Afterward: Lakoff, Edelman, and "Hierarchy"

As I mentioned in the Introduction, I had not seen George Lakoff's "Women, Fire, and Dangerous Things" nor Gerald Edelman's "Bright Air, Brilliant Fire" until very recently. It was remarkable to me, therefore, to see how closely Lakoff's logical and epistemological conclusions resembled those of Cassirer[1], (considered as the combination of Cassirer's dual theses: his logical thesis of "the functional Concept of mathematics" and his epistemological thesis of "Symbolic Forms"), and how closely Edelman's biological and philosophical answers, based in Lakoff's and his own original work, resembled my own conclusions. There is an uncanny parallelism of structure, (though not of consequence), between the paths we have followed to arrive at our conclusions.

Our structural differences are differences of degree –but important differences. I believe that Lakoff, (and Edelman), have gone too far in the case of logic, and not far enough in the case of epistemology. They fail[2], crucially thereby, to provide the grounds for an answer to the ultimate problem: i.e. how can "mind" or "consciousness", (normally taken) coexist with the existence of the brain?

Lakoff:

Lakoff grounds his work in logical reflections of Wittgenstein[3] which questioned the adequacy of the classical logical Concept and in the work of Rosch and a host of modern empirical researchers which further challenged that classical Concept by demonstrating exceptions in actual human usage of language and concepts across cultures and even within our own legitimate contemporary usage. From these grounds and his own original work, Lakoff drew strong conclusions about the nature of logic[4] –and the human mind- itself.

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[1] Of which Lakoff, apparently, was unaware

[2] -innocently for Lakoff who never promised such an answer, but more pointedly for Edelman who did

[3] E.g. Wittgenstein's "family resemblances"

[4] compare Cassirer: "... Every attempt to transform logic must concentrate above all upon this one point: *all criticism of formal logic is comprised in criticism of the general doctrine of the construction of concepts*." –cited at the beginning of my Chapter 2.

The Classical Concept

The classical concept[1] is defined "by necessary and sufficient conditions" - that is, by set theoretic definitions on properties. It is an elementary theorem of logic that the whole of the operations of sentential logic, for instance, may be grounded solely in the primitive operations of intersection and complement.[2] More generally, logical sets and categories, (concepts[3]), are defined on presumed "atomic properties" and are commensurable wholly based on the set-theoretic possibilities of those sets –i.e. union, intersection, complement, etc.

Concept-sets, (within this classical perspective), express a hierarchical "container schema" moreover, (using Lakoff's language). Though Lakoff frames his discussion to the same end slightly differently, by this I mean that whenever we classically specify a genus, we do so by eliminating one or more of these atomic properties, (by intersection of the properties of species), at the same time thereby specifying an expanded extension, (union) –i.e. the set of "objects" which the genus concept encompasses. The delimitation, (by property containment), of the genus category is contained within, (is a subset - an intersection of), that of the species category while the *extension* of the species category, conversely, is contained within, (is a subset of), the extension of the genus category. In specifying a species category on the other hand, we do so by adding one or more properties –ultimately "atomic properties" to the properties of the genus concept and this species concept encompasses a diminished, (intersectional), extension of the extension of the genus.[4] This classical categorization therefore expresses an absolute, rigid and *nested* hierarchy of levels and containment. In Lakoff's terms it expresses a hierarchical "container schema".[5]

Ultimately, (because they *are* nested), at the limits these processes specify (1) a *largest* concept: "something", (defined by *no* atomic properties), whose extension is "everything", and (2) a *smallest* concept: a particular "object" in

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[1] Lakoff is concerned with primarily with categories, but the distinction is technical and not necessary to this discussion. Cassirer dealt specifically with concepts, but he covered essentially the same ground.

[2] Or on other subsets of set operations as well

[3] See prior footnote: categories vs. concepts

[4] "Cross categorization", the "other . . . classical … principle of organization for categories" refers to the various possibilities at any stage of genus or species categorization – on the particular choices of which "atomic properties" are to be eliminated or added. Cf Lakoff pps. 166-167

[5] ibid

reality, (or possible reality), defined by *all* its atomic properties[1]. Given the classical paradigm then, reason necessarily begins with "something", (the most general concept), and points, inexorably, to some "*thing*", i.e. a specific object.[2]

But Lakoff plausibly argues that concepts[3] in legitimate human usage are actually determined by *any* rule, (to include the classical rules of set operations on properties as just one *special case* of a rule), or even *by no rule at all*! Thus metaphorically based categories, such as the Japanese concept of "hon" are generated, (determined by), a metaphoric rule of extension and metonymically based categories are generated by a rule of metonymy. (Metonymy is the case where one instance of a category is made to stand for the category.) "Don't let El Salvador" become another Vietnam" is an example Lakoff uses of a metonymically based category.[4] Here "Vietnam" stands for the concept of all hopeless, unending …. wars.

In the case of "radial categories", such as the concept of "mother", (to include birth mother, adoptive mother, foster mother, surrogate mother, etc.), or of "Balam"[5] in the Dyirbal aboriginal language in Australia, they are determined by simple historical accident –they are not generated from the central model by general rules .. [but] .. must be learned one by one."[6] (Extensions from the central model are not "random" however, but are "*motivated*", his emphasis, "by the central model plus certain general principles of extension.")[7]

He argues his case rigorously and scientifically by exhibiting myriad examples that are *not* compliant with the classical Concept and analytically by demonstrating the degradation of concepts in actual bi-cultural environments –i.e. where a culture and language is being overrun by another, ("language death"), as

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[1] to include spatio-temporal properties

[2] or *the exact converse* –i.e. beginning with some specific object or objects in reality or possible reality and ending with everything!

[3] he would say "categories"

[4] P. 77. Actually I like his "ham sandwich" better, but it was pre-empted by Edelman!

[5] The category which is the source of his title and includes, among other things, women, fire, and dangerous things.

[6] Lakoff, P.91

[7] As I will repeat later, this discussion of Lakoff's thesis is woefully inadequate, but it will have to do for the purposes of this appendix. He states as the "main thesis of [his] book .. that we organize our knowledge by means of structures called *idealized cognitive models*, or ICMs, and that category structures and prototype effects are by-products of that organization." Ibid, p.68

is the case with the Dyirbal aboriginal language in modern Australia.[1] The degradation is characterized by the loss of blocks of suborganizations, not of random individual elements.

Lakoff's logic is not trivialized by this "free formation" of concepts however, (as it might seem it *would* be[2]- logic being [paraphrase] "mostly concerned with categories"), as he bases logic and the relevance of concepts ultimately in a *preconceptual context* rather than in the concepts themselves. Concepts, (categories), he argues, are not created in a vacuum, but within preconceptual schemas: "idealized cognitive models", (ICMs). The latter are ultimately determined, (he argues), by the function of the body in the external world–all describable from "body in the world".

