing a particular force of resistance or lacking of resistance, etc. to the key for their *mutual* manifestation of an unlocking.

The reciprocity of dispositional states for their mutual manifestations that are their *common* product is deep and complex. This reciprocity should not be expressed in terms of unhelpful distinctions such as power to give vs. power to receive, agent vs. patient, active vs. passive, causal conditions vs. standing conditions. What? – Standing *by*?! Instead, *whatever* is causally operative should have its full status as Reciprocal Dispositional Partner for a Mutual Manifestation.

The important point is that for the manifestation of *one* dispositional state it will need to be a reciprocal disposition partner with some other dispositional states amongst its reciprocating partners, *if they exist* and are in the relevant relationship. The lighting is a mutual manifestation of the dispositional state of the match that needs to be a reciprocal partner with the cooperation of the reciprocal disposition partner of the enfolding oxygen amongst a great deal else.

This view of the innumerable interconnectednesses and dispositional reciprocities of properties, largely unknown but existent still, contrasts with the simple-minded view that because nature does not lay out *The Cause* of each event, causality itself is mind-dependent.

A dispositional state is *there* in the most simple or complex physical instances or psychological instances. It is there to provide the relevant richness of alternative manifestations with its multiple alternative reciprocal disposition partners, some of which would be mutually exclusive

in their actualization but *ready to go* for present, distant, non-existent, or even *never-existent* manifestation conditions, that is, reciprocal disposition partners.

With reciprocal disposition partners *each* being for the *mutual* manifestation, *each* must have the directedness and selectivity *for* such a manifestation. If, by misfortune one or more partners do not in fact *exist*, the reaching out and directedness and selectivity *for* their manifestation is fully contained in the existent partner.

Water has a directedness of a dispositionality as solvent *for* salt and *not* gold even without the existence of salt for the *mutual* manifestation of a coming into a solution of salinity. And salt has a directedness and dispositionality as soluble in water and *not aqua regia*, even without the existence of water for that same *mutual* manifestation of a coming into a solution of salinity.

You need an existent reciprocal partner entity having the directedness of an existent disposition but *any* existent reciprocal partner is sufficient and does not need the existence of its other reciprocal partners for the existence of its directedness to what would be *their* mutual manifestation.

4. FORMS OF INFINITY

1. The Disposition (D) of a *particular* thermostat is directive and selective to a *particular* furnace to which it is connected at t_1 P_1 *for* the *alternative mutual* manifestations of degrees of change in heat *with* alternative reciprocal disposition partners of a cat's tail or falling plaster or coat sleeve of the butcher or the tail of a unicorn or . . . altering the set point of the thermostat. This appears to be infinite.
2. The D of a quark is directive and selective *for* the mutual manifestation of a *particular* kind with particular kinds of reciprocal disposition partners of various *arrangements* of its quark cousins, *wherever* or *whenever* they may be. It has its disposition readiness for them, *even* if they were to cease to exist. This appears to be infinite.
3. The D of a quark is directive and selective *for* the alternative mutual manifestations of *various* kinds with alternative kinds of reciprocal disposition partners proximate, distant, unreachable and of kinds that even may not exist. This appears to be infinite.
4. The D of anything probably isn't at all places and times. So, it will be finite in duration and extension. But the infinity of directedness and selectedness of any D is from the *Here and Now* to an infinite number (anywhere, anytime) of reciprocal disposition partners of a particular kind for a particular kind of mutual manifestation or for any number

of reciprocal disposition partners (actual and non-actual) of different kinds for different kinds of mutual manifestation. Duration of a D helps verification but that is irrelevant to the ontology.

5. DISTINGUISHING DISPOSITIONALITIES

There cannot be exactly similar dispositional states in exactly similar reciprocal partnerships for different mutual manifestations.

If the dispositional states are *complex* then in a way there can be different dispositional state partners that have similar mutual manifestations. That is, amongst the different aspects of the mutual manifestations there can also be similar aspects.

It is clear that the same dispositional state can have different mutual manifestations with different reciprocal disposition partners. For example, the same water thrown on burning wood or burning oil on water has very different consequences (see below).

What we tend to select as “the” dispositional state for a particular kind of mutual manifestation is the reciprocal disposition partner that has the greatest stability and availability to its varying reciprocal disposition partners or, more trivially, that is merely of greatest interest to us.

What a dispositional state is depends not only on with what alternative partners it is for but also upon with what alternative partners it is not for or even prohibitive against.

6. NO DISPOSITIONAL STATE IS BOUND TO ITS MANIFESTATIONS INDEPENDENTLY OF ITS POSSIBLE DIFFERING RECIPROCAL DISPOSITION PARTNERS

The concept of reciprocal disposition partnership for mutual manifestation loosens the simplistic linguistic bondage of a specific and unique dispositionality for a specific and unique manifestation. Instead, it allows that the *identical* dispositional state with *different* reciprocal disposition partners can have *different* mutual manifestations.

The same dispositional state will vary in the nature of its manifestation as it plays its role as reciprocal disposition partner in varying mutual manifestations with its varying reciprocal disposition partners. The differences can be striking.

Water thrown on burning wood and water (identically the same) thrown on oil burning on water has strikingly different mutual manifestations because of the difference between the reciprocal disposition partners in the

burning wood and the oil burning on water. In wood fires, water acts as an extinguisher by (a) effectively covering up the microstructure of wood, sealing it from the oxygen needed to advance the combustion through the wood, and (b) generating steam and otherwise absorbing the thermal energy that is required for the combustion to advance through the wood. In the case of an oil fire, water (a) does *not* seal the oil from the air, but rather sinks underneath the oil, but (b) does absorb some of the combustive thermal energy – however if the water reaches its boiling point, steam will quickly rise through the oil with such kinetic energy that it impels oil particles into the air, thus radically increasing the aggregate exposure of carbohydrates to the oxygen, which radically increases the rate of combustion (which can in turn increase the quantity of steam generated, thus creating an explosive positive feedback loop). This effect is obviously just the opposite of the reduction of carbohydrate exposure to oxygen in the wood case. *The shared disposition is the water's tendency to absorb thermal energy, to the point of creating steam.* In one case the steam helps extinguish the fire while in the other it exacerbates the fire. Thus one disposition manifests itself in two radically different ways given different reciprocal partners.

The manifestation subsequent to neurotransmitter release from the pre-synaptic neuronal membrane can be excitatory, inhibitory, or neutral according to the dispositional nature of the receptor sites in the post-synaptic membrane. The receptor sites may allow entrance of calcium ions (excitatory), chloride ions (inhibitory), or they may be masked (neutral). Variation exists within these categories as well. The capacity state of the synapses from the pre-synaptic membrane remain, of course, exactly the same with identical dispositionality. The only difference lies in the difference in their reciprocal disposition partners (the receptors in the post-synaptic cells) allowing differences in their *mutual* manifestations.

This becomes particularly obvious in mental cases. A smiling can be a reciprocal partner for very different and indeed *opposite* mutual manifestations according to which of its alternative reciprocal disposition partners are present and involved.

A disposition can have antagonistic reciprocal disposition partners that even extinguish it or block it.

7. MANIFESTATIONS ARE DISPOSITIONAL TOO

In thinking of how to give an account of dispositions, it could be tempting to treat manifestations as themselves disposition-free, or at least not to *raise* the question of their dispositionality. This would be a gross error. Salt manifesting its solubility in water by the manifestation of dissolving

can be such only if the salt in solution is *recoverable*. Whatever is involved in the manifestation event *itself* is not in pure act, that is, manifesting *everything* of which it is capable.

One cannot hope for disposition-free manifestations.

It becomes obvious that dispositionality is prior to and more basic and far more numerous than their mutual manifestations, that is causes and effects. A particular kind of cause and effect may not exist though the relevant dispositions *do* exist but a kind of cause and effect can't exist if the relevant dispositions do not exist. So ontological priority and candor require cause and effect to be explained in terms of reciprocal disposition partners in their mutual manifestation and not *vice versa*.

A manifestation of a dispositional state should be seen in *depth* as the tip of the disposition iceberg at the *time*, rather than looking to a temporal spread of apparent manifestations perhaps for epistemic purposes. This leads to the concept of Correlativity of Disposition and Manifestation.

Manifestations and dispositions are correlative. A manifestation is what it is only as *from* a relevantly deep enough and broad enough Disposition Base Array, and a Disposition Base Array is what it is only as *for* kinds of alternative manifestations under alternative kinds of conditions.

8. DISPOSITIONAL DEPTH

An infatuated lover thinks he hears his lover say, "I believe she will come" and he instantly leaps to agree, saying, "Oh yes, I think she will come". The lover coolly replies, "I said, I didn't think she will come" and the infatuated lover sputters (*all* of this, as it were, with sincerity), "Oh yes, yes, I mean, I meant that she won't come".

One may say that the manifestation does not come from a deep enough, strong enough disposition base.

9. DISPOSITIONAL BREADTH

A child is being taught the ten times table and is told that $10 \times 2 = 20$. The child is bright and of a strong, determined nature and instantly learns to at least *say*, " $10 \times 2 = 20$ " under many conditions. He has the *saying* of it from a deep disposition base. However, it lacks breadth. The child does not know *any* arithmetic, like another child who, when asked what $2 + 2$ makes, replies, "I don't even know what 2 makes". So, with the first child one may say the disposition base has depth but lacks breadth.

It will help to consider a non-mental case. How are we to think best about the *soundness*, in the sense of being made to last, of the bridge's standing up when a truck crosses it? Is it *just* that the bridge bears the stress, without deformation, of the truck crossing it? Or is it that what is needed are many different kinds of events interrelated to the one in question in which the bridge, over time, in many ways bears stress without deformation? That cannot be so. We know that the *one* occasion of bearing the stress is not enough simply *in* itself and yet we also know that it doesn't *need* those other stress-resistant events actually to occur for the bearing of the stress on the one occasion to be that of doing so *soundly* in the sense required. It should be something about the bridge on the occasion, and that should not be the Rylean disposition *halo* of the counter-to-the-facts-fact about the bridge.

We are able to think of the bridge's standing up soundly on that occasion as a manifestation of the soundness of the bridge as embodied in the stability of its sub-structures (with nothing built in for untimely deterioration or breakage, etc.), *rather* than divine interference or the purely accidental proppings up of a happenchance wind-carried piece of gravel, etc. The soundness of the bridge can, then, in terms of its actual disposition base, quite understandably, be there in *full* for only 1/10 of a second if a hydrogen bomb blows up the bridge. More might be needed *epistemically*, but that is irrelevant.

Michael Dummett (1979) gives an ill-chosen example of a capacity, that of "Good at learning foreign languages". This is a poor case because it is tied to performance. The case should be "capable of learning foreign languages easily", which could be said of those who in fact never get around to learning a foreign language but their facility with their first and only language suggests, rightly or wrongly, the further capacity for acquiring foreign languages.

If attention is focused *only* on the manifestation (whether the case is mental or non-mental) or even on a number of manifestations, to provide the richness of directedness and selectedness that has occurred, then attention is focused in the wrong place, where we *know* we can't find what we are looking for. This is reinforced by the unfortunate disjunction "dispositional or occurrent" applied to propositional attitudes such as believing and having a thought, desiring, etc., that suggests that in the *occurrence* of the sounding of a word or making an inscription or visualizing or having the "Aha!" experience or saying in one's head, "Oh, dear me, *yes*" (fill in the occurrence any way you like), *somehow* the whole relevant aboutingness is *there*. Yet, whatever *occurs* is consistent with a different aboutingness or "expressive potential" being possible or even none at all. Everybody knows

that, but the implications must be faced and an explanation given. Namely, if it is not and *cannot be there*, then you should not make a problem or a mystery of not *finding* it there! Then where *is* it? On the particular occasion what else *is* there? It has been shown to be in the depth and breadth of the actual disposition base from which the manifestation comes, whether the case is non-mental *or* mental, and in the correlativity of manifestation *from* and disposition *for*. The richness consists in the actual disposition being *for* an indefinite number of (but not just *any*) alternative manifestations with alternative reciprocal disposition partners and its specificity consists in what the disposition is *not* for or may even prohibit.

10. DISTINCTION BETWEEN NOT HAVING A DISPOSITION FOR SOMETHING AND HAVING A PROHIBITIVE DISPOSITION AGAINST IT

Any disposition or Readiness Potential, mental or *non*-mental, simple or complex, is *for* an infinity, within limits, of *alternative* manifestations with an infinity, within limits, of *alternative* reciprocal disposition partners actual and *non*-actual, present and absent and even never-existing. The *limits* of directedness are *set* by the still greater infinity of manifestations the disposition is *not for* as well as the manifestations it *prohibits*. This is the ontology of the specificity of dispositionality.

A difference can be drawn between:

- (A) *not* having a disposition for manifesting x

and

- (B) *having* a disposition for *prohibiting* x.

The distinction is essential to understanding the constraints and limits of the infinities.

This difference is one between

- (A') a state or entity simply not having a disposition for a particular kind of manifestation, though there is nothing about the state or entity that would require alteration for its addition

and

- (B') a state having a disposition that is prohibitive against a particular kind of manifestation such that it would require *alteration* for the addition of the disposition that is prohibited. An example would be of a square peg that is disposed to prohibit fitting in the way a round peg would in a round hole.

One should see that the dispositionality *for* a set of manifestations *other* than some other set of manifestations is in virtue of what it is *not* for or even *prohibitive* against manifesting. This is the basic ontology for setting the *limits* of the infinities of directiveness and selectivenesses of the disposition whether the dispositional states are psychological or *non*-psychological, and even whether they are systemic or non-systemic (e.g., elementary particles).

Seeing the richness of correlativity between manifestation and disposition, one can understand how thought can be an indivisible unity though only partially expressed. The manifestation fragment gets its fullness of import by being *of* a deep enough, broad enough, relevant disposition base array. That is for an infinity of alternative manifestations with alternative disposition partners – an infinity within limits.

It can be seen just how the disjunction Occurrent or Dispositional Belief is clumsy and superficial. What is occurrent is some manifestation fragment that can have the specificity and richness of its import *only* by being *from* the richnesses of the disposition base array of which it is the manifestation.

11. NON-MENTAL DISPOSITIONS AND THEIR KINDS OF DIRECTEDNESS

Causal dispositions are directive and selective, that is, they are dispositions *for* and *to* some kinds of things *rather* than others, and, so they are, whether physical or mental, in their very *nature* directive, projective, discriminatory readinesses *for* and *to* what is external to themselves (Martin and Pfeifer 1986).