> "There are at least two kinds of structure in our preconceptual experiences:
>
> A. Basic-Level structure: Basic-level categories are defined by the convergence of our gestalt perception, our capacity for bodily movement, and our ability to form rich mental images.
>
> B. Kinesthetic image-schematic structure: Image schemas are relatively simple structures that constantly recur in our everyday bodily experience: CONTAINERS, PATHS, LINKS, FORCES, BALANCE, and in various orientations and relations: UP-DOWN, FRONT-BACK, PART-WHOLE, CENTER-PERIPHERY, etc."[3]

These schemas, however, being at the *basis* of our reasoning[4], are necessarily mutually relativistic and equipotent and we utilize them on a "best fit" rationale. The concepts that arise within them need not be commensurate *across* them. Thus he arrives at a relativism of logic and concepts.

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[1] See Lakoff, pps. 96-102

[2] If, according to Lakoff, (1) legitimate concepts may be formed on any principle or no principle, and if, also according to Lakoff, (2), most of the business of logic is concepts, (categories), then it would appear, (at first glance), that (3) logic could prove *any* conclusion. But if logic can prove anything, then it can prove nothing! Thus it would appear, on the face of it, that his purported impossibility of a rigorous, comprehensive structure for categories in general would imply the invalidation of logic in general.

[3] Lakoff, p.267.

[4] rather than categories

Lakoff's Concept/category in many ways resembles Cassirer's[1] and he rejects, (as does Cassirer), the classical "necessary and sufficient conditions", (as he phrases it), which ground set theoretic abstraction and the Aristotelian generic Concept. His logical and ultimately epistemological relativism, (in his "idealized cognitive models"), is also very similar to, (though it is not as abstract and comprehensive as), Cassirer's "Symbolic Forms" which is described in my Chapter 4.

Cassirer and Lakoff's Logic

Cassirer rejected the logical sufficiency of classical categorization as does Lakoff, but he did *not* reject the possibility of an absolute, comprehensive structure for categories, (which Lakoff does). Instead Cassirer retained *an overall formal structure* for categorization in the notion of a mathematical functional rule or series.

Cassirer did not question the *legitimacy* of the classical schema, but he did question its *necessity* and *sufficiency.* (Which is pretty much where Lakoff and myself stand as well.) He argued that it is, in fact, a special and *limit case* of the Concept and of the possibilities of logic. Cassirer maintained that many concepts – and *specifically* the very concepts of mathematical and physical science[2] – demonstrate *another* mode of concept formation and specification than the

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[1] There is an uncanny parallelism of argument throughout between Lakoff's and Cassirer's treatment of logic. Consider, as an example, the following:

"Category cue validity defined for such psychological (or interactional) attributes might *correlate*", (his emphasis), "with basic-level categorization, but it would not *pick out* basic-level categories*; they would already have to have been picked out* in order to apply the definition of category of category cue validity so that there was such a correlation." (Lakoff: P.54, my emphasis) This is almost an exact parallel to one aspect of Cassirer's argument against the classical concept, and the "theory of attention", (see my Chapter 2), –and for a "new form of consciousness".

Discussing Erdman, Cassirer writes: "…instead of the community of 'marks,' the unification of elements in a concept is decided by their 'connection by implication.' And this criterion, here only introduced by way of supplement and as a secondary aspect, proves on closer analysis to be the real logical *prius*; " (his emphasis), "for we have already seen that 'abstraction' remains aimless and unmeaning if it does not consider the elements from which it takes the concept to be *from the first* arranged and connected by a certain relation." Cassirer, "Substance and Function", p.24

[2] Cf Cassirer, "Substance and Function", "Einstein's Theory of Relativity". Incidentally, the original title for "Substance and Function" was "Substanzbegriff und Funktionsbegriff", i.e. Substance Concepts and Function Concepts!

classical scheme, (this is the subject of my Chapter 2). Both concept formation upward, (genera), and downward, (species), can obey *another* rule-based law, i.e. the properties of their extensions can embody a series other than the *specific series* of identity. As a crude example, one member of the extension of a concept, (using an example drawn from numeric sets), might contain the numeral "2", another the numeral "4", another "8", "16"… rather than the numeral "2" being in all of them. Thus the concept would express, (and be formed on the principle of), the series 2,4,8,16,… across its extension rather than being based in the series of identity: 2, 2, 2,…. , (the classical schema). The extension of a category, therefore, may be defined based upon the possession of some property belonging to a series or function *on* properties rather than on the possession of some identical property(ies). Concepts can be specified by a function *other than* identity.[1]

Cassirer has supplied a clear counterexample and an alternative to the classical schema, (which I explained at length and further extended as the subject of Chapter 2). Simplistically, (and as crude illustration), we may have three pieces of "metal" in front of us for instance, wherein *none* of their properties are the same! The first is a one pound piece of gold, (color: yellow, specific gravity: a.aaaa…., conductivity: b.bbbb…., etc.), the second a two pound piece of lead, (color: gray, specific gravity: l.lll…, conductivity: m.mmm…., etc), and the third a three pound piece of tin: (…, …., …., etc.) None of these properties need be *identical* however. They are related as "metal", (and are specified as "metal objects"), because the color of each, (for instance), *is a value of the function* COL(x) ε {yellow, gray, silver,…), the specific gravity of each is a value of the function SG(x) ε {lll…, ggg…, …}, and so on. These objects, (the objects called "metal objects"), can "cross party lines", so to speak –i.e. they are not the product of strict set-theoretic intersection of atomic properties. In the illustration their intersection across these properties is null! The extension of scientific and mathematical concepts, (*specifically*, Cassirer argues), need have *no* atomic properties in common[2] . Repeating a short citation from my Chapter 2:

> "Lambert pointed out that it was the exclusive merit of mathematical 'general concepts' not to cancel the determinations of the special cases, but in all

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[1] Cassirer's "series" could be ordered by *radically variant* principles, however: "according to equality", (which is the special case of the "generic concept"), "or inequality, number and magnitude, spatial and temporal relations, or causal dependence"[1] -so long as the principle is definite and consistent. But please remember that these are *principles of category construction* rather than *properties* of categories. see my Chapter 2

[2] Compare Wittgenstein's "family resemblances".

> strictness fully to retain them. When a mathematician makes his formula more general, this means not only that he is *to retain* all the more special cases, but also be able *to deduce* them from the universal formula."[1]

But this possibility of deduction does not exist in the case of the scholastic, (Aristotelian), concepts, "since these, according to the traditional formula, are formed by *neglecting* the particular, and hence the reproduction of the particular moments of the concept seems excluded."[2]

> "The ideal of a *scientific* concept here appears in opposition to the schematic general presentation which is expressed by a mere *word*. The genuine concept does not disregard the peculiarities and particularities which it holds under it, but seeks to show the *necessity* of the occurrence and connection of just these particularities. What it gives is a universal *rule* for the connection of the particulars themselves.... Fixed properties are replaced by universal rules that permit us to survey a total series of possible determinations at a single glance."[3]

Consider "the ellipse as a simple mathematical example of a genus" for instance. Its species are functionally related –and fully recoverable- in the defining equation of ellipses in general.