The disposition can be *for* what may never exist – the fit of a particular lock for a non-existent key or a substance soluble in a solvent that does not exist in nature and whose manufacture is simply too expensive and so never gets made, and, finally, there may be some fundamental particles irreducibly different in kind from one another that are disposed for reactions to one another but fail to ever manifest such reactions because of cosmic space-time separateness.

A non-mental dispositional state needs, *just* as much as does a mental state, to be characterized in terms of *that* to which the state is directed, which may or may not be present or even exist.

Just as a belief needs *content*, namely, what would follow the “that” in “belief that . . .” so a disposition needs a *what-for*, namely, what would follow the “for” in “disposition for . . .”, e.g., “disposition *for* dissolving in H₂O” (and *not aqua regia* or xyz).

A non-mental (as well as mental) dispositional state may be directive in a way that is indeterminate in reference to a particular individual or in a way that is determinate (to a *particular* individual) in reference.

A particular hen has or has not a set of dispositions and capacities for laying *an* egg (not any *particular* egg) and furthermore, the hen may have a set of dispositions and capacities for laying a *particular* egg provided by the causal context (e.g., the *one* egg that has actually begun to form). Externalism (and “broad content”) may unarguably enter where the directedness is to a *particular* entity, uniquely provided in the physical context, rather than to just *anything* that happens to be of a particular kind.

Holding a belief or having *understanding* (or kindness, for that matter) can be “holistically” and “fully”, at a *particular* time, *in* the head, without magic, as well as *soundness* can be *in* the bridge at a *particular* time, namely as an actual disposition-state array that may or may not have actual manifestations at the time *or* ever.

The *correlativeness* of a disposition-manifestation is such that for something to *be* a particular kind of manifestation it must *come* from a relevant deep enough, broad enough disposition base, and for something to *be* a disposition base it must be *for* alternative kinds of typifying manifestations. Nature comes in package deals, or power-nets. The dispositionality for a set of manifestations will also be *not* for or prohibitive against an infinite number of *other* manifestations. Recall that this is how ontological limits are set upon the infinities of directiveness and selectivenesses intrinsic to each dispositional state, whether simple or complex. It should also be remembered that manifestations are dispositional states in their own right.

So dispositions or Readiness Potentials exist embodying programs for and *not* for and even prohibitive against an infinity of manifestations under a limited scope as described above. This account of the dispositional as directive and selective readinesses with the Correlativeness of disposition and manifestation is such that the *manifestation* “carries” the richness of the disposition base it is *from* or *of*. It is *natural* that so little can carry so much. Every disposition is in this way a holistic web.

How far the richness of such a model can go in its use to explain modalities and rule-following in mathematics (*contra* Saul Kripke) needs further explanation (Martin and Heil, forthcoming).

With externalism running riot in semantic circles, it should help to see that even in the simplest form of directedness, through the dispositionality of the simplest non-mental property of the simplest non-psychological entity, the directedness can be internalist and narrow. Projectability to any-of-a-kind-x-that-may-come-along is satisfied *within* the entity itself by its dispositional states and obviously does not require that the dispositional

states *themselves* have anything x-like as their “typical cause”. Indeed, nothing x-like may even exist. But that is how it goes with *any* reciprocal disposition partner whether the dispositionality is *in* the observer or *in* the environment. This directedness is intrinsic to non-mental as well as mental dispositions and it is clearly narrow, that is, it goes from inside to outside. It would be outlandish to go against nature itself and deprive the directedness and selectiveness of mental dispositions of such a *natural* narrow and internalist inside to outside function. An externalist or broad account, going from outside to inside, is also readily available for the directedness of a dispositional states toward an *individual* rather than just to anything similar in kind. In such a case the *individual* x must be in an actual causal network such that it is the *only* thing of the kind x that can serve as a manifestation condition (reciprocal disposition partner) of the dispositional states.

In the concepts of “reciprocal disposition partners” and “mutual manifestation” a way can be seen to bridge the narrow content-broad content gap. The physical environment and the individual human mind should be considered to be *reciprocal* disposition partners for the *mutual* manifestation of perception. The reaching out comes from *both* sides of the partnership in their mutual manifestation.

The externalist and the internalist both miss the point. The *directedness* (ready to go) to the mutual manifestation of perception is found in *each* disposition partner whether state of a perceiver *or* state of the environment *even* if the other does not exist! And both are needed for the actualization of the perception that is their *mutual* manifestation.

It is clear that forms of directedness and selectiveness are free gifts of non-psychological nature and should *not* be asked for all over *again* at the psychological level. It will, of course, need further work to discover what *more* is needed to make the directedness and selectiveness *mental*.

Given a realist view of dispositions as fully actual even without the actuality of their manifestations or their reciprocal disposition partners, a purely dispositional account of properties has a degree of plausibility. This plausibility is enhanced by the impossibility of characterizing any property as purely qualitative, that is, as existing without any implications of dispositionality. I shall argue, however, that in the end, it is equally implausible to characterize any property as purely dispositional.

12. PROPERTIES ARE NOT ONLY DISPOSITIONAL

Sydney Shoemaker (1981), James Fetzer (1981) and Hugh Mellor (1974, 1991) have been recent proponents of the claim that a property is identi-

cal with its causal powers. Take for example the following passage from Shoemaker (1981, p. 332):

Suppose, however, that all of their causal powers and potentialities, all of their dispositions to influence other things or be influenced by other things, were exactly the same. Then, I suggest, they would share all of their properties in the narrow sense, all of the “intrinsic” properties. Likewise, when I say that the loss by my pencil of the property of being fifty miles south of a burning barn, or the property of being such that Gerald Ford is President, is not a real change, the cash value of this is that the acquisition or loss of these so-called properties does not in itself make any difference to the causal powers of a thing. This suggests a view about what intrinsic properties, properties in the narrow sense, are. According to this view, what constitutes the identity of such a property, what makes it the particular property it is, is its potential for contributing to the causal powers of the things that have it If we could indicate all of the ways in which the having of this property could contribute to the causal powers of things, we would have said all there is to say about the intrinsic nature of this property. Such, at any rate, is my suggestion.

Before evaluating Shoemaker’s purely dispositional account of properties, let us consider a more general point. A lack of candour beset the statement of some of the great reductive ontologies such as phenomenism, and behaviorism, and also operationalism. The vocabulary used in presenting these theories discouraged a clear view of their ontological commitments. I am not trying to push these views into giving translation or logical entailment accounts. I am perfectly happy if they scrub up their vocabulary and then just add “etc.” Then the doctrines will at least be ready for consideration.

(a) Phenomenalism got away with:

For “There is an *x* in the next room”: “It would tend to look *x* to me if *my sensory capacities were in good working order and I were to go into the next room and view in the direction of x* etc.” The italicized part of the sentence is not expressed in terms of the basic terms of the ontology. When the candid attempt is made to do so and to scrub the vocabulary clean — that is, to reformulate the putative analysis in purely phenomenal terms — its anti-intuitiveness becomes apparent.

(b) Behaviourism got away with:

For “I am having mental imagery of ‘Greensleeves’ as played by Glenn Gould”: “I would behave *as if hearing* Glenn Gould play ‘Greensleeves’, or, by saying *sincerely*, if I *thought* the occasion called for it, that it was as if Glenn Gould were playing ‘Greensleeves’, etc.”

Again, the italicized part of the sentence is not expressed in terms of the basic items of the ontology. “Hearing”, “sincerity”, and “thought” are not behaviour terms. When the candid attempt is made to scrub the vocabulary clean, the anti-intuitiveness of the view becomes apparent.

The very same holds true of the Shoemaker–Mellor–Fetzer view that all which is intrinsic to properties is exhausted in their dispositionalities.

(c) *The Dispositionalist gets away with:*

For “x and y are equal in length”, “x and y are disposed to *fit* or not *fit* into the same *containers* in the same way ignoring their *width and weight*, etc.”

The story is no different than it is for Phenomenalism and Behaviourism. The need is to couch all of the vocabulary in terms of dispositionalities and only dispositionalities.

Let us demand maximum candour here. If properties are treated as only capacities/dispositions, let us have that up front. Explicitness is necessary in all ontological domains, but particularly in the domain of the mental because of the ambiguity of terms such as “behaviour” where *sensory* (therefore, sentient) feedback may be implicit. When stated explicitly, the Shoemaker–Mellor view is revealed to have the anti-intuitiveness of a reduction of all the properties of whatever the dispositions are for (namely, the manifestations) to just further dispositions themselves. What, on this view, is introspected as the very quality of the *feel* of the feeling of a kind of pain? Indeed, what, on this view, is the account of the (non-number) quality of length as directional spread seen or felt of a form of extension?

Your knowledge of the existence of physical x or mental y has to involve the causal set of dispositions of x and y to affect your belief that x or that y. That set of dispositions is specifically operative on that occasion for that belief. This, however, does not establish (*contra* Shoemaker) that the content of what you know or believe is nothing more than the set of causal dispositions or functions that make you or would make you believe x or y.

Dispositionalists believe that all that appears to be qualitatively intrinsic to things just reduces to capacities/dispositions for the formation of other capacities/dispositions for the formation of other capacities/dispositions for the formation of And, of course, the manifestations of any disposition can only be further dispositions for This image appears absurd even if one is a realist about capacities/dispositions. It is like a promissory note that may be actual enough but if it is for only *another* promissory note which is . . . , that is entirely too promissory.

The dream of either a purely qualitative, non-dispositional or a purely dispositional account of properties is philosophical fantasy. No property is in “pure act”, free of all unfulfilled potency unless it is a property of God (or perhaps the number 2). And no property is only its capacity for the production of further capacities for

It is my suggestion that the properties of entities that are constitutive of any state of affairs must be qualitative as well as dispositional, and dispo-

sitional as well as qualitative. They are correlative (Locke), complementary, inseparable, and covariant when they are displayed in their intrinsic and irreducible form at the level of the “finer interstices”.

What has been (misleadingly) called “The Limit View” (Martin 1994, p. 519) treats any intrinsic property not as a two-part compound of the purely qualitative and non-dispositional and of the purely non-qualitative and dispositional, but as a two-sided dispositional-qualitative coin. These cannot be abstracted as fully distinct and separable elements, but must be considered as unrealizable limits for different ways of being the same unitary property. Supervenience is not to the point. The dispositional and the qualitative are equally basic and irreducible; there is no direction for one being basic in a property and the other being “supervenient”.

The above characterization in terms of “different ways of being” is still too suggestive of a mixture. It is even more than necessary covariance (as in equiangular and equilateral). For any property that is intrinsic and irreducible, what is qualitative and what is dispositional are one and the same property viewed as what that property exhibits of its nature and what that property is directive and selective for as its manifestations. These cannot be prised apart into the purely qualitative and the purely dispositional. What is exhibited in the qualitative informs and determines what is the forness of the dispositional, and what is the forness of the dispositional informs and determines what is exhibited in the qualitative. There is no direction of priority or dependence. There is no reduction of one to the other.

The only way that this can be expressed is by claiming that the qualitative and dispositional are identical with one another and with the unitary intrinsic property itself. This is perhaps a surprising identity, but frequently it happens that different representations turn out to one’s surprise to be of the identical entity.

This claimed identity may be easier to see once one understands clearly that it is not a matter of one aspect being non-relational (the qualitative) and the other aspect being relational (the dispositional). This is because dispositionality is *not* a relation between what is dispositional and what is its manifestation. It is not a relation because the dispositional can fully exist and be “ready to go” with the total *non*-existence of the manifestation and the reciprocal disposition partners needed for the manifestation. Their absence or non-existence does not affect the readiness of the dispositional state such that *it* would have to alter in order to have its manifestations.

What is qualitative and what is dispositional for any property is less like a two-sided coin or a Janus-faced figure than it is like an ambiguous drawing. A particular drawing, remaining unitary and unchanged, may be seen and considered one way as a goblet-drawing and differently consid-

ered, it is a two-faces-staring-at-one-another-drawing. The goblet and the faces are not distinguishable parts or components or even aspects of the drawing, although we can easily consider the one without considering, or even knowing of, the other. The goblet-drawing is identical with the two-faces drawing.

It might be thought, however, that something could exist in a qualitative state but in no dispositional state. Perhaps we may be able to think of something that is totally inert and unchanging, but that is different from being without any dispositionality. A thing or property that is intrinsically incapable of affecting or being affected by anything else actual or possible is not merely a case of inertness: it amounts to *no-thing*.

Getting clear about what properties are determines the scope of the empirical question of what properties in particular there are or may be, including their qualitativity as well as their dispositionality, in either the physical domain (which includes “theoretical” entities) or the psychological domain.

13. DISPOSITIONS AND QUANTUM THEORY

Instead of measuring operations or observations one can speak of measures. Quantum theory has commonly been interpreted as encoding measurement predictions, and the unreducible indeterminacy of quantum “states of affairs” understood as unreducible probabilities (less than unity) stated in measurement predictions. This interpretation imposes an essential mind-dependence of quantum events described in the theory. The choice is whether to interpret the wave function as a physical continuant at all.

Arthur Fine has shown a fascinating vacillation in Schrödinger’s interpretation of measurement predictions as between referring to and not referring to the wave function as a real continuant. Fine (1986) describes Schrödinger’s laconic letter of 13 July 1935 to Einstein:

Schrödinger then proceeds to set out briefly what he thinks is going on; namely, that the classical physical model has in fact been abandoned but that instead of replacing it with another, one has simply declared all of its determinables to be exactly measurable in principle and in addition prescribed with wise, philosophical expressions that these *measurements* are the only real things, which is, of course, metaphysics. Then in fact it does not trouble us at all that our claims about the *model* are monstrous.

In such a mood (very different from the mood in which he attempted interpretations in terms of wavelength models), Schrödinger rejects all attempts to provide a model. Even the model of sparse and intermittent measurement events as the only “real” posits is described dismissively by

him as “metaphysical”. This vacillation provides few crumbs for ontologically hungry philosophers, whether realist, anti-realist, or something in between.

The drive to Pythagoreanism and the tendency to deprive properties of their nature may take the form of limiting basic physical descriptions to statistical or probabilistic claims concerning purported states.