Conversely in the specification of species and subspecies, ("downward"), the process does not necessarily lie in the addition of (identical) atomic properties either, (the members of the extension of a subspecies, which is *also* a category, need not contain (any) identical atomic properties by the same reasoning), but can be accomplished instead in the identification of the value of a sub-function whose possibility is implicit within the genus.[4] Ultimately, (and recursively), the question proposes itself: *need there be* a lowest, "bottom" level concept *at all*?[5]

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[1] Cassirer, "Substance and Function", P.20-23

[2] ibid P.20-23, my emphasis

[3] ibid P.20-23

[4] Since we can build a genus without commonality, so can we build a super-genus. Turning our perspective around, then, we may speciate downward from that super-genus without the utilization of commonality!

[5] The other pole is clearly impossible. There is clearly no Concept, (category), of all concepts under Cassirer's vision as it would necessarily be defined on "the rule of all rules". But some, (most), rules are obviously inconsistent with other rules –disallowing the concept.

Speciation is no longer necessarily intersection or containment,[1] (it is no longer necessarily nested), so there is always the possibility of another, further rule of assembly for a subspecies of *any* species –at *any* level![2] There is thus no longer a *necessary* logical focus on an ultimate "thing".

Cassirer argues that the ultimate "objects", (the "theoretical objects"), of mathematics and physical science are "implicitly defined" by, (and express), the fundamental laws of the science itself. He argues that they are instances of complex speciation based in the general functional rules, (the laws), of the sciences themselves and not objects "in reality".

Some of Lakoff's categories, it is true, are also rule based, (other than the classical rule), but in the case of his "radial categories", they may be formed by historical accident. Lakoff concluded that categories may be formed by classical rules, other rules or "*no rule at all*"! But this characterization divorces him from the possibility of any universally comprehensive categorical structure.[3] Cassirer includes this special latter case as an *ad hoc* rule, (series), however, rather than as an example of "no rule". It would correspond to the special case in mathematical set theory wherein a set is defined by the explicit listing of its members. Cassirer's conception may be likened to a line segment bounded on one end by the classical criterion of identity of properties across members, (a "unity"), with the central section composed of any and all functional rules, (i.e. rules of series/regular functions on those properties), and bounded at the other end by the rule of explicit listing, i.e. no *other* rule, (a "zero"). This view reconciles the two conceptions, I think, and might be acceptable to Lakoff.[4] What it does besides, however, is reveal a comprehensive structure across the *whole* of categories/concepts.

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[1] Since there is no longer a necessary presumption of nesting, the implication that there must be a "least member" is no longer justified.

[2] Remember that under Cassirer's Concept, we do not eliminate *properties* to speciate, but rather *functions*.

[3] Cf: the discussion of the crucial role of comprehensiveness vis a vis mathematical ideals near the end of this Afterword.

[4] Compare Lakoff, p.146 : "in the classical theory, you have two choices for characterizing set membership: you can predict the members (by precise necessary and sufficient conditions, or by rule), or you can arbitrarily list them, if there is a finite list. The only choices are predictability (using rules or necessary and sufficient conditions) and arbitrariness (giving a list). But in a theory of natural categorization, the concept of *motivation*", (his emphasis), "is available. Cases that are fully motivated are predictable and those that are totally unmotivated are arbitrary. But most cases fall in between –they are partly motivated."

Cassirer suggested another, (and more classical), "middle ground" wherein the principle of "necessary and sufficient" is not grounded in an *identity* of properties, but in a functional relationship between them. The relationship between their proposals is more complex than is

I have suggested a further extension beyond Cassirer's "Functional Concept" and sets of n-tuples however in my arguments of Chapter 2. Just why is the color of "gold-metal" *yellow* instead of gray? Why is "gold" a *particular* n-tuple rather than some *other* mix of possible place-values? Physical scientists will never agree with Lakoff, for instance, that it could be just an (accidental) property of a "radial category", nor, possibly even with Cassirer, that it is simply an element in a multi-place series. They will insist that it must be a *necessary* property determined by physical law. Cassirer apparently glimpsed this connection in his conception of the "ideal objects" of the sciences, but he never fully exploited it. (I have pursued it in my "Concept of Implicit Definition".[1])

Both Lakoff and Cassirer followed the paths of their logical conclusions to see the essential flaw in "naïve realism", (as Cassirer termed it), and "objectivism", in Lakoff's words, (I have used the term "naturalism"). If the classical logical schema of strict hierarchical containment were legitimate, and, more importantly, if it were necessary and sufficient, then the *only* possibility of science, as the resolution of experience and reality with logic, would lie in the absolute objective existence, (however reduced), of our ordinary objects. If valid logic and conceptualization is broader than that, however, then the possibility of reality is considerably enriched. Valid conceptual, (or utilitarian cognitive), "objects" need not then express "membranes" around spatio-temporally contiguous properties of *ontological*, (i.e. metaphysical), objects or groups of such objects![2] They can "cross party lines"!

Cassirer had no problems with such an implication. It was implicit, of course, in his neo-Kantian origins. Lakoff did. In his laudable commitment to realism, he was forced to consider the *minimal necessary* requirements of such a (scientific) realism.[3]

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possible to describe here, but as a thumbnail sketch of my opinion, the deficiencies in the classical category that Cassirer resolves in his "Functional Concept of Mathematics", Lakoff attributes to his Cognitive Models whereas the deficiencies in classical metaphysics are resolved by both of them very similarly in the epistemological relativity of "Symbolic Forms" by Cassirer and of "ICM's" by Lakoff. Cassirer's is the more general of the two solutions to the latter problem, however, as it is not framed within a specific image of the world, but within the constraints only of abstract epistemology as Kant definitively iterated them.

[1] Cf my Chapter 2

[2] This discussion constitutes my answer to one of the more difficult objections to my first thesis wherein it is objected that "schematism" is "just a level of abstraction", (Richard Reiner, private communication). The discussion above shows why it need not be!