Einstein (1949) stated this doctrine clearly, though with the strongest disapproval:

They [Born, Pauli, Heitler, Bohr, and Margenau] are all firmly convinced that the riddle of the double nature of all corpuscles (corpuscular and undulatory character) has in essence found its final solution in the statistical quantum theory. On the strength of the successes of this theory they consider it proved that a theoretically complete description of a system can, in essence, involve only statistical assertions concerning the measurable quantities of this system.

If what is claimed is taken seriously, and if this is not to be a Pythagoreanism of pure numbers, then it is an ontology of pure “probabilifying-nesses” — probability facts or probability bundles somehow embedded in space-time.

The ontology of such probabilifyingnesses, if it is not Pythagorean, may be expressed as equivalent to primitive dispositionalities, propensities, or potentials. A probabilifyingness is more like a propensity than it is like a specific manifestation-directed disposition. Propensities can admit of degree; so there may be a propensity of a certain degree for outcome A and of a certain degree for outcome B.

Let us consider interpretations that take Schrödinger’s wave function as a state that grounds or is the truth-maker for the measurement predictions and probability statements concerning measurement outcomes such that its “theoretically complete description . . . involve[s] only statistical assertions”.

Such an interpretation of quantum theory represents quantum “states of affairs” as probability-less-than-unity states that ground measurement predictions. On such an interpretation, the full characterization of a state of affairs is just in terms of unreducible probabilities; it excludes any further complement that could not itself be expressed in terms of probabilities. A parallel interpretation in terms of tendencies is that of full characterization of a state of affairs just in terms of unreducible tendencies.

Speaking of probability facts or even probability bundles or states is merely an alternative way of speaking in terms of pure but unspecified tendencies. This becomes most apparent when it is claimed of their ontological status that they are not reducible to and need not have or be based on a ration of actual relevant occurrences. What other than tendencies could be

the ontological ground for such cases of probabilities with non-occurrent frequencies? The opportunities for mathematization no doubt affords this metaphysics an added respectability.

Characterizing states of affairs only in terms of irreducible probabilities, then, if it has an ontological status that is not Pythagorean, is just equivalent to a characterization in terms of irreducible tendency or propensity properties. The probability (less than 1) or the tendency can be satisfied or actualized for a particular state of affairs in the absence of the outcome the probability is for or the propensity is to.

The irreducible disjunctivity in a higher order account of irreducible probability rests in a probabilifying “linking” or “connecting” as a primitive relation between universals (Armstrong, 1983) above pure “happening”, in a way that is far from clear. Even allowing such disjunctive “linking”, it does no work for the production of the particular disjunct that actually results. Even a view that admits primitive tendencies or propensities has the similar problem of being irresolubly disjunctive and not taking us up to the very production of the specific result itself.

This is not a naive complaint about indeterminacy – I am pointing out a metaphysical gap. It is like a nomination procedure for a disjunction of candidates, but it does not decide among them. Were it to elect one disjunct or candidate, it would decide for one rather than another, and thus be determinate between them. If there is not such a selection or production of one disjunct rather than another between the candidates then there is not an election or a production of a disjunct at all. The explanation of the success of a candidate or production of a disjunct, short of magic, would be incomplete, and the links in this disjunctive linkage would not take us to the result but only to a pre-result determination of disjunctivities. We need an account of disjunctivity that could take us to the result. This is no more than a graphic presentation of what is anti-intuitive in current models of the collapse of the wave function. Perhaps an account in terms of a primitive “disposition flutter” would help.

A disposition flutter would be an ontologically primitive oscillator built into the basic and irreducible properties of the elementary particle itself rather than something fixed by hidden conditions outside the particle and its intrinsic properties. Each flut of the flutter (oscillation) of the dispositions intrinsic to the properties of the particle, however unpredictable, would be an irreducible ontic ground for the manifestation of a determinate result.

Thus conceived, a disposition flutter is intrinsic to irreducible properties of an elementary particle. There is no need to look to hidden factors extrinsic to the basic properties of the particle itself, just as the rate of

“decay” has sometimes been represented as intrinsic to the nature of an atom and not to be explained by extrinsic and hidden causes or variables.

The intrinsic disposition flutter *itself* is not a mutual manifestation of reciprocal disposition partners though the particular flut of a disposition flutter may, with its reciprocal partners, *have* a mutual manifestation.

The disposition flutter may occur too quickly to measure, thus appearing to be random or non-determinate. Or, the disposition flutter may be intrinsically irregular giving the impression of non-determinateness.

If a disposition flutter is intrinsic, it is like other irreducible intrinsic factors for elementary and basic particles or aspects of spatio-temporal segments (if one exchanges particle theory for field theory): their presence and nature is not to be explained in terms of anything else. An account of this sort provides maximum determinacy.

14. PYTHAGOREANISM

It appears that relations between properties involved in causal situations may be necessary or contingent. An example of necessary relations between distinct properties is how a round peg does not fail to fit into a round hole the *way* a square peg does. A seeming example of contingent relations between distinct properties in a causal situation is that obtaining between the freezing of water and the expansion of water.

Examples of contingency in causal situations, following Locke's suggestion and consonant with the Limit View, may be only “seeming” examples. When we get, if we ever do, to what constitutes macroscopic entities we get down to a specificity of how the work gets done. As we move amongst the fittings within the “finer interstices” and the “insensible corpuscles”, the appearance of contingency may disappear. It is there that the measures of quantities are suited to the mathematicizations of nature with its accruing necessities. And the relations within the most intimate parts of nature get their expression (and it is tempting to think their *full* expression) in terms of algorithms and mathematical formulae.

Let there be a warning: “This way lies Pythagoreanism”. We should see that physics has tended to be, in Locke's phrase, a “partial consideration” *qua* the measures of quantities and not let it become a denial and expungement of the properties for and of which the quantities have a measure.

The properties of things at the macroscopic and molecular levels are complexes of simpler properties of their constituents in all of their interrelatednesses and interreactivenesses. The tendency toward Pythagoreanism increases as the posited constituents, and their changes, are further and

further removed from direct observation. At the level of the entities of particle physics, the quantities assessed for changes and change potentials are projected from the observable changes of objects and measuring devices, and by the direction derived from available mathematical models. These quantities do service for what is required for mathematizations in terms of which the theory is to be ultimately expressed.

The properties that the quantities of changes and change potentials are of may not be explicitly denied, but are not considered except in terms of their numerical nature. From a Pythagorean point of view, quantities of projected change and change potentials are nested or grouped uniquely as intrinsic to, and typifying of, the numerical nature of some theoretical entity, rather like number-packets of algorithms and mathematical formulae in space-time. What the changes and change potentials stand for over and above pure quantity can be disregarded in the “partial consideration” *qua* the numbers formed by the mathematicization of projected quantities of changes and change potentials. This non-regard of the properties in terms of which changes occur and change potentials stand, can, if it turned into a denial, become Pythagoreanism or perhaps the propertyless therenesses of the simple atoms of extreme atomism.

We have been led by Quine and by others to think that necessity and contingency are one, that there is no distinction in reality between them. There was a comic strip in which one character says to the other, “Marriage is where two people become one”. In the next panel, the second character is clearly considering the statement. In the final panel, the second character asks, “Which one?”