[3] The criteria of Putnam's, Lakoff's and Edelman's basic realism are, I have argued in my chapters 3 and 4, essentially the same ones definitively identified by Kant. Kant is grossly

He lists Putnam's requirements of "internal realism"[1] as:

(1) "A commitment to the existence of a real world external to human beings

(2) a link between conceptual schemes and the world via real human experience; experience is not purely internal, but is constrained at every instant by the real world of which we are an inextricable part

(3) a concept of truth that is based not only on internal coherence and "rational acceptability", but, most important, on coherence with our constant real experience

(4) a commitment to the possibility of real human knowledge of the world."[2]

He has extended and refined Putnam's position somewhat from this basis, (his "basic realism"), to be able to answer certain further questions that arise, but this is a reasonably concise rendition of his stance vis a vis realism. I have discussed his position, (as reiterated by Edelman), briefly in the preface to my Chapter 2, wherein I agreed with (1) – (3), but strongly qualified (4). I had argued the equivalent of his essential conclusions as the subjects of my chapters 3 and 4, i.e. the (bare) "axiom of externality", and the (bare) "axiom of experience" respectively. Because of his conclusions, Lakoff was further forced into a position of epistemological, (as well as logical), relativism –against what has been called a "God-eye view of reality".[3]

Lakoff's relativism, necessary because of his logical conclusions but challenged in his own mind, (admirably, I maintain, as I consider myself a strong realist as well), by his fervent commitment to science and realism, is ill defined however. Though he talks about relativism at length, he never clearly defines it. He begins by noting the anathema which "relativism" is considered by the scientific world, but argues that there are, in fact, many different forms of relativism. (Neither he, nor I, advocate a "relativism of everything".) The most cogent interpretation I can give to it, (Whorf aside), is that he advocates a cognitive and logical relativism based on bodily function, (in the world), which leads to a relativism of contexts, (ICM's), which employ different categorical, (conceptual),

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mischaracterized as an "idealist". He was, in fact, the penultimate modern realist in just the sense demanded by these thinkers. See chapters 3 and 4.

[1] Which he uses as the jumping off point for his own "experiential realism". Edelman, incidentally, has adopted Putnam's definition pretty much "as is".

[2] P.263

[3] cf my chapter 4 for a discussion of Cassirer's arguments on the same subject and of my extension of them.

schemas. Within each of these ICM's, there *does* exist a structure consistent with rigor, however,[1] but ultimately the ICM's themselves are relativistic.

I like what Lakoff has done, (hugely!), but his ICMs, the relativism in which he has based them, and his epistemology are deficient insofar as they are all derived from, (grounded in the concept of), the human body and the functions of that body in the world. This is his overview, and this is the context within which they are framed. That very body in the world is conceived *in the primary set theoretic sense*, (he would call it the "container schema" ICM), however! But if they all may be *described* within the container schema, (the body in the world), then ultimately all of his ICMs and his epistemology are *theoretically reducible* to a container schema! This is a contradiction of his own position against a "God's eye" picture of the world.[2] It is the *generality* of Cassirer's solutions[3] and of my extensions of them, (founded ultimately in a neo-Kantian perspective), which allows the solution of the general logical and ultimately of the epistemological problems.

Though Lakoff rejects the view that "anything goes" –that any conceptual system is as good as any other, nowhere does he approach the possibility of a *scientific*, *mathematical* relativism which would give rigor to his conceptions –save within a tacit objectivist context.

It is the possibility of a general and comprehensive structure of the "Concept" itself which allows the true relativity of the essential forms/ICMs. I will argue shortly, in the context of mathematical "ideals", that the various "generators" of such an ideal must each be capable of generating the *whole* of the "space" of that ideal –to include all possible alternative generators as well. Thus each (legitimate) structure must be *comprehensive* to be translatable, (i.e. capable of itself being generated by *another* set of generators). But its concepts/categories/objects may be *distributed* in the translation.[4] This is intelligible only outside of the classical conception of logic, and is the essence of my conclusion of chapter 4. Lakoff's "Concept" is certainly broader than the classical concept, but he takes his arguments too far –against *any* rule of concept formation.

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[1] "The main thesis of this book is that we organize our knowledge by means of structures called *idealized cognitive models*, or ICM's, and that category structures and prototype effects are by-products of that organization.." Lakoff, 1987, p.68, his emphasis.

[2] I.e. all his arguments against it are reducible within it. I will have more to say on this subject shortly and will suggest a way out of his dilemma.

[3] and their origins in science and mathematics

[4] cf my Chapter 4

Please do not misunderstand me. I loved Lakoff's book. It is brilliant, far reaching, and, I believe, essentially valid. He develops and documents his arguments solidly, but I think his strongest point is in his clear and cogent examples from our own normal usage[1], (as well as from extensive anthropological studies), which makes his essential case almost unanswerable. His conception is considerably richer than it is possible to describe within the confines of an appendix, nor is it as simplistic as I have characterized it. We have huge areas of agreement and possible interaction, (his and Rosch's "basic level categories" have a natural correlate in my "schematic perceptual objects", for instance.)

Lakoff's ICMs are biologically based –on the human organism. Human cognition and human reason consists, for Lakoff, in the application of the best fit of these inbuilt ICM's, (and their respective categories), to a given problem or situation. They constitute an "embodied logic" deriving from the nature of the human organism itself. There is an obvious parallel between Lakoff's "embodied logic" and the more general case I have argued. I have argued that logic is indeed embodied, *but at the primitive level of cellular process!* This more general characterization allows the crucial epistemological move,[2] (which Lakoff's does not), beyond the "God's eye view" he disclaims.

The distinction is important because at the cellular level of phenomenology biology becomes a *pure form*, (in Cassirer's "Symbolic Forms" sense and compatible with Cassirer's Hertzian premise). This is especially transparent in Maturana and Varela's book, for instance, (see chapter 3), i.e. in its explicit constructiveness and the subsequent purity of their phenomenology.

Citing a few pertinent examples quoted earlier in chapter 3:

> "Our intention, therefore, is to proceed scientifically: if we cannot provide a list that characterizes a living being, why not propose a system that generates all the phenomena proper to a living being? The evidence that an *autopoietic unity* has exactly all these features becomes evident in the light of what we know about the interdependence between metabolism and cellular structure."
>
> "*Autopoietic unities specify biological phenomenology as the phenomenology proper of those unities"*, (my emphasis), "with features distinct from physical phenomenology... because the phenomena they generate in functioning as autopoietic unities depend on their organization

[1] Cassirer's case was grounded primarily in scientific examples.

[2] Through what Maturana and Varela call "structural coupling"

and the way this organization comes about, and not on the physical nature of their components."

"Ontogeny is the history of structural changes in a particular living being. In this history *each living being begins with an initial structure. This structure conditions the course of its interactions and restricts the structural changes that the interactions may trigger in it*", (my emphasis). "At the same time, it is born in a particular place, in a medium that constitutes the ambience in which it emerges and in which it interacts. This ambience appears to have a structural dynamics of its own, *operationally distinct* from the living being. This is a crucial point. As observers, we have distinguished the living system as a unity from its background and have characterized it as a definite organization. *We have thus distinguished two structures that are going to be considered operationally independent of each other*, (my emphasis), "living being and environment."

These are purely *constructive* and *operational* definitions, (or capable of being made so within "structural coupling"), in the precise sense of Hertz and Cassirer and clearly mesh with the substance of my chapter 4. They are Hertzian "images" with a definite, predictive logical structure.

At the level of cellular biology therefore, biology becomes a *pure form*, and, as such, it, (and the logic I posit within it), is capable of legitimate embodiment[1] within the now viable scientific epistemological relativism espoused by Cassirer and myself. It is this deeper placement, (and not as reductive physics), which allows an escape from the inconsistent "God's eye view" implicit in Lakoff's and Edelman's theses, and enables a truly consistent relativism.

It is because of Lakoff's Wittgensteinian origins, I think, that he has gone too far, (-and not far enough). Had he started from Cassirer instead, the case might have been different. I will return to Lakoff presently to suggest a “cleaner” solution to his problem consistent with his apparent needs –in the mathematical notion of “ideals”. There is a way to save it, but I think it is too limited and inconsistent with the dictates of modern biology as espoused, for instance, by Edelman.

Edelman:

Gerald Edelman has adopted Lakoff’s, (and Putnam’s), logical and epistemological conclusions as the philosophical underpinning to his own theories

[1] i.e. as a legitimate, fundamental "symbolic form"

of "Neuronal Group Selection", (TNGS), and "re-entrant topobiological maps". He proposed the combined result as an actual answer to the problem of mind-brain. Though Edelman's is a very plausible theory of brain development and function, it is limited to dealing with "mind" only *reductively* -i.e. as strictly biological and therefore physical *process* and falls to the same objections that I, (and the preponderant Naturalist camp as well), have raised. "Mind", normally taken, is therefore *superfluous* therein! Edelman explicitly denies the "homunculus", (as do I), but his "Cartesian theatre" is specifically a physical and spatial one. It is spatially and temporally distributed. Though he does not explicitly deny the existence of "mind" as ordinarily taken, he tacitly reinterprets it and reduces it to a description of process. He fits very comfortably, I feel therefore, within the naturalism, (and "objectivism"), which Dennett, Churchland, et al espouse.[1] I do not question the insightfulness or the importance of Edelman's work –it is profoundly important and very solid –but, because of its limitations, (derived from Lakoff), it falls short of an answer to the problem of consciousness, retains internal inconsistencies, and does not resolve the mind-body dilemma.

Starting with the nature and limitations of embryology, Edelman makes a case for a very different concept of "recognition systems". His exemplar "recognition system" is the immune system. The immune system, he argues, does not depend on information about the world –i.e. we do not create new antibodies from informational templates resident in newly arrived antigens. Rather, science finds that the body randomly generates a huge diversity of antibodies *before the fact* and reactively selects from this pre-existing diversity "ex post facto" as he phrases it. This, the immune system, is a system of process, not of information.

> "A recognition system … exists in one physical domain", (for the immune system it is within an individual's body), " and responds to novelty arising independently in another domain, (for the immune system it is a foreign molecule among the millions upon millions of possible chemically different molecules) by a specific binding event and an adaptive cellular response. It does this *without* requiring that information about the shape that needs to be recognized be transferred to the recognizing system *at the time when it makes the recognizer molecules or antibodies*. Instead, the recognizing system *first* generates a diverse population of antibody molecules and then selects *ex post facto* those that fit or match. It does this continually and, for the most part, adaptively." Edelman, P.78

[1] Save on the issue of "information"

Cognition, our *ultimate* "recognition system", he argues, is a parallel case and must be reconceived accordingly. Because of the sheer size, and the place and time sensitivity of embryological neural development, the neural system, (he argues), is progressively "pruned" ex post facto from random preexisting variety over the stages of its development in like manner to the immune system.

> "given the stochastic (or statistically varying) nature of the developmental driving forces provided by cellular processes such as cell division, movement, and death, in some regions of the developing nervous system up to 70 percent of the neurons die before the structure of that region is completed! In general, therefore, uniquely specified connections cannot exist."
>
> "the principles governing these changes are epigenetic –meaning that key events occur only if certain previous events have taken place. An important consequence is that the connections among the cells are therefore not precisely prespecified in the genes of the animal." Edelman, pps. 23- 25

Of the great diversity of (preexisting) neural connections generated at any stage, particular connections are reinforced and kept, or pruned and deleted, in tune with place and time dependent events the scenario of which is too complex "by several orders of magnitude" to be embodied in the human genome. This pruning is achieved operationally, not informationally. Embryological development is too complex, too dependent on place and time to be prespecified. His argument in some ways parallels my own of appendix A wherein I argued that there simply hasn't been enough time in evolutionary history, (nor ever will be), to create such an information engine.

In his "ex post facto" adaptive "TNGS", Edelman argues a criterion of *competence* , (as, indeed, did Darwin –and as did I in my first chapter), rather than one of information in the evolution and development of organisms –and specifically of the *human* organism.

> "The immune selective system has some intriguing properties. First, *there is more than one way to recognize successfully any particular shape*. (my emphasis) Second, no two individuals do it exactly the same way; that is, no two individuals have identical antibodies. Third, the system has a kind of cellular memory." Edelman, P.78 (These comments are directly relevant to my discussion of bounds and limits and the "parallel postulate" of cognitive science.)

He too disclaims the possibility of a "God's eye view" of reality by an organism.[1] But competence, as I have argued, does not imply *parallelism*. It is the question of bounds and limits that I have argued previously,[2] and Edelman falls into the same epistemological trap as does Lakoff, (and Maturana and Varela as well). Other than this failing, however, I believe his overall position and arguments are very strong.

On "Presentation"

Edelman challenges ordinary logic and ordinary epistemology, (the classical, "objectivist"/"naturalist" views), for some of the same reasons that I do. In his TNGS, he has framed the same problem, and reached largely the same conclusion that I did under the issue of "presentation".

> "some of the reasons for considering brain science a science of recognition", [under his special definition of "recognition systems" cited above]. " The first reason is almost too obvious: brain science and the study of behavior are concerned with the adaptive matching of animals to their environments. In considering brain science as a science of recognition I am implying that recognition is not an instructive process. No direct information transfer occurs, just as none occurs in evolutionary or immune processes. Instead recognition is selective."

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[1] cf: my "Axiom of Externality" and "Axiom of Experience", (Chapters 3 and 4).

[2] Let me repeat a footnote of my Chapter 1: The question, of course, is whether "information" is necessary to competence. I will argue, (in Chapter 3), that it involves a distinction between "bounds" and "greatest lower bounds" of biologic survival. A given organism, (to include human beings), must reflect a *lower* bound of competence in the world. But "information" requires that it reflect a *greatest* lower bound, and this is inconsistent with the fundamental premises of evolution. It is the "parallel postulate" of cognitive science.

> "a potent additional reason for adopting a selective rather than an instructive viewpoint has to do with the homunculus. …the little man that one must postulate 'at the top of the mind', acting as an interpreter of signals and symbols in any instructive theory of mind…. But then another homunculus required in *his* head and so on, in an infinite regress… selectional systems, in which matching *occurs ex post facto* on an *already existing* diverse repertoire, need no special creations, no homunculi, and no such regress." Edelman pps. 81-82

Presentation, in any sense other than an eliminative one, *requires* a homunculus, and this is the problem that Edelman believes he has solved- in essentially the same way that I did. But, in doing so, he believed he had solved the whole of the mind-body problem.