Quine’s answer seemed to be, “All is contingent”. But then, in “Whither Physical Objects?” (1976), he took the step from the need for the existence of numbers (the measure for quantities) for physics, with an invocation of the Principle of the Identity of Empirically Isomorphic Theories (a very fancy term for the verificationism Quine never rejected), to Pythagoreanism – all is number, that is, numbers and their relations – the mathematicization of space and time:

Carnap was propounding such a *Koordinatensprache* already in 1934 [*Logische Syntax der Sprache*, pp. 11, 40], and not because of constraints on the notion of physical object from the side of physics; for the scheme has also a certain intrinsic appeal. Numbers and other mathematical objects are wanted in physics anyway, so one may as well enjoy their convenience as coordinates for physical objects; and then, having come thus far, one can economize a little by dispensing with the physical objects As physicalists we have welcomed bodies with open arms On the other hand the mathematical objects attained the ontological scene only begrudgedly for services rendered It is ironical, then, that we at length find ourselves constrained to this anti-physical sort of reduction from the side of physics itself. It is this I have wanted to bring out.

and

Physical objects, next, evaporated into space-time regions; but this was the outcome of physics itself. Finally the regions went over into pure sets; still, the set theory itself was there for no other reason than the need for mathematics as an adjunct to physical theory.

After that, the Quinean answer to the question, "Which one?" might better be, "All is *necessary*".

This unfettered deontologizing which results in a world of pure number seems as clear a *reductio* as in philosophy. There are two hoary alternative detours on the road back from the unworldly abstraction of Pythagoreanism. Reversing direction to move back from the Quantities to the Measures and Measure Potentials is just old fashioned Operationalism all over again. Moving further back to the Measurer's measure-observations and Measurers' possible measure-observations is just Idealism-Phenomenalism Subjectivism all over again.

Once we recognize that the properties of nature require the qualitative as well as the dispositional, we can see that there is no alternative remaining for the road back from Pythagoreanism but to ask, "What are the *physical* qualia (that is, qualities)?"

This is not to ask for anything inconsistent with the conservation of energy or the laws of thermodynamics. The question is meant only to indicate that mathematizations in physical theory are partial characterizations of what is changing and at work: to make explicit the need for qualities is not to add more work by something not measured or measurable. Properties (including both qualitative and dispositional aspects) of elementary particles or segments of fields, whatever these properties may turn out to be, are what change and have typical change potentials whose measures are ascribed and given quantities. These properties have been tacitly there all along as they needed to be.

We should see physics as a partial consideration *qua* projected quantities of changes and change potentials, and not as the expungement of properties including their qualities and dispositions for which there are those quantities and change potentials. What the simpler properties amongst the "insensible corpuscles" that constitute the macroscopic properties really are, whether sentient or non-sentient, may be a great surprise.

The qualities of shape and size are intrinsic and provide the form and extent of the "shell" of the entities that have them. These qualities are space-fillings noted by Berkeley and Hume and Blackburn (1990), in that they are needed as intrinsic to what has size and shape and are to what the properties of size and shape are the extensional limits. They are needed for *what* is changing or different in virtue of which all of the quantities of

such changes and differences of ultimate constituents (whether particles, aspects of fields or super-strings) are assessed.

These needed qualities should not be the ontologically questionable secondary qualities that for many have come to be thought of in terms of primary qualities, leaving aside the status of the question of their powers to affect observers.

When we consider the need for physical qualia (that is, qualities), even in the finest interstices of nature, largely unregarded and unknown, among them should belong the qualia (qualities) required for the sensing and feeling parts of physical nature. But first things first. Let us appreciate the need for physical qualia (qualities) and make sure we do not leave out any that are needed.

An account of neuronal qualities in terms of a purely directional vector function with its dispositionality for potential alternative trajectories would embody a pure dispositionalism something like the on-the-go American Sunday Driver. Every arrival point is seen only as a point for departure, and the qualitative nature of what is present at any point in the driver's progress is of no interest. The qualitative nature of what occupies the place is spelled out in terms only of its actual and potential trajectories from and its actual and potential trajectories to other places. The qualitative nature of what is at those places is in turn spelled out in terms only of . . . etc. This vectorial approach mathematizes well, but one needs a model explicitly incorporating vectors (for directional connectivities) and single cell groups (for the properties of what are connecting) with the different research emphases of each made necessary to the other.

It is almost inevitable for functionalist driven researchers and theorists to place exclusive emphasis upon the neuronal interconnections within the neural network. This is the road to Pythagoreanism of the brain. Against this is a useful corrective by Getting (1989, p. 187):

Although knowledge of connectivity is essential, network operation depends upon the "cooperative interaction" (Selverston et al. 1983) among multiple network, synaptic, and cellular properties, many of which are inherently non-linear. No longer can neural networks be viewed as the interconnection of many like elements by simple excitatory or inhibitory synapses. Neurons not only sum synaptic inputs but are endowed with a diverse set of intrinsic properties that allow them to generate complex activity patterns. Likewise synapses are not just excitatory or inhibitory but possess an equally diverse set of properties. The operation of a neural network must be considered as the parallel action of neurons or classes of neurons, each with potentially different input/output relationships and intrinsic capabilities interconnected by synapses with a host of complex properties.

The task is to discover those quality-disposition properties, in psychological or non-psychological domains, for which changes and change potentials have been given quantities. At the most basic level of elemen-

tary particles this task needs not only the discipline of physics and what Bertrand Russell called “a nose for reality”, but also a great deal of luck.

This is no threat to the laws of thermodynamics – I am not suggesting the addition of “an excess of work from nowhere”, but of making salient and evident to the mind what is intrinsic to the properties in virtue of which the work is done. It is simply taking note of what is needed to make natural properties “whole”. This will not be expressed *only* in terms of further algorithms and other mathematical formulae, however essential these may be for the depiction of the intrinsic character of the “finer interstices of nature”.

There is, then, a *physical* qualia-qualities problem, leaving aside what problem, if any, arises for *mental* qualia-qualities.

15. EMERGENCE

If the whole is complex (see Section 2), let us try to talk and think about the simpler constituents and their relationships that constitute it as well as we can.

If the shape of a cloud is hazy and not sharp-edged, it is still dense enough in the middle less and less dense at the periphery so that one can project degrees of density of elementary particle populations (or aspects of fields or superstrings or . . .) in a spatial-temporal region and with varying degrees of stability to constitute the shape of the cloud. As Russell always saw, and before him, Locke, observable physical wholes are never sharp-edged because of the penumbra of what Locke called “fleeting particles”. So, also the “sharp-edged” shape and size of a footruler is constituted without remainder of a density-cloud of elementary particle populations, etc. Reassuringly, this density-cloud has extensional properties and constitutes the extensionality of the macroscopic whole. So this is not a case of emergence *or* reduction. The extensional properties of the whole are found in the density populations of elementary particles.

The case of fluidity is a clear case of ontological reduction of what seemed to be simple (fluidity) to the smoothly tumbling molecules.

We should stop looking for cases of emergent properties from one level of being to another level – say, from the micro-physical to the macro-physical, or from the macro-physical to the micro-physical because surely the macro properties in *virtue* of being complex, are not *really* anything over and above complexes of simpler micro properties. The causal work should not get done twice over at the level of the relationships of the micro properties and then all over *again* at the level of the macro properties that only consist in these relationships of micro properties.

The place to think in terms of cases of emergent properties is at subsequent stages or space-time segments at the *same* level (uni-level emergence rather than multi-level emergence) which is also the only and *basic* level such that the question of reduction to some still more basic level does not arise.