Re-entrant Maps

To this point, (his theory of "TNGS"), his argument is very plausible and compatible with my own conclusions. His rationale from that point onward, however, bears examination.

His theory of re-entrant topobiological maps, (reactively linked cortical surfaces), is quite plausible and highly interesting, but, ultimately, it is tied to a truly topological correspondence of those maps with the "real" world, (contrary to his conclusions of the first part of his thesis). "Maps… correlate happenings at one spatial location in *the world* without a higher-order supervisor…"[1] These maps themselves *do*, therefore, embody a "God's eye view", (contrary to the implications of TNGS). I have suggested a different orientation of Edelman's schema in the discussion of my Chapter 1, wherein I suggested we step back from our human (animal) cognitive prejudice and consider the larger "global mapping" also described by Edelman, (which relates "*non-mapped"* areas of the brain to the topobiological maps), as the primary focus of biological process. Under this perspective, the "objects" of our topobiological maps may be reconceived, not as

[1] Edelman, p.87, my emphasis

God's-eye renditions of ontology, but rather as *organizational foci*, (efficacious artifacts), of process.[1]

Edelman rationalizes his biological solution to the problem of the brain and the mind upon Lakoff's, (and Putnam's), answer. To him that answer is important because it allows a rationale for the brain which is *not* based in information as, in fact, he has concluded that it *is* not, (inconsistently with his theory of re-entrant maps, I maintain). He therefore reaches a conclusion very similar to my own. But again, like Lakoff's, his conception is too limited and incorporates an inherent contradiction. His concept of the world, like Lakoff's, is based in a container schema. We, you and I and Lakoff and Edelman, *are organisms too after all*. But then "TNGS" requires that even *our* brains are not informational![2] It is the *generality* of Cassirer's solution –and of my extension of it –the generality of the

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[1] An aside: While I hope it should be clear by now that I have no affinity for traditional idealism, I think it is worth quoting a short passage from Edelman as it talks about levels of "strangeness" in theories:

> "and Berkeley's monistic idealism –suggesting that inasmuch as all knowledge is gained through the senses, the whole world *is* a mental matter –falters before the facts of evolution. It would be very strange indeed if we mentally created an environment that then subjected us (mentally) to natural selection." Edelman, p. 35

Berkeley aside, Edelman seems very put out with the very strangeness of the (recursive, re-entrant?) complication of such an idea. The complication, he implies, boggles the mind! But much of modern science is even more mind-boggling. My thesis proposes an even greater "boggle", but results in an integration of epistemology and an actual solution to the mind-body problem.

Modern epistemology is radical at both the extremely small and at the extremely large (and fast) scales. It is *only as algorithms* they are comprehensible. And yet everyone, (read this as "most realists"), seems to accept that at the *middle scale* epistemology must be simple. Consider instead the *truly* mind boggling possibility I propose that the middle scale is algorithmic *as well!* Does this not explain "the prototype" which Rosch demonstrated and which ground Lakoff's and Edelman's very logical theses. Prototypes and the logical relations between them would, under this view, represent the "objects" and the "calculus" of algorithmic biology. If this thesis be accepted, then continuity, temporarily removed from epistemology by modern science, is restored across the board. This is a major epistemological and scientific result and worth the price we must pay for it. So was quantum mechanics!

[2] I think that Edelman would comment here, as he did on another occasion, that this conclusion would "boggle the mind"! Maybe so, but I think we'd better get used to such a state. Modern physics? Edelman's own conclusions? …

Concept and the generality of the *scientific* relativism which allows a consistent and meaningful solution[1] to the problems of the brain, mind and epistemology.

The Cartesian Theatre

What Edelman has not solved is the *other* problem, the problem of the "Cartesian theatre"[2], (i.e. "mind", ordinarily taken), and this is the most important problem. It is that which we normally *mean* when we use the terms "consciousness", "sentiency", etc. Its comprehensive solution is the subject of Chapter 2: the Concept of Implicit Definition and its integration with biology as the unified rule of ontogenic coupling. Edelman's solution remains an essentially naturalist, (objectivist), one itself however and is, I argue moreover, epistemologically inconsistent. It is compatible with the rest of the eliminativist camp in that ultimately all his correspondences, (his stated epistemology to the contrary), are from topobiological maps, *themselves topologically corresponding to "the (real) world"*! His "mind" is purely process, spatially and temporally localized –and known! His *is* "a God's eye view".

Edelman is very derisive of Penrose's "Emperor's New Mind",[3] but I think he has missed a major aspect of it. Penrose, (though he doesn't say so explicitly), and the "quantum people" are trying, (Goedel aside), I think, to supply a "non-localization" –i.e. a spatial universality to the brain's perceptual and cognitive objects- to make headway on the problem of knowing. They are trying to conceive an answer to Leibniz' problem of the "one and the many" within a *physical* space. The "chaos theory people" stand in a similar motivation I think, but attacking the logical problem of the object from a perspective of localized process, conceiving our objects as "attractors". But even were such solutions meaningful, (and they *are* interesting), they would miss the requirement of *a self-standing logical space in depth* which the Concept of Implicit Definition, as combined with the schematic model of biology, supplies and which furnishes the foundation of "meaning" and "knowing". Dennett glimpsed such a possibility[4] for a Cartesian theatre based in

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[1] by allowing a reorientation of the problem to a consideration of forms rather than of information

[2] after Dennett

[3] "Penrose's account is a bit like that of a schoolboy who, not knowing the formula of sulfuric acid asked for on an exam, gives instead a beautiful account of his dog Spot." Edelman, P.217

[4] but using an inadequate logic

logic in Shakey the Robot's program, (as I cited previously[1]), but his naturalist/objectivist metaphysical prejudice enervated the concept before it could bear fruit.

But ordinary logic,[2] (Shakey's program for instance), is inadequate to the problem. It is essentially dimensional: linear, planar, multi-dimensional, missing the integration in depth –missing the autonomy and (logical) self-sufficiency which is necessary to knowing and to meaning.[3] [4]

That aspect of ordinary mind we call the "Cartesian Theatre" does not work as a linear, a planar, or even as a multidimensional space[5] -even as a *logical space*. As I argued in chapter 2, each requires "presentation", either physical or logical. Nor do such conceptions supply "knowing", "meaning" or "motivation", except as unnatural and gratuitous appendages.

C.I.D. and the schematic model focus logic and cognition in biology. Biology has *innate* depth and structure –derived from the single principle of efficacy as coupled with Darwinian survival –of ontogenic coupling, and these necessarily pass to the logic and the cognition which are embedded in it! The Concept of Implicit Definition as coupled with the schematic model[6] supplies an integration and a rationale in depth *–and an autonomy*- implicit in its biological roots.[7] Edelman got very close to this answer, but his efforts were frustrated by his epistemological beginnings.

Cassirer, ("symbolic forms"), Rosch, ("prototypes" and "basic levels"), and Lakoff, (ICM's), demonstrate that dimensional logic is not adequate to the realities of the human mind. Nor, even putting aside the problem of "information", (Maturana and Varela, Freeman, Edelman), can such a logic supply meaning or

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[1] cf the "Dennett Appendix" - "the color phi"

[2] "associationist logic" in Dreyfus' term

[3] Wittgenstein's objection is clearly pertinent here. He raised the question of the necessity for one to have *another* rule: i.e. another rule to apply any given rule. C.I.D./biology, however, supplies a consistent rationale. "One" *is* a rule, "one" doesn't *apply* the rule. "One" is the single, "ex post facto" and unified rule of ontogenic coupling!

[4] and which could provide the enrichment necessary to the possibility of future scientific development moreover. All the other proposals yet presented are essentially *just* explanatory –i.e. logically reductive- and hold little promise for further exploitation.

[5] cf Wlodek Duch for instance

[6] i.e. the "*concordance*" mentioned in the Introduction

[7] It supplies "the rule which we need to apply the rule which we need to apply the rule …" demanded by Wittgenstein. Ultimately it is a *constitutive* rule. But one doesn't "apply" this rule. Rather, "one" *is* a rule –namely the constitutive rule of ontogenic coupling as the term is used by Maturana and Varela.

motivation except in a very unnatural and perverted sense. It is biology itself which supplies this aspect –in the concept of a schematic model and an enlarged logic. This is my argument of Chapter 1 as culminated in Chapter 2.

On Epistemology:

But let me be more generous to Lakoff and Edelman. In basing their conceptions on our ordinary world, or, to call a spade a spade, on our ordinary naïve realistic conception of the world, (people, baseballs, cars and all the things they do), they are *trying to preserve experience!* This they identify with realism. They seek to preserve their logical and biological conclusions with the *objects* of that ordinary realism,[1] and their relativism is a laudable and understandable attempt at a reconciliation. I have explained my answer to the same problem in terms of the multiple possible axiomatic foundations of mathematical systems, but another line of understanding is possible. Consider the notion of a mathematical "ideal".

The mathematical definition of an ideal is technical,[2] but the example given by Birkhoff and Mac Clane[3], while rather "longish" is more easily understood and is clearly directly applicable, (by its substance), to the immediate problem.[4] It illustrates a very different and very concrete notion of "relativism". While encompassing a scope much wider than simple geometry, that example provides a very clear illustration of the concept:

> "The circle C of radius 2 lying in the plane parallel to the (x,y) plane and two units above it in space is usually described analytically as the set of points (x,y,z) in space satisfying the simultaneous equations:

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[1] cf Lakoff's discussion, (p.262) of the "objects" of our experience –his chair, for instance. "It is important not to read Putnam out of context here, especially when he talks about objects. *An 'object' is a single bounded entity*…. Putnam, being a realist, does not deny that objects exist. Take, for example, the chair I am sitting on. It exists. If it didn't, I would have fallen on the floor." (my emphasis). Compare this reference with my modification of Kant's position on "objects" which I advocated in the footnote in Chapter 5.

[2] "Definition. An ideal C in a ring A is a non-void subset of A with the properties
(i) c_1 and c_2 in C imply that $c_1 - c_2$ is in C;
(ii) c in C and a in A imply that ac and ca are in C"
Birkhoff and Mac Clane, "Modern Algebra", 1953, pps.372

[3] ibid, pps.380…

[4] i.e. it deals with well defined "objects"

(16) $x^2 + y^2 - 4 = 0, \qquad z - 2 = 0.$

These describe the curve C as the intersection of a circular cylinder and a plane. But C can be described with equal accuracy as the intersection of a sphere with the plane z = 2, by the equivalent simultaneous equations:

(17) $x^2 + y^2 + z^2 - 8 = 0, \qquad z - 2 = 0.$

Still another description is possible, by the equations

(18) $x^2 + y^2 - 4 = 0, \qquad x^2 + y^2 - 2z = 0.$

These describe C as the intersection of a circular cylinder with the paraboloid of rotation:

$$x^2 + y^2 = 2z.$$

Therefore *the only impartial way to describe C*", (my emphasis), " is in terms of *all* the polynomial equations which its points satisfy. But if f(x,y,z) and g(x,y,z) are any two polynomials whose values are identically zero on C, then their sum and difference also vanish identically on C. So, likewise, does any multiple a(x,y,z)f(x,y,z) of f(x,y,z) *by any polynomial a(x,y,z) whatsoever.*", (my emphasis). "This means that the *set of all polynomials whose values are identically zero on C is an ideal.* This ideal then, and not any special pair of its elements, is the ultimate description of C.

In the light of this observation the special pairs of polynomials occurring in equations (16)-(18) appear *simply as generators*", (my emphasis), " of the ideal of all polynomials which vanish identically on C. Any polynomial obtained from the equations of (16) by linear combination with polynomial coefficients, as

(19) $h(x,y,z) = a(x,y,z)(x^2 + y^2 - 4) + b(x,y,z)(z - 2),$

will be in this ideal. Conversely, it can be proved that any polynomial equation h(x,y,z) = 0, which represents a surface passing through our circle, can be represented in the form (19). But the set of all these polynomials (19) is simply the ideal (x^2 + y2 – 4, z – 2), generated by the two original polynomials (16) in the ring $R^{\#}$[x,y,z] of all polynomials in x, y, z with coefficients in the field $R^{\#}$ of real numbers. The polynomials of (17) generate the same ideal, for these polynomials are linear combinations of (16), while those of (16) can conversely be obtained by combination of the polynomials of (17). The polynomial ideal determined by this curve thus has various bases,

(20) $(x^2 + y^2 – 4, z – 2) = (x^2 + y^2 + z^2 – 8, z – 2) =$
$(x^2 + y^2 – 2z, z – 2)…$"

The mathematical "ideal" just described opens a door to a better conclusion to Lakoff's and Edelman's arguments, and a simpler understanding of my own. *None* of these generators stands prior to any other, nor does it "create" the figure comprehended. Each stands, rather, as an equipotent and relativistic "logical", (i.e. explanatory), basis fully exhausting the actuality of the figure.