It seems excessive to demand at the elementary particle level of physics that *every* intrinsic property produced in particular concatenations of particles must be in the concatenation that produced it. Somewhere in the desert, perhaps, very special and complex concatenations of particles may be produced in the hope of the occurrence of *both* anticipated *and* unanticipated intrinsic properties that would occur only under the conditions of such specially complex elementary particle concatenations. Emergence, it would appear, may occur at the most basic level of elementary particle physics. The medieval doctrine (or a twist on it), that all of the perfections (intrinsic properties) in the effect must be found in the cause, does not seem to be self-evidently true. The world would be not only dull, but *absolutely* and *evenly* dull. So emergence may not be a bad thing, not even a bad theoretical or explanatory thing.

The emerging physical properties can be encapsulated, with luck, in terms of general laws. This, of course, makes them no less ontologic ally emergent.

Emergence might appear to be a metaphysically magical idea, so long as we don't look carefully at *non*-emergence. If there is *no* emergence of properties, then all simple and intrinsic properties of the effect would have to be found in and extracted from the cause. This can be called the "pipeline" view of causality. On that account the world is a great deal more boring than it appears to be.

I say "extracted from the cause" because that is the model that occurs to me to explain how the intrinsic properties in the effect *had* to be found in the cause – that is, they had to *come* from it somehow. Extraction is one, though a very peculiar, possibility. The *non*-emergence metaphysicians may be able to suggest more intuitive alternatives. That would be their responsibility. The denial of emergence is a daring and exciting ontology that would need very careful defence and development in order to have any degree of plausibility whatsoever.

Group wholes such as armies, social clubs or the year's weather can all be treated compositionally. Predicates such as "winning the battle", "having a membership rally" or "having too much rainfall" are not translated into statements about the ultimate constituents and there should be no attempt to find entailments between such predicates embedded in statements about these complexes and statements about the ultimate constituents. What *fully*

constitutes and *is* the whole complex object, group, event, state, process, property, or relation at any particular moment may vary at some other occasion. For example, in some cases there may be some inhibitory factors that required other factors to overcome such inhibitory elements.

Considering complex wholes to be the simple constituents in their numerous relationships and connectivities with one another and with what is external to them and their potential (dispositions) for these with acceptable additions, subtractions, replacements and alterations of properties, etc. (cf. Section 2 for details), it should be clear that if there *is* a simple, emergent property of that complex whole then it is a simple property *amongst* the simple properties of the ultimate constituents. That is, it is found only in the special and complex interrelations and interreactivities of all of the constituents with one another and whatever is external to them and their potentialities with their varying degrees of stability that together are just what the whole comes to or, if you like come *down* to. No doubt, this simple emergent property would have enormously numerous interrelatednesses that we might never discover. There *may* be a case of acquiring properties that fit the non-pipeline view in theoretical physics. It is the still conjectural case of neutrino oscillation in which the neutrino oscillates from three forms: (1) electron neutrino, (2) muon neutrino, and (3) tau neutrino. This suggests not just a new combination of properties the neutrino already had, nor properties extracted from something else, but rather the acquisition by the neutrino of a *new* property. If so, then *that* is emergence!

It does not count against a property or quality to say that it is emergent. A non-emergence view of the world does not seem to be obviously correct. That still leaves it wide open as to what properties emerge from what.

16. REDUCTION

(a) Explanatory Reduction

Different kinds of explanations are not “reducible” (that is, by entailment or translation) to one kind of explanation though the items and happenings mentioned in different kinds of explanations may be “reducible”, that is, come down to (be nothing over and above) the same items and happenings mentioned in that explanation. One may think of the occurrence of an event mentioned in *any* kind of explanation in an interest-relative way such that without that interest-circumscription the explanation would not be what it is. Explanations are mind-dependent, theory-laden, interest-relative. But none of this applies to objects or events *themselves* and how they are constituted – *they* are not interest-relative or language-relative. It should

not take too much effort to see that this is just the obvious fact that the *same* object or event can figure in many different explanations or could have figured in none because there were simply no explainers.

(b) Ontological Reduction

Leaving aside the ontologically irrelevant matter of supervenience, ontological reduction concerns the question of whether something A comes down to, reduces to, just consists in, isn't anything over and above something B. As we know, since John Wisdom's work in the 1940s, such reduction does not require translation or entailment relations between statements about A and B. It requires only the success of the disclaimer "nothing over and above". There are two criteria for a plausible reduction:

- (i) What is being reduced must be complex in order to be reduced to its simpler constituents. Intuition is tricky because we can err in our judgment of what is simple or what is complex. Beliefs and desires seem obviously complex, the sensed aspect of a specific pitch of an auditory input seems simple.
- (ii) The reducing constituents should intuitively fit the nature of what is being reduced. That is, it can't be ad hoc and it can't be mere correlation, however exact.

The double helix had the right fit for the gene to the expert eye and smoothly tumbling molecules have the right fit for fluidity. It is not evident that neuronal firings have that same kind of right fit for the features of experience even for many expert eyes. This is why so many of the workers in neuroscience themselves keep coming back to the "problem" of sentience. The arguments, "What *else* can it be, stupid?" or "You'll get used to the idea" would not be considered conclusive in other areas of science.

If the qualities of the experiential are simple and are not evidently fit for reduction to familiar neuronal properties, then *unreduced* they find their way as *unreducible* properties amongst the elementary particles or fields or strings, or . . . as the unreducible properties of extension are unreduced in the degrees of varying density populations of kinds of particles.

There is no flouting here of the laws of thermodynamics by bringing in causes from nowhere. It is simply a matter of *not* leaving out the intrinsic properties of what is involved in the work that is done.

The question is whether the case of the properties of immediate experience is unreduced as in the case of the properties of extension or reduced as in the case of fluidity.

17. MENTAL CHAUVINISM

I have attempted to show how quantitative we are in our scientific representations of nature. Our reasonable demand for measurable experimental results in science may lead to the unreasonable limitations to purely quantitative interpretations of such results. It was seen how this tended toward a Pythagoreanism of numbers in space-time with space-time itself collapsing perhaps into numbers.

It was shown how emergence cannot meaningfully be thought of as between different levels of being, but as uni-level at the basic level of the simplest, most irreducible uncomposable elements of nature – the elementary particles or aspects of fields or strings or At *that* level it seems an absurd legislation to endorse the medieval dictum that the perfections of the effect must be found in the cause – the pipeline view – that would preclude the possibility of some intrinsic irreducible properties found in a concatenation of particles that were explained by but not also found in some other concatenation of particles, and there do seem to be cases of this within theoretical physics as with neutrino oscillations. If that possibility is not an absurdity, then nature need not be a bore and emergence can be normal and have natural explanation and not be inexplicable and anachronistic mystique.

Putting these results together shows how giving room for the qualitative nature of experience need not be more strange, difficult, mystery mongering, or in defiance of the laws of nature than would be the giving room for the qualitative nature of non-mental physical entities that may have been overlooked in giving exclusive priority to their quantitative and perhaps dispositional character.

How is the qualitative fit for evolution? The quality display is a perfect internal model for external projections. It is the natural material for such projective use (*rather* than inference). There can be sensory and sensory-like griddings for percepts, dreaming, imagery, illusion, and hallucination with varying degrees of and changes of qualitative occupancy.

The qualitative provides the *feel* of the feelings in our upsets and delights, our feelings of anticipation, unease at failure, such that it can be evoked in memory imagery for the *continuance* of actively dealing with what it is *used* to represent. (A. Damasio 1994 provides a neurophysiological modelling of this.) It is also *what* is apt for savouring – the qualities of sense experience and the qualities of the feel of feelings, negative as well as positive ones.

The argument has been that the nature of the physical world (that will include the mental) *cannot* be fully characterized in terms of only the quantitative and/or powers (dispositions that get turned into probabilifications

that tend to Pythagoreanism) but also requires the qualitative. And, it was argued, like old forms of phenomenalism, behaviorism and operationalism, their sparseness was attractive only because it was never spelled out in full candid explanations. An explicit inclusion of the qualitative, whether in a mental case or a non-mental case, is not adding more “work” and therefore flouting the laws of thermodynamics. It is only explicitly fulfilling the ontological requirements of the qualitative character of what *already* has quantity and the work potential of dispositionality. The need for qualitative character is the need to be complete as a property in the physical world.

I now want to return to a function that is found in most, and probably all, mammalian mental cortical systems. There may be a relatively simple answer to some perplexing problems to be found in the function. It should be seen in detail (in work in progress) how close to conscious cortical functioning the non-conscious vegetative autonomic system is. This is essential to do in such detail in order to be very clear about just what functions are lacking in these subtle and complex non-conscious systems. The function I wish to discuss is that of internal signals. An internal signal is a signal generated within a central integrative control center primarily for use within that center, that does not typically produce output to what is outside that center. The internal signal is *qualitatively* similar to an external signal that has its cause outside the center and that typically produces output to what is outside that center.

This function is noteworthy for its statement having to make explicit mention of *qualitative* similarity. So the qualitative is an essential ingredient of this function. However, there is not and cannot be any specification in terms of the function itself of what qualities are in fact similar. That is left entirely open to what kind of entity has such a function.

I shall give a range of four instances of such a function:

(i) There is the beautiful case, mentioned to me by Rüdiger Bittner, of internal and external mail. This is a case of what is either internally or externally caused being such that the internal and external mail (input) are qualitatively similar. The internal mail is given internal input and output use *within* the system. Whereas the external mail is given external input and output use *outside* the system.

(ii) A chess computer registers (external signal) an opponent’s move. A qualitatively similar internally generated signal is used as a starting point for modelling possible moves in the game. This modelling includes internal uses resembling external uses corresponding to moves the *machine* could make, and internal uses of internal signals which would be qualitatively similar to possible registrations (external signals) of moves the *opponent* could make.

(iii) There seem not to be any internal signals given only internal use that are qualitatively similar to external signals of the very job-oriented vegetative systems. However, with lesser or greater technical difficulty it should be possible to induce such a functional capacity.

(iv) To bridge the many steps in between intermediary species, I want to make a very special place for the qualities of the internal signals and their uses of the mammalian higher primates, and most specially for the human species itself.

Each of these four requires for internal function the *qualitative* similarity of its own internal and external signals that it uses internally. But there *need not* be any qualitative similarity *between* any of the four.

I shall be a mental chauvinist and value and even savour those sentient qualities that make our internal and external signals similar – simple and unreduced *or* complex and reduced – that are *embedded* in the internal function of the inner life of our minds.

NOTES

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REFERENCES

- Armstrong, D. M., C. B. Martin, and U. T. Place: 1996, *Dispositions: A Debate*, Routledge, London.
- Armstrong, D. M.: 1989, *Universals: An Opinionated Introduction*, Westview Press, Boulder.
- Armstrong, D. M.: 1983, *What is a Law of Nature?* Cambridge University Press, Cambridge.
- Blackburn, Simon: 1990, 'Filling in Space', *Analysis* 50(2).
- Cartwright, Nancy: 1983, *How the Laws of Physics Lie*, Oxford University Press, Oxford.
- Damasio, Antonio: 1994, *Descartes' Error*, G. P. Putnam's Sons, New York.
- Dummett, Michael: 1979, 'Common Sense and Physics', in G. F. Macdonald (ed.), *Perception and Identity: Essays Presented to A. J. Ayer With His Replies to Them*, Macmillan, London.
- Einstein, Albert: 1949, 'Reply to Criticisms', in P. A. Schilpp (ed.), *Albert Einstein: Philosopher-Scientist, Library of Living Philosophers*, University of Chicago Press, Chicago.
- Fetzer, James: 1981, *Scientific Knowledge*, D. Reidel Publishing Company, Dordrecht.

- Fine, Arthur: 1986, *The Shaky Game: Einstein, Realism and the Quantum Theory*, University of Chicago Press, Chicago.
- Getting, P. A.: 1989, 'Emerging Principles Governing the Operation of Neural Networks', *Annual Review of Neuroscience* **12**.
- Martin, C. B.: Forthcoming (with John Heil), 'Rules and Powers', *Philosophical Perspectives*.
- Martin, C. B.: 1996a, 'How It Is: Entities, Absences and Voids', *Australasian Journal of Philosophy* **74**(1).
- Martin, C. B.: 1996b, 'Properties and Dispositions', 'Replies to Armstrong and Place', 'Final Replies to Place and Armstrong', in D. M. Armstrong, C. B. Martin and U. T. Place, *Dispositions: A Debate* (ed., T. Crane), Routledge, London.
- Martin, C. B.: 1994, 'Dispositions and Conditionals', *The Philosophical Quarterly* **44**.
- Martin, C. B.: 1993, 'The Need for Ontology: Some Choices', *Philosophy* **68**.
- Martin, C. B. and K. Pfeiffer: 1986, 'Intentionality and the Non-Psychological', *Philosophy and Phenomenological Research*.
- Martin, C. B.: 1984, 'Anti-Realism and the World's Undoing', *Pacific Philosophical Quarterly* **65**.
- Martin, C. B.: 1980, 'Substance Substantiated', *Australasian Journal of Philosophy* **58**(1).
- Mellor, D. H.: 1991, *Matters of Metaphysics*, Cambridge University Press, Cambridge.
- Mellor, D. H.: 1974, 'In Defense of Dispositions', *Philosophical Review* **83**.
- Quine, W. V. O.: 1976, 'Whither Physical Objects?', in R. S. Cohen, P. K. Feyerabend and M. W. Wartofsky (eds.), *Essays in the Memory of Imre Lakatos, Boston Studies in the Philosophy of Science*, Vol. XXXIX, D. Reidel, Dordrecht.
- Searle, J. R.: 1992, *The Rediscovery of the Mind*, MIT Press, Massachusetts.
- Selverston, A. I., J. P. Miller, M. Wadefauhl: 1983, 'Cooperative Mechanisms for the Production of Rhythmic Movement', in A. Roberts and B. L. Roberts (eds.), *Neural Origin of Rhythmic Movement*, Cambridge University Press, Cambridge.
- Shoemaker, Sydney: 1981, 'Causality and Properties', in Peter E. French, Theodore E. Vekling, Jr. and Howard K. Wettstein (eds.), *Midwest Studies in Philosophy, Vol VI*, University of Minnesota Press, Minneapolis.
- van Frassen, Bas: 1980, *Scientific Image*, Oxford University Press, Oxford.

Department of Philosophy
University of Calgary
Calgary, Alberta
Canada