But we must consider this example in the larger context of mathematics. Not only can such descriptions be relativized in relation to a fixed coordinate system, but the very coordinate systems themselves stand in like case. Axes need not be orthogonal, nor need they be rectilinear, (e.g. polar coordinates are possible). Nor need they be fixed. They may be in translation –e.g. relative motion, (which translates to special relativity), and they need not be Euclidean, (nor Hyperbolic nor Spherical). Russell, for instance, further argued[1] that our descriptions of phenomena might even be based in projective geometry. But need they be *even spatial*? Can we not conceive of such explanations being framed as abstract transformations, which latter are *not* defined on spaces, but on abstract sets! Abstract sets, however, fall naturally within the scope of axiomatics wherein I grounded C.I.D.

Such a relativism of descriptions, combined with a scientific relativism of logic and epistemology themselves as argued by Cassirer, Lakoff, and myself, (superceding the traditional "container schema" and broadening the very ideas of "set" and "object" themselves), points to the further possibility for such an

[1] Russell, "Foundations of Geometry", 1956

"idealistic", (in the mathematical sense), foundation of logic *itself*. Need mathematics, or logic, be *necessarily* grounded in objectivist sets, (ultimate "atomic" –i.e. *least* objects -and a *fixed "Universe*" of such objects), or could it not pick itself up by its own bootstraps, (following the cue of mathematical "ideals"[1] and the findings of Cassirer and Lakoff), and stand without them?[2] This is a question –not an easy one to be sure- for abstract mathematics and the future of logic.

If we think of "experience" in the abstract –i.e. as the "axiom" without interpretation, (i.e. "impartially" in the sense of "basic realism"), – then I think an "ideal" in this sense is a very reasonable way of understanding it – beyond any particular "generator", beyond any particular interpretation.[3] But it is not necessarily a *spatial* interpretation either. Ideals are broader than this.

On a narrower focus, the possible generators of an ideal rigorously parallel the explanatory possibilities which can absolutely preserve the objects of ordinary experience and naïve realism, (conserving shapes, boundaries, etc.). As such, the ideal they ground is entirely commensurate with Lakoff's and Edelman's conceptions and logically validates their (limited) relativism.

Within the perspective of that same "basic realism", the "experience" we deal with need not be taken as ultimately *informational* however,[4] but can be taken as specifically organizational and operative instead[5] as I have argued in my Chapter 1 and consistently with Edelman's "TNGS". Though *connected* with externality, (as representative of successful- .i.e. *adequate* process[6]), it need not be further taken as conveying information about that externality. It need not be taken as *paralleling* externality. The latter presumption, I have argued, goes far beyond the needs and the implications of Darwinian biology.

The deeper issue is that of an adequate definition of "experience" itself. Need we identify it with the absolute and necessary preservation of ordinary objects? Or, might we not, consistent with the foundations of their own conceptions and the work of Rosch upon which it is grounded, consider even our ordinary perceptual objects *as "prototypes" of a larger experience*? Prototypes are

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[1] though presently itself conceived in set-theoretic terms

[2] This would be the truly transcendental logic after which Kant sought.

[3] "context-free" in Van Fraassen's term

[4] This my qualification on Putnam's 4th requirement of basic realism

[5] contrary to Putnam's 4th requirement

[6] "ex post facto", in Edelman's words

objects of utility, of efficacy, after all, they are not foundational objects.[1] Could not our ordinary objects be considered, (as I have argued), as prototypes, ("schematic perceptual objects"), of a *biological* calculus?

"Experience" in a *modern* sense must be broadened to include the experience of the results of scientific experiment, and *that* experience, at least insofar as modern physics is concerned, is not commensurate with the preservation of objects, nor is it commensurate with ordinary spatiality. Without even considering the deeper implications of QM or of Relativity, one need only consider results of the "twin slit" experiment or the implications of its multiple execution to see the point. Not even *cardinality* is preserved![2] Similarly, consider Penrose's "most optimistic" view of quantum mechanics, (most optimistic for objectivism/naturalism, that is):[3]

> "I shall follow the more positive line which attributes *objective physical reality* to the quantum description: the *quantum state*.
>
> "I have been taking the view that the 'objectively real' state of an individual particle is indeed described by its wavefunction psi. It seems that many people find this a difficult position to adhere to in a serious way. One reason for this appears to be that it involves our regarding individual particles being spread out spatially, rather than always being concentrated at single points. For a momentum state, this spread is at its most extreme, *since psi is distributed equally all over the whole of space*, (my emphasis),...It would seem that we must indeed come to terms with this picture of a particle which can be spread out over large regions of space, and which is likely to remain spread out until the next position measurement is carried out...."

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[1] see Lakoff for a discussion of Rosch, prototypes, and the logical significance of the latter. It is a very illuminating discussion.

[2] In answer to a question I asked on this point, a physicist correspondent of mine replied that "Yes, you can have many slits one after another, (it is better with Mach-Zehnder interferometers than slits, with the same result that one doesn't know if the photon went through or was reflected by a mirror…. We can say that one photon may be in an arbitrary number of places at once." (Wlodek Duch, private correspondence) My point was that even the *cardinality* of this basic object, (the photon), was *purely arbitrary* –it could be 1 or 2 or 3 or 1,000,001 or …, depending on the branching structure of successive slits and the design of the experiment. But innate cardinality is perhaps the *most basic* "property" we ascribe to ordinary objects, so I think the conclusion is significant.

[3] Repeating a section of a prior appendix

The particle -this *smallest part of our "object"*- is *not* included, (spatially, reductively, nested), *within* the spatiality of the atom or within the molecule -or even within the *human scale* object of which it is the theoretical (and supposed material) foundation. Naturalism/objectivism can no longer support, therefore, even a consistent hierarchy of spatial scale![1] At the human level, of course, it is a very useful tool, and that is just what I propose it is -constructed by evolution! Science and logic suggest *other*, non-scaled and non-hierarchical organizations -i.e. they support *any* other efficacious organization. It is a simple matter of utility.

Conclusion

To conclude this appendix, let me repeat that I truly admire Lakoff's and Edelman's work. It is both profound and crucial to the resolution of the ultimate problem. But then I really like the work of *all* the authors I have cited –even those most contrary to my own conclusions. (I would not cite or spend much time on anything of lesser quality –the problem is too huge and too difficult to be distracted.) Dennett's work, for example, is very beautiful to me in his honorable and perceptive pursuit of the hard implications of naturalism. P.S. Churchland, as another example, has a "clean" mind and frames the problem wonderfully from the perspectives of biology and philosophy. None of them has resolved the fundamental problem, however, though all have come very close in different aspects of it. This is a *hard problem*, the hardest one, I maintain, that the human mind has ever dealt with. To solve it requires an intellectual ruthlessness, and specifically, a *ruthless realism*!

[1] Compare Lakoff, p.195: "In the case of biological categories, science is not on its [objectivist philosophy's] side. Classical categories and natural kinds are remnants of pre-Darwinian philosophy. They fit the biology of the ancient Greeks very well….but they do not accord with phenomena that are central to evolution. … Objectivist semantics and cognition and, to a large extent, even objectivist metaphysics are in conflict with post-Darwinian biology. I'd put my money on biology."